Introduction

The Fitchburg Commuter Rail Line Improvement Project will modernize an existing commuter rail line to provide greatly improved service and reliability to riders and commuters in a 50 mile long corridor extending from Fitchburg to Boston, Massachusetts. Completely owned by the Massachusetts Bay Transportation Authority, the Fitchburg Line is the longest, slowest and among the oldest and least reliable in Boston's commuter rail network. Nevertheless, approximately 10,000 daily riders stick with current Fitchburg Line service due to the lack of reasonably available other commuting options to the Boston job market.

Passengers board the train at West Concord Station in Concord, MA.

A long established list of infrastructure improvements was prioritized and tested to develop a Locally Preferred Alternative that will confer the following benefits to the riders, communities and even the operators, of the Fitchburg Line:

- Modernized, state of the art infrastructure allowing 80 mph travel speeds
- 945 hours/day Travel Time benefits for Existing Riders alone
- Service reliability increase from 83% to over 95% on-time performance
- Significantly enhanced passenger experience
- Support statewide and regional economic development goals
- Reduced operating and maintenance costs, even while attracting new riders

With the filing of this Alternatives Analysis report, the Fitchburg Commuter Rail Line Improvements Project has completed the Alternatives Analysis phase by recommending a Locally Preferred Alternative consisting of an estimated $150 million worth of improvements. The Project is anticipated to enter Project Development in the fall of 2007, with design to be completed in spring of 2009. Construction would take place over three seasons and be complete by the end of 2011.

Agency Participation and Project Description

The Montachusett Regional Transit Authority (MART), which is centered around the Fitchburg/Leominster metropolitan area, is the lead agency for the Alternatives Analysis process. The Fitchburg Line corridor is however owned by the Massachusetts Bay Transportation Authority (MBTA), which also manages the commuter rail service. Existing service is run, under MBTA contract, by the Massachusetts Bay Commuter Rail (MBCR) company. The Fitchburg Commuter Rail Line corridor is primarily served by these two regional transit agencies, and two regional planning agencies.

MART is the lead agency for the Alternatives Analysis Process

Throughout its evolution, the Fitchburg Commuter Rail Line Improvement Project has involved the collaboration and cooperation of numerous State Agencies. In developing, testing and selecting the Locally Preferred Alternative through the Alternatives Analysis process, this interagency collaboration has never been stronger. As the Fitchburg Commuter Rail Line Improvements project progresses, the MBTA, as the owner of the line and responsible operator of the service, will assume responsibility for the design and construction of the proposed improvements. All other agencies will continue to be involved and supportive as necessary for the completion of the Project. The required Project Description Template, included as **Appendix A-1** lists the agencies, and specific contacts that have been actively participating in the advancement of this important initiative. The Project Description template was completed on the basis of the current status of the Fitchburg Commuter Rail Line Improvement Project stands today, with the Montachusett Regional Transit Authority as the lead agency.

Study Corridor

The Fitchburg Commuter Rail Line study area is a 50-mile corridor extending northwest from Boston to the Leominster-Fitchburg area of North Central Massachusetts. The study area, as shown in **Figure 1**, represents a band of communities whose commuting options to Boston primarily consist of the Fitchburg Commuter Rail Line and Route 2. The Fitchburg Line directly serves 13 communities between Fitchburg and Boston. As it progresses westward, the corridor changes with the abutting towns characterized as urban, suburban, and western end communities. **Appendix C** includes four aerial photos of the entire Fitchburg Commuter Rail Line corridor from Fitchburg to Boston and serves as the required Project Vicinity maps for the Small Starts application.

Fitchburg Commuter Rail Line and Route 2 Corridor Study Area

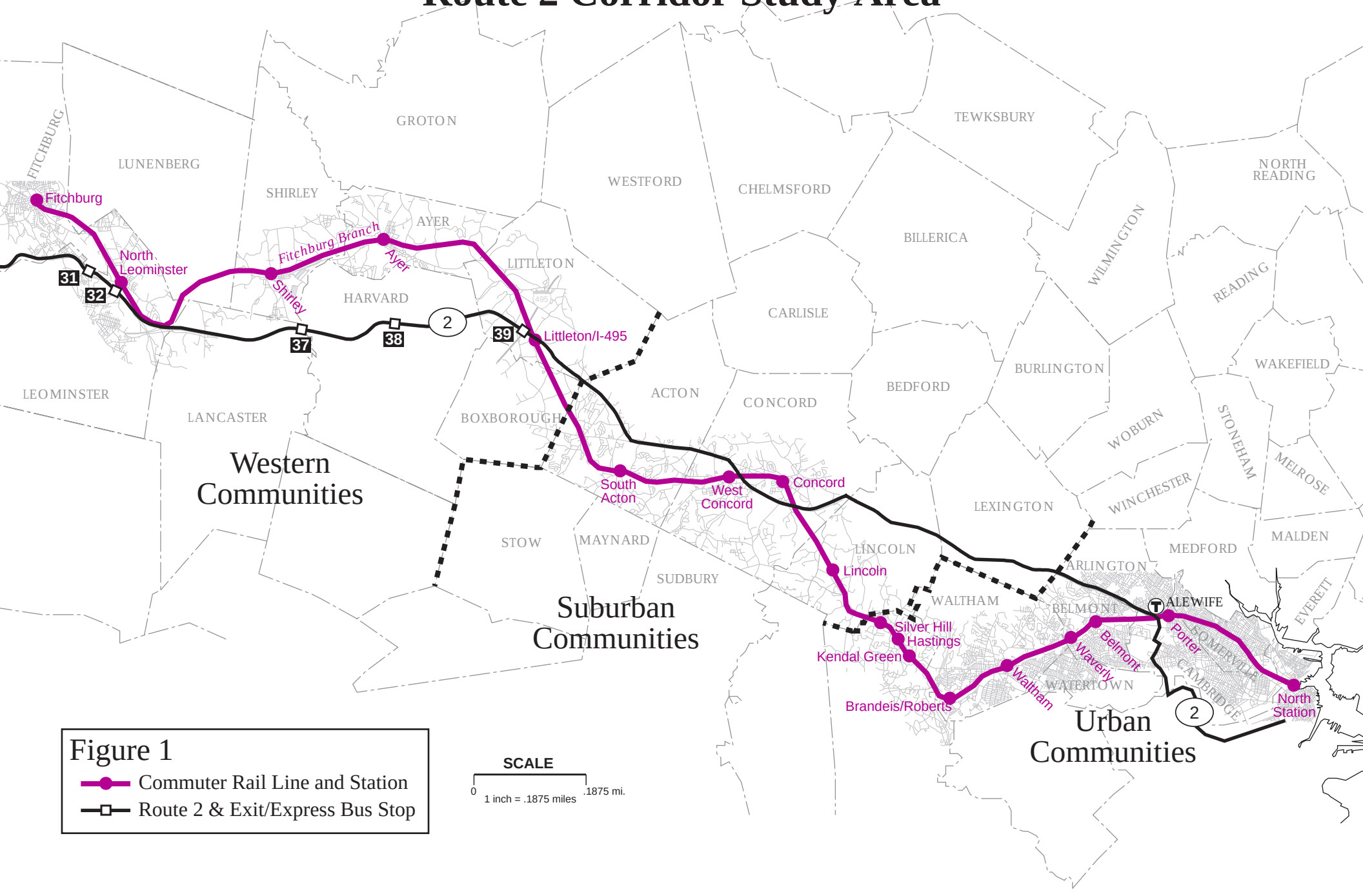


Figure 1

Commuter Rail Line and Station

Route 2 & Exit/Express Bus Stop

The urban communities have more commuting options with access to the MBTA's Red Line, MBTA bus service, Route 128 and the Massachusetts Turnpike (I-90). The urban communities also have a higher concentration of commuter rail stations on the Fitchburg Line as many of the stations are closely spaced. Meanwhile, the stations which service the suburban and western end communities are fewer and further apart. The suburban and western communities are dependent solely on Route 2 and the Fitchburg Commuter Rail Line as their options for commuting to the Boston job market. Other commuter rail lines, expressways and freeways are located too far from these communities to be viable commuting alternatives.

Demographics

Belmont Station

Due to its almost 50 mile length, the Fitchburg Commuter Rail Line extends beyond the traditional boundaries of the Boston Regional Metropolitan Planning Organization to include the towns covered by the Montachusett Regional Planning Council. The Metropolitan Boston and Montachusett Planning regions combined hosted 4,465,551 people and 2,408,584 jobs in 2006. While population is spread throughout the regions, employment is still concentrated in the Central Business District of Downtown Boston and Cambridge.

Total population and employment are expected to grow within the overall region and in the Study Corridor specifically. Present trends show that population in the western end communities continue to grow at a rate above the regional and statewide averages. **Table 1: Study Area Population Growth** shows that population grew in the western communities by 6.3% between 1990 and 2000, with a further projected population growth of 24% by 2030.

Quantitative Land Use Information for Small Starts

The required Quantitative Land Use Templates for Small Starts outline the required demographic information and are included as **Appendix A-4** of this report. Two copies of the completed template were prepared: one for the Base Year (2006) and one for the Opening Year (2013). All of the quantitative land use information includes the entire Boston metropolitan area as well as the municipalities in the Montachusett Regional Planning Council (MRPC) planning area. The additional towns were added to the

Boston regional model, as part of the planning effort for this project. All of the MRPC towns not already included were added to the CTPS Regional Travel Demand Model, to help measure this Project.

Table 1: Study Area Population Growth

Town	1990	2000	Overall % Growth	2030	30 Year Growth
Arlington[2]	44,630	42,389	-5.0%	44,163	4%
Watertown[2]	33,284	32,986	-0.9%	33,066	0%
Belmont[2]	24,720	24,194	-2.1%	25,752	6%
Somerville[2]	76,210	77,478	1.7%	79,867	3%
Cambridge[2]	95,802	101,355	5.8%	116,222	15%
Weston[2]	10,200	11,469	12.4%	13,285	16%
Lexington[2]	28,974	30,355	4.8%	33,265	10%
Waltham[2]	57,878	59,226	2.3%	63,842	8%
	371,698	**379,452**	**2.1%**	**409,462**	**8%**
Maynard[2]	10,325	10,433	1.0%	11,303	8%
Stow[2]	5,328	5,902	10.8%	6,990	18%
Acton[2]	17,872	20,331	13.8%	23,139	14%
Concord[2]	17,076	16,993	-0.5%	19,148	13%
Lincoln[2]	7,666	8,056	5.1%	8,677	8%
	58,267	**61,715**	**5.9%**	**69,256**	**12%**
Ashburnham	5,433	5,546	2.1%	7,316	32%
Ashby	2,717	2,845	4.7%	3,528	24%
Westminster	6,191	6,907	11.6%	9,737	41%
Gardner	20,125	20,770	3.2%	22,528	8%
Templeton	6,438	6,799	5.6%	8,395	23%
Winchendon	8,805	9,611	9.2%	12,950	35%
Fitchburg	41,194	39,102	-5.1%	45,543	16%
Townsend	8,496	9,198	8.3%	13,473	46%
Sterling	6,481	7,257	12.0%	10,425	44%
Lunenburg	9,117	9,401	3.1%	11,845	26%
Leominster	38,145	41,303	8.3%	49,632	20%
Lancaster	6,661	6,382	-4.2%	7,237	13%
Shirley	6,118	7,371	20.5%	9,077	42%
Groton	7,511	9,547	27.1%	14,282	50%
Harvard[1]	4,662	5,230	12.2%	6,559	10%
Ayer	6,871	7,287	6.1%	7,156	-2%
Boxborough[2]	3,343	4,868	45.6%	5,884	21%
Littleton[2]	7,051	8,184	16.1%	12,461	52%
	195,359	**207,608**	**6.3%**	**258,750**	**24%**

[1] Data adjusted to account for the closing of Fort Devens in the mid-1990's
[2] Source: Montachusett Regional Planning Commission

The Land Use templates further require that a Central Business District (CBD) be defined. As both Porter Square in Cambridge and the North Station terminal in Boston are important destination points for Fitchburg Line passengers, the CBD was defined to include both downtown Boston and Cambridge. **Figure 2** shows the Central Business District, which includes the areas around these stations and within a half mile of the rapid transit stations accessible via single seat ride from these transfer points. **Figures 3, 4 & 5** show the projected Opening Year population, employment and household densities respectively for the half mile catchment areas around all of the Fitchburg Line stations. All Land Use maps are also included as **Appendix D** of this report.

Existing Fitchburg Line Service

The Fitchburg Commuter Rail Line has 18 total stations and covers almost 50 miles from Fitchburg to North Station. The 17 stations with Inbound service, excluding North Station, had approximately 5,300 daily boardings in 2006. A total of 35 revenue service trains run daily on the Fitchburg Commuter Rail Line, but only 25 of those provide service to Fitchburg and the other western end communities. Only five daily inbound trains arrive at North Station before 9 AM, and none arrive at Fitchburg before 10:15 AM. South Acton Station, located 25.3 miles and 54 scheduled minutes from North Station, is the westernmost point served by 10 of the 35 daily trains on the Fitchburg Line. Only sixteen daily trains operate on weekends, with eight each Inbound and Outbound.

Passengers disembark at Concord Station.

Table 2: Characteristics by Station

	Station	Miles to Porter Square	Scheduled AM Peak Minutes to Porter Square[3]	Miles to North Station	Scheduled AM Peak Minutes to North Station	Inbound Trains	Daily Boardings
Western	Fitchburg	46.1	80	49.5	91	13	409
	N. Leominster	41.9	73	45.3	84	13	385
	Shirley	36.0	65	39.4	76	13	168
	Ayer	32.8	60	36.2	71	13	358
	Littleton/Rt. 495	26.7	51	30.1	62	13	179
Suburban	South Acton	21.9	43	25.3	54	18	873
	West Concord	18.5	38	21.9	49	17	460
	Concord	16.6	34	20.0	45	17	432
	Lincoln	13.3	28	16.7	39	17	329
Urban	Silver Hill	11.3	25	14.7	36	2	33
	Hastings	10.3	23	13.7	34	5	81
	Kendal Green	9.8	21	13.2	32	15	207
	Brandeis/Roberts	8.1	17	11.5	28	16	412
	Waltham	6.5	13	9.9	24	17	523
	Waverley	4.0	08	7.4	19	9	114
	Belmont	3.0	06	6.4	17	13	146
	Porter Square	n/a	n/a	3.4	11	18	184

Table 2 provides station-specific information for the Fitchburg Line including mileage and scheduled travel time to Porter Square and North Station. Porter Square is included because its MBTA Red Line connection is the earliest transfer point from the Fitchburg Line to the MBTA subway system and thus the Boston job market. The average scheduled morning peak period travel time from Fitchburg to North Station is 91 minutes (*over an hour and a half*), with an 80 minute scheduled time to Porter Square. In fact, the scheduled travel time from almost all of the western end communities to both North Station and Porter Square is over an hour, with only the Littleton to Porter Square trip at under an hour.

Morning commuters at North Station in Boston.

[3] Based on Winter'07 scheduled local service

Purpose and Need

Currently, citizens of the Suburban and Western study area communities have few options for commuting to and from the Boston metropolitan area. These modes of travel are very unreliable, particularly for a daily commute. Ridership levels on the Fitchburg Commuter Rail Line are adversely affected by poor reliability, infrequent service, and excessive travel times, the longest in the MBTA Commuter Rail system. Yet, although the Fitchburg Commuter Rail Line is the poorest performing line in the system, it has great potential to improve service for existing riders and to attract new riders if quality service were provided.

Results from the previously completed *Fitchburg Commuter Rail Line Service Expansion Study* and project's longstanding public process indicate that improving speeds would have the greatest effect on reducing travel times and, therefore, would provide the greatest benefit to the study area's commuters. Actions to achieve travel time savings were presented in the subsequent *Fitchburg Line Improvement Implementation Plan,* which was published in the fall of 2005. The overriding objective of the Implementation Plan was to reduce trip times between Fitchburg and Porter Square from the current one hour and twenty minutes to approximately one hour. In response to MBTA and FTA input, the project scope was modified to address the related issues of on-time performance and service frequency.

The primary goal of the Fitchburg Commuter Rail Improvement Project is to increase benefits to users of the transportation system by offering reduced travel times and improved service reliability throughout the corridor. In order to accomplish these objectives, substantial upgrades are necessary to overcome the significant geographical and infrastructural that plague service on the Fitchburg Line. In sum, the project is necessary to remedy the following issues:

- The Fitchburg Line has the oldest infrastructure in the MBTA system
- The Fitchburg Line is the longest in terms of both distance and travel time.
- The Fitchburg Line has one of the worst on time performance records in the MBTA system.
- The Fitchburg Line serves a region with limited commuter options.
- The Montachusett region is one of the few Massachusetts areas with significant population growth.

Population Growth

The Montachusett Region, which includes the westernmost communities in the study corridor, is the fastest growing section of the Line and is experiencing growth at a higher rate than the rest of the Boston region. Forecasts from the Central Transportation

Planning Staff (CTPS) and the Montachusett Regional Planning Commission (MRPC) indicate that the population of the Montachusett Region is expected to grow by nearly 25 percent over the next 30 years. Growth rates were presented by municipality in **Table 1: Study Area Population Growth**, which shows population growth from 1990-2000 and projections to 2030.

Across from Fitchburg Station, an industrial building was recently converted to condominiums.

According to the population data, the suburban towns within the study area corridor saw an overall growth rate of 5.9 percent between 1990 and 2000, while the western towns experienced an overall growth rate of 6.3 percent for that same period. Some communities, such as Westminster, Townsend, Sterling, and Shirley have further projected 30-year population growth of over 40%, with Groton and Littleton expected to grow by 50% of it's year 2000 population. By contrast, the suburban communities are expected to grow by only 12 percent during that same period.

Unreliable Commuting Options

As the Montachusett communities continue to grow at rates well above state and regional averages, the demand for reliable and frequent transportation to the Boston and the Inner Core job market is also expected to increase. Currently, citizens of the study area communities have few options for commuting to and from the Boston job market. These options shown in Figure 1 are limited by mode and route to automobile travel on Route 2 or by train on the Fitchburg Line. As mentioned previously, these modes of travel are not necessarily reliable, especially for daily commuters.

Route 2 extends approximately 40 miles from Fitchburg to Alewife Station in Cambridge. According to data from CTPS, the average travel time on Route 2 during the peak hours for the 22-mile stretch from Arlington to I-495 was 35 minutes. However, because of traffic variability and capacity constraints, this same data shows that the 85th percentile was 55 minutes on this segment of Route 2 during the peak hour. The uncertainty with travel time and delays is mostly due to the segment of Route 2 between Lincoln and Acton. On this segment, where the roadway is not limited-access, the average speed during the peak period is only 30 miles per hour.

The study area corridor also encompasses the stretch of Route 2 for which CTPS does not currently have travel time information available. Because of this, several travel time runs were made in March of 2006. It was found that the average peak period travel time through this corridor was 59 minutes from Fitchburg to Alewife[4]. According to historic Massachusetts Highway Department traffic counts, average daily traffic in March is about 2% lower than the average annual daily traffic for the section of Route 2 east of the Concord Rotary. It can be expected that the travel time on the Route 2 corridor would be longer during an average month, and much longer during a high traffic month.

Service Reliability

Currently, Fitchburg Line commuters face similarly poor levels of travel time reliability as Route 2 drivers. Improving the predictability of arrival and departure times does not actually shorten the scheduled trip, but would reduce a commuter's expected trip time. Commuters will adjust their schedules in accordance with expected trip times, not necessarily the scheduled trip time, as they make their travel choices.

According to data provided by the Massachusetts Bay Commuter Railroad, the on-time performance record for the entire commuter rail system in the 2005 calendar year was 91.25 percent. As mentioned previously, the on-time performance record of the Fitchburg Line was significantly lower than the system record, at 83.24 percent. The MBTA's Service Delivery Policy 2004 Update, establishes a 95% reliability standard, defined as "all trips departing and arriving at terminals within 5 minutes of scheduled departure and arrival times." From October 2005 to March 2007, the Fitchburg Line had delays totaling 11,477 minutes, making it the MBTA's lowest performing commuter rail line.

Frequency and Service Gaps

Ridership levels on the Fitchburg Commuter Rail Line are adversely affected not only by this poor reliability but also by infrequent service and excessive travel times, the longest in the MBTA Commuter Rail system. The Fitchburg Commuter Rail Line has several critical service gaps. Filling these gaps will help to improve the service, and will increase benefits. As mentioned previously, infrastructure improvements are needed to reduce delays and to provide frequency flexibility. Throughout the long-standing public process, commuters voiced their feelings concerning the lack of off peak service to Fitchburg Station. Many of the complaints were centered on the fact that potential passengers in the western communities had to drive to the South Acton Station to have the most flexibility for service.

[4] Alewife was used as the terminus because it marks the eastern end of the limited access section of Route 2 and provides a connection with the MBTA Red Line.

Currently, passengers departing Fitchburg Station in the mid-morning have only two options: the 7:20 a.m. or the 10:27 a.m. Reducing the travel time by up to 20 minutes could allow a window for a more attractive mid-morning train that leaves at 7:40 a.m. or later. While leaving later, with an improved Fitchburg Commuter rail corridor, such a train would still be able to arrive at North Station before 9 a.m. and at Porter Square as early as 8:40 a.m. Passengers returning from Boston to Fitchburg in the early afternoon experience a 3.3-hour gap in service. Outbound trains leave for Fitchburg Station at 1:20 p.m. and 4:40 p.m. Such service gaps could leave a commuter stranded in Boston during an emergency.

As shown in **Table 2: Characteristics by Station**, Fitchburg is located 49.5 miles from North Station, and 46.1 miles from Porter Square. The average scheduled morning peak period travel time from Fitchburg to North Station is over an hour and a half, with an 80 minute scheduled time to Porter Square. In fact, the scheduled travel time from almost all of the western end communities to both North Station and Porter Square is over an hour, with only the Littleton to Porter Square trip scheduled under an hour.

Many Fitchburg Line trains only provide service as far as South Acton.

Inbound boardings at the western end stations have increased over the last few years. Inbound boardings at Fitchburg Station have increased substantially with the opening of the Fitchburg Intermodal Center and adjacent garage. The Fitchburg line has the fewest amount of off peak trains of any of the commuter rail lines terminating at North Station. Based on 2005 off peak passenger counts the Fitchburg line has approximately the same number of passengers as the Lowell and Haverhill lines but has five and six fewer off peak trains respectfully. Also, all of the off peak trains on the Lowell line stop at the terminal station in Lowell as compared to only 70% of the off peak trains stopping at the terminal station in Fitchburg. Improvements in the line are needed to create the flexibility required to improve frequency.

Opportunities for a reverse commute are practically non-existent on the Fitchburg Commuter Rail Line. The first outbound train does not arrive in Fitchburg until 10:15 am. Infrequent service hampers the ability of Boston-area residents to commute to jobs

in the Montachusett region. Operational and infrastructural constraints on the Fitchburg Commuter Rail corridor make service expansion difficult.

Infrastructure Constraints

Although the Fitchburg Commuter Rail Line has the poorest operating characteristics in the MBTA system, it has great potential to attract new riders if quality service were provided. Along the Fitchburg Commuter Rail Line there exist several significant infrastructure deficiencies which greatly contribute to delays and the poor overall performance of the service. Most significantly of these constraints are the presence of single-tracked segments and interaction with freight operations on the line.

The Fitchburg Rail Line is only single tracked for an 8.8 mile stretch, which includes Littleton Station.

Two significant stretches of the Fitchburg Line are presently single tracked: an 8.8 mile stretch between South Acton and the Willows Freight Yard in Ayer and a 1 mile stretch near Waltham Station. **Figure 6** shows the Fitchburg Commuter Rail Line with the single track segments identified. The speed on single-tracked sections is currently restricted to 30 mph in Waltham and 40 mph between South Acton and the Willows. A benefit of double tracking would be increased speed and schedule flexibility resulting from the reduced incidence of conflicts between trains. In addition, double tracking is an advantage for maintenance operations, as presently maintenance on single-tracked sections must be performed during narrow windows of time when no service is scheduled, or during costly off-hour shifts.

The Fitchburg Commuter Rail Line corridor is also an extremely active freight corridor, with most freight traffic controlled by PanAm, formerly Guilford Rail. The majority of freight traffic on the line operates between Fitchburg and Ayer, and in the Willows Freight Yard. These sections merge to a

PanAm conducts significant freight operations along the Fitchburg Line.

single track at the eastern end of the Willows Freight Yard in Ayer, and continue south as a single track until South Acton Station.

Willows Freight Yard is located at the intersection of the North-South freight line between Lowell and Worcester and the East-West rail line between Fitchburg and North Station. Tracks through the Willows Freight Yard are rife with conflicts as the North-South freight trains must compete for a segment of track with the East-West commuter rail corridor. Service to local freight customers is also provided through the Willows Freight Yard. Daily freight operations on the line are significant and typically include the following service on a daily basis:

- 3 eastbound trains traveling through from Fitchburg toward Boston (approximately 11 am, 3 pm, and 11 pm)
- 3 westbound traveling between Ayer and Fitchburg (approximately 9 am, 10 am, and 10 pm)
- 1 piggyback train on duty at Ayer at 8:30 pm
- 2 local freight trains out of Fitchburg (6 am and 6 pm)
- 2 local freight trains out of Ayer (6 am and 6 pm)
- Sporadic coal service as warranted

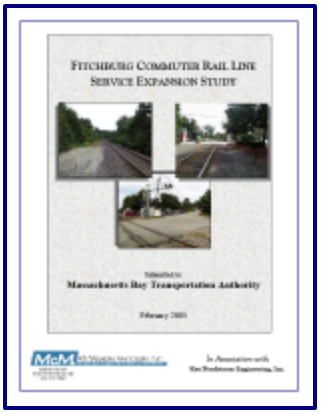
Single-tracked sections and freight interference are significant contributors to the Fitchburg Line's poor on-time performance. Other infrastructural constraints and deficiencies contributing to slow unreliable service include:

- Track conditions (only portions of the line have been updated with continuously-welded rail)
- Speed restrictions
- Alignment deficiencies and a lack of super-elevation
- Poor drainage
- Antiquated signals and crossover/interlocking systems
- A large number of at-grade crossings

Given the current condition and long term constraints of both Route 2 and the Fitchburg Line corridor, commuters, especially those in the western end communities, have poor travel options to the Boston job market. Presently, both Route 2 and the Fitchburg Commuter Rail Line suffer from deficient infrastructure and unreliable travel times. Improved service and reliability on the Fitchburg Commuter Rail Line will provide significant travel time savings and benefits to existing users and undoubtedly will entice a number of drivers to switch from highway to rail for their commute to Boston.

Project History

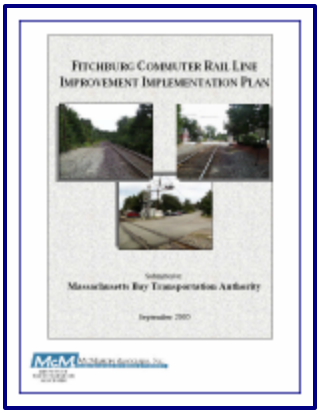
The need for improvements to the Fitchburg Commuter Rail Line was first formally identified in the MBTA's public meetings for the Program for Mass Transportation in 2001. The MBTA recognized this need and, early the next year, issued a Request For Proposals (RFP) for a *Service Expansion Study.* McMahon Associates, Inc. was selected to conduct the study. The public process and ongoing support for the Fitchburg Improvements Project were solidified on August 10, 2002, when legislation passed establishing the Fitchburg MBTA Line Corridor Advisory Committee.



February 2005: Service Expansion Study

The role of the Fitchburg MBTA Line Corridor Advisory Committee is to promote and facilitate transportation improvements, consider alternatives, and recommend actions to improve the Fitchburg Commuter Rail Line. The Advisory Committee has met frequently throughout the history of this process to review information, offer comments, and provide an open forum for the member agencies and the general public to become involved in the development process.

In the spring of 2003, three public meetings were held as a part of the *Service Expansion Study*. Through this public process the goals and objectives for the Fitchburg Commuter Rail Line were established. The *Service Expansion Study* identified infrastructure, travel time and reliability improvements and expansion possibilities to achieve the goals. The *Service Expansion Study* was completed in February of 2005. As a direct result of the study, and the momentum behind the Fitchburg Line, the MBTA began running additional express service from Fitchburg. The MBTA subsequently began an *Improvement Implementation Plan* to prioritize the improvements identified for the Fitchburg Commuter Rail Line. The *Improvement Implementation Plan* was completed by McMahon Associates in September 2005. The Plan formulated the 60-minute travel time goal and identified and priced $300 million worth of improvements to achieve that goal, including potential station consolidation.



September 2005: Improvement Implementation Plan

In September of 2005, the federal government passed the Section 5309(e) legislation for the Federal Transit Administration (FTA)'s Small Starts program, a means whereby smaller transit projects could apply for and obtain funding without having to compete with the larger, New Starts projects. The Small Starts process was selected as the best

way of obtaining funding for the Fitchburg Line in order to get the improvements process moving forward as quickly as possible. Work began with the Federal Transit Administration (FTA) to configure the Fitchburg Commuter Rail Line as a Small Starts project. This collaboration culminated with the filing of a *Scoping Package* with the FTA in April 2007. The *Scoping Package*, filed by the Montachusett Regional Transit Authority (MART) identified the Alternatives to be evaluated in the Small Starts process, and marked the formal entry into the Alternatives process.

Definition of Alternatives

As a first step to being considered for federal funding under Section 5309(e) {"New Starts" funding}, the Fitchburg Commuter Rail Line Improvement Project completed a Scoping Package, which was filed with the FTA in April of 2007. The Scoping Package described the parameters of the proposed project and established the improvement packages that would be evaluated in the Alternatives Analysis (AA) process. Upon filing of the Scoping Package, the Fitchburg Line Project was approved to begin the Alternatives Analysis by the Federal Transit Administration (FTA), which is the first defined step towards a funding award.

The Scoping Package described in detail the five Alternatives that would be evaluated in the Alternatives Analysis phase of the Project, and included a No Build, Baseline, and three Build packages, which are described as follows:

No Build

The No-Build Alternative is a requirement of the National Environmental Policy Act (NEPA) regulations and serves as the benchmark for establishing both the environmental impacts of the alternatives and the cost-effectiveness of any other tested improvements. When examining an existing corridor, the No Build examines only "committed" improvements. Per FTA guidance, the No Build can also serve as the Baseline Alternative for existing transit corridors.

The No-Build Alternative assumes the only programmed investment in the Fitchburg Commuter Rail Line – the ongoing installation of continuously-welded rail. Continuously-welded rail will not directly generate higher operating speeds, but is a prerequisite for future signal improvements and other potential future upgrades of the Fitchburg Line. The ongoing continuously welded rail upgrades are being completed by the MBTA at a cost of **$5 million**.

Baseline

FTA guidelines require that the proposed project be evaluated against a Baseline Alternative, which establishes a starting point of assessment for project evaluation and a consistent structure for estimating the qualities of the Build Alternatives. The Baseline Alternative is intended to represent a relatively low-cost approach to addressing transportation problems and increasing transit usage in the Study corridor. Unlike the improvements contained in the No-Build Alternative, the Baseline Alternative does not have any funding specifically identified.

Working with the FTA and the Operating Agencies, an agreed upon Baseline Alternative was included in the Scoping Package, which added service to the Fitchburg Line, without negatively impacting service for any existing riders. To accomplish this, the Baseline Alternative adds an additional express train in both the AM & PM peak periods between Fitchburg and Boston. The **$30 million** cost of the Baseline Alternative includes the additional train set required to run the service, an expansion of the layover facility, as well as track improvements at the Fitchburg terminal.

Build Alternatives

Three Build Alternatives (which are outlined in **Table 3**) were identified in the Scoping Package, and represent cumulative packages of investment in the Fitchburg Commuter Rail Line infrastructure. The *Fitchburg Line Service Expansion Study* and *Improvement Implementation Plan* previously identified and prioritized individual infrastructure improvements for the corridor.

Many of these, such as an upgrade of the signal system from wayside to in-cab would serve to modernize the line. Re-installing double tracks on the two single track segments, improving grade crossings, upgrading the railbed alignment, and adding track to the Willows freight yard, were identified as the most important improvements to upgrade speeds, travel times, and reliable operations along the entirety of the Line.

These systemwide improvements form the basis of the lowest cost improvement package. Two additional improvement packages added other items such as station upgrades and grade separations, which would further serve to speed travel and improve the passenger experience on the Fitchburg Line.

Table 3: Alternatives Evaluated

No Build		**$5,000,000**
- Continuously Welded Rail		
Baseline		**$30,000,000**
- Upgrade or Relocate Fitchburg Layover Facility	-Purchase Additional Train	
- Interlocking West of Fitchburg Station		
Alternative 1		**$149,800,000**
- Systemwide Track Improvements		
Upgraded horizontal and vertical alignments to achieve 80 mph		
- Install Fiber Optic Cable from Ayer to North Station–PHASE I		
- Replace the Wayside Signal System with in-cab system from Ayer to North Station–PHASE I		
Providing new crossovers and interlockings and retire existing		
- Reinstall double track from Ayer to South Acton		
- Complete the Fitchburg Line Master Drainage Program		
- Construct Commuter Rail Flyover or install additional track at Willows Yard		
- Replace the Rte 62 Bridge in Concord		
- Construct High Level Platforms		
South Acton	Littleton	
- Install Double Track through Waltham and High level Platform @ Waltham Station		
- Upgrade Grade Crossings		
South Street, Waltham	Viles Street, Weston	
Church Street, Weston	South Great Road, Lincoln	
Alternative 2		**$174,500,000**
- Alternative 1 Improvements plus		
- Install Fiber Optic Cable from Fitchburg to Ayer (Willows)–PHASE II		
- Replace the Wayside Signal System with in-cab system from Fitchburg to Ayer (Willows)–PHASE II		
- Construct High Level Platforms	Concord	
Alternative 3		**$239,000,000**
- Alternative 1 and Alternative 2 Improvements plus		
- Construct High Level Platforms	North Leominster	
West Concord	Waverly	
Lincoln	Belmont	
Brandeis/Roberts	Porter Square	
- Construct new Regional station at Ayer/Shirley/Devens		
- Upgrade Grade Crossings		
Conant Road, Weston	Lincoln Road, Lincoln	
Tower Road, Lincoln	Rte 111(Mass Ave), Acton	
- *Grade Separation*/Grade Crossing Closures		
Parker Street, Acton	Baker Avenue, Concord	
Conant Rd, Concord	Arlington Street, Acton	
Old Sudbury Rd, Lincoln	Main Street, Shirley	

Refinement of Alternatives

Upon entering the Alternatives Analysis process, the individual and systemwide improvements were examined in further detail. Each of the infrastructure improvements were re-evaluated for their feasibility, necessity and potential costs and benefit. Meetings were held with the Massachusetts Bay Transportation Authority (MBTA) and Mass Bay Commuter Rail (MBCR), respectively the owners and operators of the Fitchburg Commuter Rail Line to evaluate the improvements. Both agencies were integrally involved in the discussions around the packaging and testing of the Alternatives.

The refinement of the Alternatives was completed along with the determination of how to build, test and analyze the improvement packages using the RTC Rail Simulation. Coordination with the FTA staff was ongoing throughout this process. Based upon these meetings and analysis, the three Build Alternatives identified in the Scoping Package were refined and detailed for testing and analysis. The necessary improvements and costs for the Baseline Alternative were also clarified further. As in the Scoping Package, the three defined Build Improvement packages were cumulative.

Capital Costs and Standard Cost Category Worksheets

Preliminary capital cost estimates have been developed for the majority of the build items under consideration for inclusion in the build alternative packages. These cost estimates were originally developed in 2004 for the *Service Expansion Study* and have been updated as needed as the project advanced. The updated cost estimates were used in estimating alternative costs for the Baseline and each of the Build Alternatives. The cost estimates were further inputted into FTA's required Standard Cost Category (SCC) worksheets, which determine the costs to be used in the cost effectiveness calculations. The FTA has implemented this capital costing format (SCC worksheet), to establish a consistent format for the reporting, estimating and managing of capital costs for New and Small Starts projects. The SCC worksheets are meant to help control project costs and risks and increase cost estimate reliability from entry to preliminary engineering and on forward through final design. As part of the Alternatives Analysis process this project developed its cost estimates in the SCC format, and the SCC cost worksheets for each of the Build Alternatives are included as **Appendix B** of this report. A description of the worksheets and methodology used to complete each is presented below.

Standard Cost Category Worksheets

The worksheet tabs completed and the associated methodology used described below.

- Main Worksheet for Build (Alt 1) and Baseline
- Project Description
- Funding Sources by Category
- Funding Source By Year
- Inflation Worksheet
- Schedule
- Build Annualized for Alt 1 and Baseline

Main Worksheet for Build (Alt 1) and Baseline

The Main Worksheet is the most critical because it includes a cost breakdown of each improvement by FTA category and line item. The worksheet includes allocated contingencies (by specific subcategory line item) and total project costs. Costs are shown both for base year and year of expenditure. The Main Worksheets display all costs in thousands (x 000), and categories are linked to and referenced from the Inflation Worksheet.

Previous estimates sorted the proposed improvements into components or pieces of an implementation plan. These components were first divided into the major categories, for both construction-related (10-50) and non-construction-related (60-80) costs. A percentage of the alternative's total expenditure was deducted from each component to include costs for the following categories (80--Professional Services and 40--Sitework & Special Conditions). The costs associated with Sitework & Special Conditions were further divided into subcategories based on a percentage of proposed work in that subcategory. Additionally, inflation was deducted from the alternative's total project cost in 2011 dollars to adjust it to 2007 dollars so that the funds could then be allocated to each year of the project and escalated accordingly.

The original improvement components were then further assigned to the specific subcategory listed in the SCC worksheet. An example is in the "Systems" category, where improvements were divided into *50.01 – Train control and signals; 50.02 – Traffic signals and crossing protection;* and *50.05 – Communications.* The Base Year Dollars as a percentage of construction cost and total project cost were evaluated to check that they were within industry and project related ranges.

Project Description

The project team filled in a description of the improvements associated with each of the FTA sub-categories. The descriptions provide the ability to cross reference the written description of the alternative with the cost derivation.

Inflation

This worksheet calculates the cost of inflation and accounts for the difference between Base Year Dollars and Year of Expenditure Dollars. The Fitchburg Commuter Rail Line Improvement project costs were spread across the years 2007-2011, based on the expected year in which specific expenditures would occur. Each category was evaluated separately to determine the rate of expenditure. The yearly ratio of construction expenditure compared to the total project cost was evaluated and determined to be within the typical range expected for this type of transit project. Based on a FHWA Transportation Planning Update, Fall Edition 2006, *"for metropolitan long-range transportation plans, TIPs, and STIPs, FHWA and FTA generally would be comfortable if States used a four (4) percent annual inflation rate for construction costs for 2007 and beyond, for both highways and transit."* The inflation rate used was 4%, which is in line with highway and transit projects in Massachusetts. The Inflation Worksheet provides a double check of the alternative's cost in year of expenditure dollars and compares the dollars that were entered in the Build Main Sheet.

Annualized Cost – Build and Baseline

For each line item within the Standard Cost Categories a useful life in years is identified the spreadsheet. Base year costs (annual basis) are derived automatically within the spreadsheet. The only information which is to be entered in the Annualized Cost worksheet is the unallocated contingency. These contingencies were spread across the line items according to perceived risks.

Operating and Maintenance Costs

The Fitchburg Commuter Rail Line Improvements Project involves substantial upgrades to the infrastructure of an existing commuter rail corridor. The Alternatives Analysis process reviewed the benefits that a series of improvements would have on the current service schedule. No changes to the schedule were proposed or tested, and therefore the Operating and Maintenance cost changes are likely to be minimal as they are primarily based on the added savings and costs of traveling faster.

For the Fitchburg Commuter Rail Line Improvements Project, the Operating and Maintenance (O&M) costs were calculated based on the several measurable cost changes. Even with no change to the operating schedule, measurable cost changes include increase in fuel use, the labor costs to run the line, and the elimination of operating costs due to the removal of Waltham Tower.

Fuel costs are based upon the time spent accelerating. The locomotives in the Massachusetts Bay Commuter Rail service typically use 166 gallons per hour and accelerate at 0.5 mph/second. To reach the higher speed of 80 mph takes about 50

seconds longer than it does to reach the current maximum speed of 60 mph. Over the course of a year, this translates to 114,335 more gallons of fuel used. The price of fuel for the locomotives as of August 2007 was $2.20 per gallon.

The track and infrastructure upgrades impact the labor portion of the operations and maintenance costs in different ways. Labor costs are based upon a typical annual salary of $50,000, with overhead cost per employee is calculated at a rate of 50%, for a total of $75,000. The updated track infrastructure would require less daily maintenance and one fewer employee to maintain. However, the maintenance of the upgraded in-cab signal system would be more sophisticated and require an additional two employees.

The removal of the Waltham Tower would eliminate the need for the equivalent of 4.5 full-time staff. Using the same rates as above, this translates to a savings of $337,500 per year. There would also be a savings associated with utilities to operate the tower, which is estimated at approximately $3,000 per year.

The net change in operating and maintenance costs is a savings of about $14,000, that is it will take $14,000 less to operate the line than it previously did. **Appendix G** includes a delineation of the calculation process.

Study Methodology

The *Fitchburg Commuter Rail Line Corridor Alternatives Analysis* analyzed to the extent possible the travel time savings, reliability benefits and cost effectiveness of each of the Alternatives described previously. The evaluation focused on the potential of each package to reduce travel times, improve reliability, and contribute to the overall goal of a one-hour trip time for commuters from Fitchburg to Porter Square.

Each of the Alternative packages analyzed consisted of a series of infrastructure improvements which would allow for Fitchburg Line service to operate faster and more reliably. With the exception of the additional express service identified in the Baseline Alternative, no changes to the current operating schedule of service were proposed. The project used Rail Traffic Controller (RTC) Simulation software to model and simulate the travel time and reliability benefits of each of the Alternatives. The travel time savings and operational improvements derived from the Rail Simulation were then used to determine the impacts of these benefits.

Rail Simulation Software

The Rail Traffic Controller (RTC) software program was used to model and simulate the travel time and reliability of each of the Alternatives. The RTC software has been

typically used to develop railroad operating plans, diagnose network bottlenecks, recommend schedule changes, evaluate various capital improvement scenarios, and assess the impact of adding new trains to a network. National users of RTC have included Burlington Northern Santa Fe (BNSF), Amtrak, Union Pacific, Metra (Chicago), Bay Area Rapid Transit (BART), CalTrans, New Jersey Transit, CSX, and the Massachusetts Bay Transportation Authority.

The backbone of the Rail Traffic Simulation is the building of the track network on which trains will be dispatched. The Rail Traffic Controller (RTC) Network incorporates all of the significant elements of the track infrastructure including track alignment and geometry, switches, crossovers, stations, grade crossings, and signals, all of which are coded as nodes or links. For each node or link the operating characteristics and restrictions are coded into the software, and collectively form the network.

After a network is drawn, the operating characteristics of all trains on the line are incorporated into the software. These characteristics include the operating schedule, engine type, passenger vs. freight, train linkages, number of passengers and other variables. The RTC software then simulates operations of the trains on the rail network. Trains are dispatched and their resulting travel time, operations and conflicts, are analyzed. Dispatch results are summarized and the software produces time-distance stringline diagrams; train performance calculator profiles displaying elevations, speed, throttle, brake settings, cumulative distance and run time; detailed individual train schedules; track occupancy charts; timetables; and operating statistics by setting appropriate parameters in the software.

Modeling the Fitchburg Commuter Rail Network

The Fitchburg Commuter Rail network was modeled from North Station in Boston to just west of Fitchburg Station. The network was completed using the track charts obtained from the Department of Operations at Mass Bay Commuter Rail (MBCR), the contracted operators of Fitchburg service. The nodes and the links were drawn and coded based on the actual Mile Posts (MP) from the track chart.

Meetings were then held with the Massachusetts Bay Transportation Authority (MBTA) and MBCR, respectively the owners and operators of the Fitchburg Commuter Rail Line to review the individual elements of the Fitchburg Commuter Rail Line Improvements and modeling assumptions. These discussions served to provide assumptions for all elements to be programmed in the model. All agencies worked collaboratively, reviewing drafts in progress, and the modeled networks and operating assumptions continued to be modified until they most closely resembled reality.

The No Build, Baseline, Alternative 1, Alternative 2 and Alternative 3 were all built as individual networks. **Figure 6** shows the Rail Simulation Network for Alternative 3. For

the Fitchburg Line, several constraints were noted, including: track alignments, speed limits and change points, freight trains, grade crossings, crew change delays, and dwell times. The constraints were calibrated to existing conditions and assumptions were made about how the improvements were coded. The schedules were then dispatched to determine the changes in travel time based on the improvements in the network. Factors to demonstrate operating variability, such as freight interference, were also added to replicate actual operating conditions, and to calculate the travel time savings and improved reliability that the Alternatives will provide.

A complete description of the RTC Simulation – Report on Methods and Assumptions was prepared through the course of the Alternatives Analysis. The Report details the individual improvements, assumptions and resulting measurables for the Rail Simulations conducted. The complete version of this report is included in **Appendix E**.

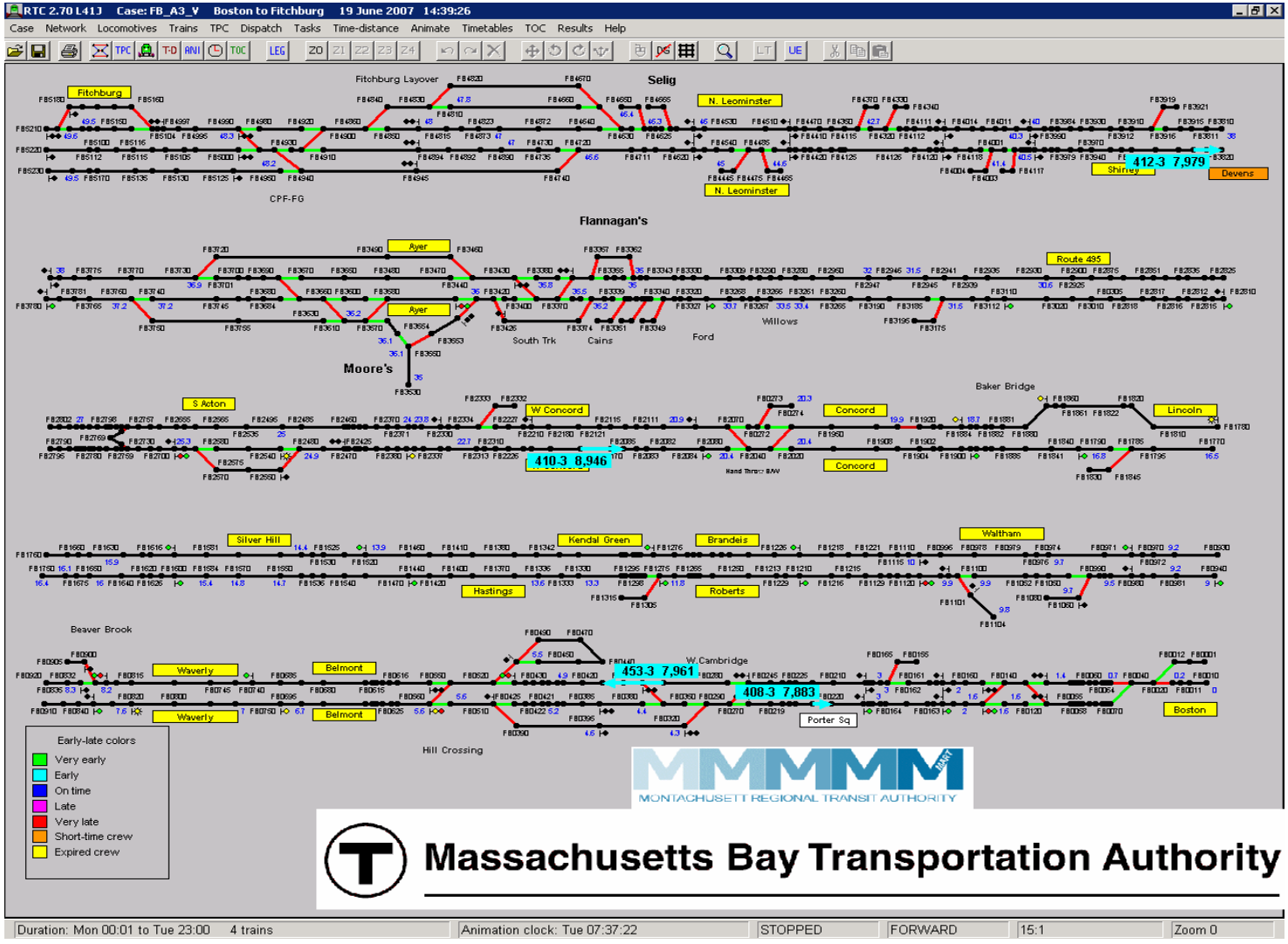
Rail Simulation Results

For each of the five evaluated alternatives, the Rail Traffic Controller (RTC) software simulated the complete operation on the Fitchburg Commuter Rail Line for ten separate typical weekdays. These simulations produced ten sets of data for each of the 34 daily weekday trains. The ten data points for each of the trains were compiled and calculations were made to determine the average and the standard deviation of travel times for each alternative. Reliability and total travel time were examined as a means of comparing the performance of each alternative.

Generally the travel time improved on each scheduled train for each cumulative alternative. Not surprisingly, the Baseline Alternative performed approximately the same as the Existing/No Build Condition. The Baseline included additional express service without any associated infrastructure improvements, so travel time savings were not likely. However, reliability actually worsened for the Baseline, as the added service created additional conflicts on the overburdened infrastructure.

Alternative 1 performs well in comparison to Existing Condition, with travel times about 10 minutes faster than the No Build Baseline. Alternative 2, which includes the improved signal system between Ayer and Fitchburg, is typically 12 and even as much as 15 minutes faster than the No Build. Alternative 3 is typically 2-3 minutes faster than Alternative 2 for the entire trip. The difference between Alternative 3 and the Existing/No Build Condition are even more pronounced, with total trip time typically 15 minutes faster for Alternative 3. **Table 4** displays a summary of the results: travel times between North Station and Fitchburg for each alternative. Another interesting note is that travel time savings for outbound trips are typically higher than inbound trips, which is due to the fact that currently outbound trips are subject to more freight interference and operating restrictions.

Figure 7: Rail Simulation Network for Alternative 3



Reliability is also expected to increase for each of the three alternatives, as each alternative has a projected on-time performance of greater than 95%.

User Benefit Calculations

CTPS expanded its current regional travel demand model set, as shown in the Land Use section of this report, in order to develop ridership and user benefit projections. The study team collected copious current year and historical data, such as traffic volume counts, parking lot usage surveys, travel-time runs, and ridership counts, for use in the calibration and validation process of the newly expanded model. However, as part of ongoing coordination efforts with FTA staff, a simplified approach was recommended. This recommendation differed from the traditional FTA guidance for determining User Benefits for New Starts and Small Starts submissions.

The Fitchburg Commuter Rail Line Improvement Project focuses on improving an existing right-of-way by primarily changing run time and improving reliability into and out of Porter Square and Boston. The Rail Simulation approach described earlier replicated the proposed improvements for the entire daily schedule. Since no service changes were proposed, the exact travel time savings for existing riders could be calculated for each alternative. FTA and the proponent felt that this simplified forecasting to User Benefits could produce User Benefits sufficient to achieving a Medium Project Rating.

Table 4: Travel Times between North Station and Fitchburg

Avg. Daily Travel Times (min.) from Fitchburg to North Station Based on An Average Runtime for All Trains in that Time Period using RAILSIM								
Inbound	AM	Diff	MD	Diff	PM	Diff	NT	Diff
NB	88.8		70.8		61.3		84.8	
Alt1	79.0	-9.8	65.2	-5.6	55.7	-5.7	76.0	-8.8
Alt2	77.8	-11.0	63.4	-7.4	54.3	-7.0	74.8	-10.0
Alt3	75.0	-13.8	61.8	-9.0	53.0	-8.3	73.0	-11.8

Outbound	AM	Diff	MD	Diff	PM	Diff	NT	Diff
NB	62.0		88.3		77.2		91.8	
Alt1	53.3	-8.7	77.0	-11.3	67.7	-9.5	78.4	-13.4
Alt2	52.7	-9.3	75.3	-13.0	66.5	-10.7	76.2	-15.6
Alt3	51.0	-11.0	73.7	-14.7	64.7	-12.5	75.2	-16.6

In light of this decision, CTPS developed a spreadsheet-based approach to calculate travel time (passenger hours to North Station) for existing year 2006 riders, by station.

CTPS then calculated the travel time for each of the three proposed project alternatives based on the improvements shown in the service plans developed by the consultant team. **Table 4** contains a summary of the travel time assumptions occurring by time period and alternative. **Table 5** displays the changes in passenger hours for each alternative relative to the no-build condition by time period. Passenger hours saved were used as a proxy and sole component of user benefits. The detailed calculations of the passenger hours of savings for each alternative by time period are shown in **Appendix E-2**.

Table 5: Daily Passenger Hours Saved (Proxy for User Benefits)

Daily Avg. Passenger Hours Saved Using 2006 Existing Ridership Calculated Using Station Level Boardings						
Inbound	AM	MD	PM	NT	Daily	Difference
NB	2,975	457	310	307	4,049	
Alt1	2,696	426	290	281	3,693	355
Alt2	2,707	422	282	281	3,692	357
Alt3	2,584	407	277	272	3,540	508
Outbound	AM	MD	PM	NT	Daily	Difference
NB	324	478	3,040	362	4,204	
Alt1	270	419	2,615	310	3,614	590
Alt2	267	414	2,558	307	3,545	659
Alt3	224	401	2,106	296	3,028	1,176
Both	AM	MD	PM	NT	Daily	Difference
NB	3,299	936	3,349	669	8,252	
Alt1	2,966	845	2,905	591	7,308	945
Alt2	2,973	836	2,840	587	7,237	1,016
Alt3	2,809	808	2,383	569	6,568	1,684

In general, the use of travel time savings (passenger hours) as a proxy for user benefits is a rather conservative forecasting approach that does not account for increased ridership. This could come from increased demand at stations between the base year and the project's opening year (2013) or from the likely increases in transit ridership, resulting from auto diversions, due to the perceived reduction in run time of the rail service.

The calculation of travel-time savings as a proxy for user benefits was first completed on a daily basis and needed to be converted to an annual value. Recent historical annual, weekly, and weekend ridership along the Fitchburg Commuter Rail Line was compared and contrasted to determine an annualization factor. A full description of the annualization factor is a required submittal of the Alternatives Analysis process and is

included as **Appendix E-2** of this report. Based on the analysis completed, a value of 290 was chosen as best representing the average number of annual days of service.

Table 6: Annualized Travel Time Savings for Existing Users

Both	AM	MD	PM	NT	Daily	Diff.	Annualized 290	2030 Factor x 1.5
NB	3,299	936	3,349	669	8,252			
Alt1	2,966	845	2,905	591	7,308	945	273,981	410,971
Alt2	2,973	836	2,840	587	7,237	1,016	294,544	441,816
Alt3	2,809	808	2,383	569	6,568	1,684	488,503	732,755

In order for the net user benefits to be ultimately compared to those of the larger New Starts projects, the FTA standardized a growth factor to be applied. According to page 10 of the FTA's *Updated* Interim Guidance and Instructions for the Small Starts Provision of the Section 5309 Capital Investment Grants Program of July 20, 2007, "The factor used in this adjustment will be 1.5; meaning user benefits will be increased by 50 percent. Without this adjustment, Small Starts projects would be held to a higher standard since the breakpoints were originally calculated assuming a 20-year forecast." Another reason for multiplying them by a factor of 1.5 "was to account for the additional user benefits that are expected to accrue from the project over a 20-year period." The results can be seen above in **Table 6**.

Table 7: Capital Costs Assumed

Scenario	Capital Cost	Annualized Cost	Incremental Cost	Useful Life
No-build	$ 5,000,000	$ 363,000	$ -	13.8
Alt1	$ 149,800,000	$ 10,206,000	$ 9,843,000.00	14.7
Alt2	$ 174,500,000	$ 11,914,000	$ 11,551,000.00	14.6
Alt3	$ 239,000,000	$ 16,023,000	$ 15,660,000.00	14.9

These annualized User Benefits were then used to calculate the project's Cost-Effectiveness (CE) ratio. This computation, performed by dividing the annualized project costs (capital and operating) by the annualized project user benefits, measures cost per user benefit hour. As a precursor to this step, the consulting team calculated the costs and annualized them using the FTA's Standard Cost Category (SCC) worksheets. **Table 7** lists the capital costs being assumed in this analysis; **Appendix B-1** displays an itemization of the costs using the SCC. Note that per FTA guidance, the operating costs for each of the alternatives are held constant over time.

The project's CE ratio was finally compared against the FTA's range of national evaluative threshold CE ratios ("High", "Medium-High", "Medium", "Medium-Low", "Low") and accordingly categorized to determine how competitive the project could be for Small Starts funding. The results of the analysis show that based solely on existing ridership and run-time reductions achieved from the proposed improvements, both Alternative 1 and Alternative 3 demonstrate a cost-effectiveness rating of Medium. This ranking shows both of them could be competitive for FTA Small Starts Funding, while Alternative 2 achieves a Medium-Low ranking. **Table 8** shows the Cost-Effectiveness and Rating for each of the three Build Alternatives.

Table 8: Fitchburg Cost-Effectiveness (CE) Ratings

Scenario	Incr. Hrs Saved	Incr. Capital Cost	CE	2009 Rating
Alt1	$ 410,971	$ 9,843,000	$ 23.95	Medium
Alt2	$ 441,816	$ 11,551,000	$ 26.14	Medium-Low
Alt3	$ 732,755	$ 15,660,000	$ 21.37	Medium

Additional User Benefit Factors

The Locally Preferred Alternative for the Fitchburg Commuter Rail Improvements Project will reduce travel time for existing riders by about 10 minutes in each direction. The improved line will also offer greater reliability and arrival certainty for users. As shown, the User Benefits for current ridership achieve a cost-effectiveness ratio of $23.95.

However, Looking at the project in more detail shows that project benefits are likely to be much higher. The calculations presented thus far include all of the costs but not all of the potential benefits of the Project. Additional User Benefits can also be expected based upon the following:

- New riders, most of which are auto diversions
- Growth between 2007 and Opening Year

New Riders/Auto Diversions: FTA guidelines suggest new riders, especially those diverted from automobiles, generate greater user benefits than travel time savings experienced by existing riders. Previous planning efforts have predicted up to a 40% increase in Fitchburg ridership if all improvements identified in the Implementation Plan were completed. The LPA includes most of the systemwide improvements from the Implementation Plan, so potential ridership would be less. However using even a conservative assumption of 10% ridership growth, would yield 1,000 new daily riders, who would be primarily diverted from auto trips. Given the span of service, it would be assumed that each transit rider diverted would generate an additional hour of user benefits, this conservative assumption of new trips would generate approximately 1,000 additional hours of User Benefits/day. New riders could therefore generate more than

the 945 passenger hours/day shown to be saved by existing users. When factored annually, over 290,000 additional hours of User Benefits could easily be generated by the Project.

Area Growth: The Small Starts guidance suggests a 1.5 growth factor to cover population, employment and ridership growth in the Study Area, over a 20 year planning horizon. The Fitchburg Line effort looked only at benefits to existing riders, using 2006 ridership numbers. Based on recent trends, additional ridership growth could be expected by the Project's opening year of 2013. Between 2003 and 2006, ridership on the Fitchburg Line increased by 15.4 percent. It is likely that ridership will continue to grow as population grows. If only a 1% annual growth in ridership is assumed, it would yield an additional 600 total new passengers by the Opening Year. New riders would come from throughout the Line; therefore, the 6% growth was applied to the total passenger hours saved by existing riders to represent growth by the Opening Year. This calculation shows that newly attracted riders by the Opening Year would account for a savings of 57 passenger hours/day and over 16,000 passenger hours/year by 2013. Reapplying the 1.5 growth factor to this interim growth would further save an additional 28.5 hours/day and 8,220 hours/year, over the 20 year planning horizon.

Based only on known measurable factors, the Fitchburg Commuter Rail Line Improvement Project achieves a Medium Rating for Cost Effectiveness. The total 410,971 incremental passenger hours saved shows a Cost-Effectiveness of $23.95 per User Benefit. However, using the assumptions outlined above, the estimated User Benefits that can be achieved by the Fitchburg Commuter Rail Line project are much higher. **Table 9** below shows an almost 75% increase in User Benefits when additional factors are estimated conservatively. As these benefits will accrue without any additional costs, the Cost Effectiveness rating could be seen to improve from $23.95 down to well below **$14 per User Benefit.**

Table 9: Annualized User Benefits

	User Benefits	Incremental Capital Cost	Cost Effectiveness	
Existing Riders	410,971*	$9,843,000	$23.95	
New Riders diverted from Auto (10% of Existing Riders)	290,000	0		
Growth to Opening Year (1% annual growth assumed)	16,000	0		
Conservative User Benefits Summary	**716,971**	**$9,843,000**	**$13.73**	Medium-High
*Passenger hours saved for Existing Riders				
Shaded Areas represent the conservative estimates described above				

Selection of Locally Preferred Alternative

The selection of the Locally Preferred Alternative (see **Figure 8: Project Map**) was a collaborative process built on solid analysis and interagency coordination. The selection was further informed by the long history of public input, the recognition of the need for system wide improvements and the reality of present State and Federal funding availability.

The Analysis began with the modeling process, the first step of which was to build and simulate the existing Fitchburg Line network. Each alternative (including the Baseline) was then built and modeled using the software. The benefits, in the form of travel time savings for each set of improvements, were compared to the Existing/No Build and Baseline scenarios.

This information was then shared with operating and funding agencies and elected officials to develop a recommended Locally Preferred Alternative to present at the public meetings. Representatives from the MBTA (including the Railroad Operations and Planning Departments), the Executive Office of Transportation & Public Works, Montachusett Regional Transit Authority, and Massachusetts Bay Commuter Railroad were all present and contributed to the development of the recommended Locally Preferred Alternative.

The costs of each of the alternatives were analyzed and weighed against the travel time saved for the existing riders on the Fitchburg Commuter Rail Line. These calculations, as shown in **Table 8** showed that both Alternative 1 and Alternative 3 achieved a Cost Effectiveness rating of less than $24/per User Benefit, which qualified for a Medium rating per current FTA guidelines. However, through the Alternatives Analysis process, the importance of completing systemwide upgrades to the entire Fitchburg Line was reiterated. With $75 million of State funding anticipated, and $75 million of federal funding sought, additional elements of Alternatives 2 and 3 were reconsidered for their inclusion as part of the $150 million recommended project.

Alternative 1, as analyzed, cost $149.8 million, but did not include the signal upgrade between Ayer and Fitchburg. In order to include this upgrade in Alternative 1, several items were reevaluated. The Route 62 bridge replacement was removed because it was already included in the MBTA's capital budget. The Master Drainage Program and Willows Freight Yard improvements were also reevaluated. It was determined that similar operational and reliability benefits for these elements could be achieved for less than the original total costs predicted. At Willows Yard, for example, both a flyover and an additional track were evaluated to separate freight and passenger service, but the alternatives always carried the cost of the flyover track. The added track at Willows

Freight Yard could yield the same level of travel time and reliability benefits, at almost half the cost.

The Project Team then prepared a recommended Locally Preferred Alternative (LPA) to present during the community process.

Recommended Locally Preferred Alternative

Track improvements to achieve up to 80 mph design speed

In-cab signal system

Installation of double track at Waltham and from Ayer to S. Acton

Track improvements at Willows Freight Yard

Fiber optic cable & wireless access (WiFi)

Upgrade of four grade crossings

Construction of high level platforms:

- South Acton
- Littleton
- Waltham

Improvements to the drainage system

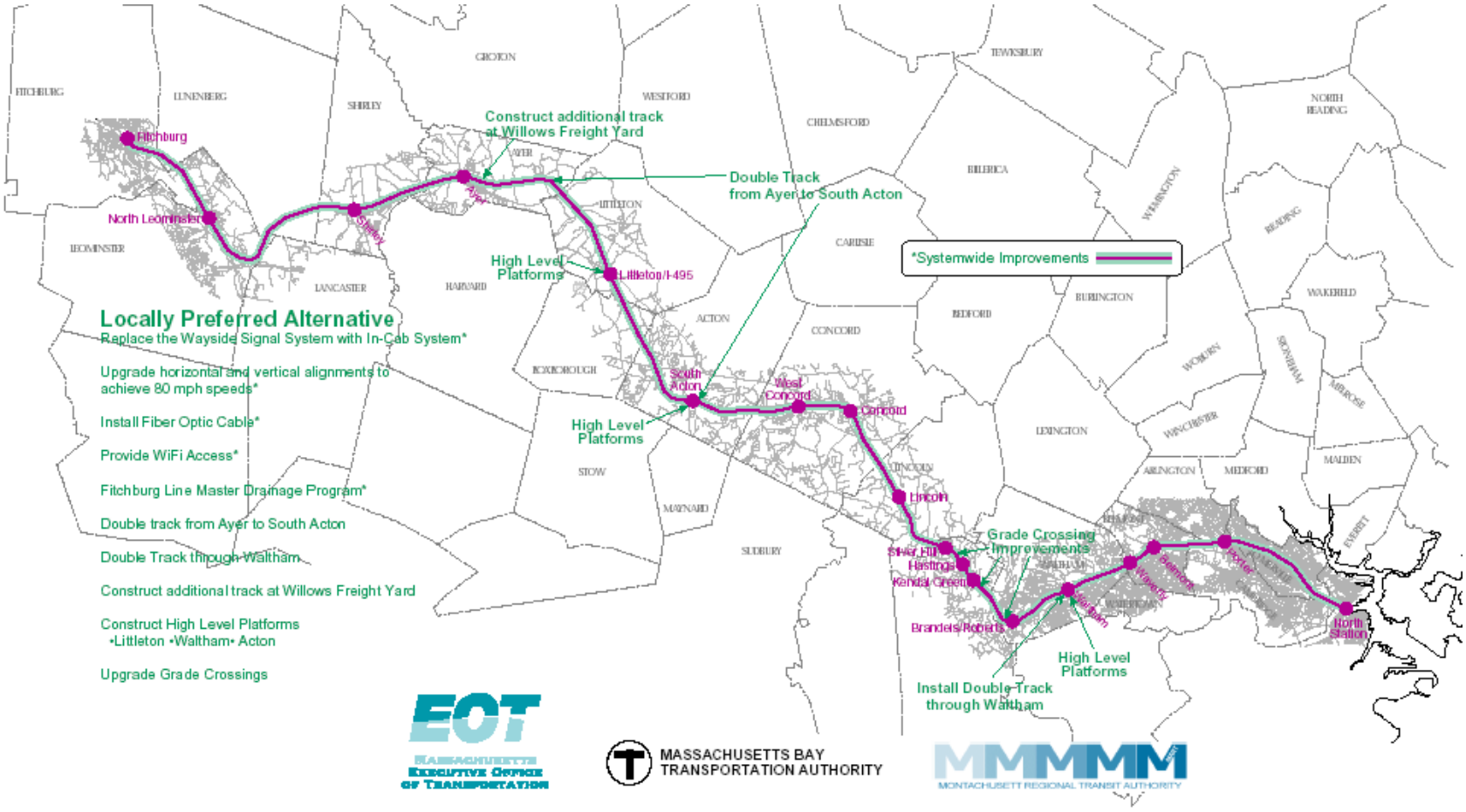
A series of three public meetings were hosted in different communities along the Line to determine the Locally Preferred Alternative (LPA). These meetings occurred on the following dates/locations:

- Wednesday August 15, 2007 (Waltham, MA)
- Tuesday August 21, 2007 (Fitchburg, MA)
- Thursday August 23, 2007 (West Concord, MA)

In each meeting, the Project Team presented an overview of the history of the Fitchburg Commuter Rail Line Improvements project, including the history of the Project, the existing conditions, need for improvements, and an outline of potential improvements to the line. Study methods and resulting travel time savings accrued from the implementation of the recommended LPA were presented. An extensive public comment and question and answer session was part of each public meeting

Public comment at each of the three meetings was overwhelmingly positive, as can be evidenced in the meeting minutes attached as **Appendix F.** Many of the attendees also had suggestions for additional improvements or items to be examined further, such as providing added parking or exploring potential station consolidation. Several comments also referred to specific constraints, problems, or desires for improvements at a

Figure 8: Project Map



particular station. All specific questions and comments were recorded, and either were forwarded to the appropriate agency or will be considered during the design of the project. The public comments will continue to inform future improvements along the Fitchburg Commuter Rail Line.

There was a general consensus throughout the Public Process to proceed expeditiously with the recommended Locally Preferred Alternative. The Locally Preferred Alternative is shown on the Project Map in **Figure 8**. The Locally Preferred Alternative represents the most appropriate set of improvements for the Fitchburg Commuter Rail Line given the results of the technical analysis and public process as well as the proposed budget, as determined by the project team. The total cost for the Locally Preferred Alternative in Year of Expenditure dollars would be $149.8 million.

FTA Forecasting Reporting Requirements[5]

The Travel Forecasts and Cost Effectiveness templates are required submissions by the FTA for the AA component of the small starts process. The Travel Forecast and Cost Effectiveness templates are included in **Appendices A-2** and **A-3**, respectively. Both templates were completed based on information prepared by CTPS for the Cost Effectiveness Calculations and used the alternative methodology developed in conjunction with the FTA. The benefits shown represent only existing riders and the cumulative travel time savings they enjoy. The Cost Effectiveness Calculations and the documentation of the methodology are included as **Appendix A-3** under separate cover as part of the overall list of deliverables for this Project.

The Cost Effectiveness Template links information from the travel forecast and land use templates as well as the annualized cost information from the standard cost category worksheets. The numbers are based upon a comparison of the Baseline, which is also the No Build in this case, to determine the cost effectiveness of the project as measured by User Benefits. User Benefits were calculated on the basis of travel time saved by Existing Riders only.

The template also includes new information on the annual operating and maintenance costs for the Project. The Fitchburg Improvement Project is expected to result in an annual savings in operating and maintenance costs due to reduced crew costs from improved travel time, and maintenance savings due to the infrastructure upgrades.

[5] The methods and information were informed by published FTA guidance and ongoing coordination with FTA staff.

Details for the operations and maintenance factors were described in the Operations and Maintenance Section of this report.

It is highly likely that the travel time savings achieved by the Fitchburg Improvement Project would further attract additional riders, and show even greater benefits. Regardless, the benefits to Existing Riders alone are enough to earn a medium rating and provide project justification under the expedited reporting requirements under the Small Starts program.

Project Scheduling and Finance

One of the goals of the Fitchburg Commuter Rail Line Improvement Project is to implement the recommended alternative as quickly as possible to help improve service for existing riders. Broad community support exists for the implementation of the Locally Preferred Alternative, and all of the relevant agencies have been cooperating and are ready to begin the implementation process. The Massachusetts Executive Office of Transportation and Public Works (EOTPW) is committed to seeking bond funding as the local match for the federal funds.

The Project Schedule and Finance section of the Alternatives Analysis report lays out the schedule and documents the proposed funding that will be used to complete the Fitchburg Commuter Rail Line Improvements Project. This section also provided the explanation and derivation for the information recorded on the required schedule and finance reporting sheets required as part of the Alternatives Analysis report for the FTA's Small Starts process.

Schedule

Figure 9 shows the complete Project Schedule for the Fitchburg Commuter Rail Line Improvements Project from the current Alternatives Analysis phase through Project Construction and into Revenue Operations. The Alternatives Analysis process is complete in September with the filing of this report with approval into Project Development expected, and the Project will soon transition to the MBTA. A Request for Proposals for Design is being prepared and will be released by the MBTA once approval into Project Development is granted. Project Development combines preliminary and final design into a singular design phase of the project and is expected to take about one year. Pending the execution of the Project Construction Grant Agreement, an estimated completion by 2012 is anticipated.

Project Management Plan

A number of State, regional and local agencies have participated in the Fitchburg Commuter Rail Line Improvement Project. Two of the previous planning efforts have been issued and managed by the Massachusetts Bay Transportation Authority. The Montachusett Regional Transit Authority is the lead agency for this Alternatives

Analysis process. The Massachusetts Executive Office of Transportation and Public Works has been involved at strategic points of Alternatives Analysis process. Information used to complete the Alternatives Analysis process has been provided by multiple regional planning agencies, the Central Transportation Planning Staff, municipalities and State Legislators.

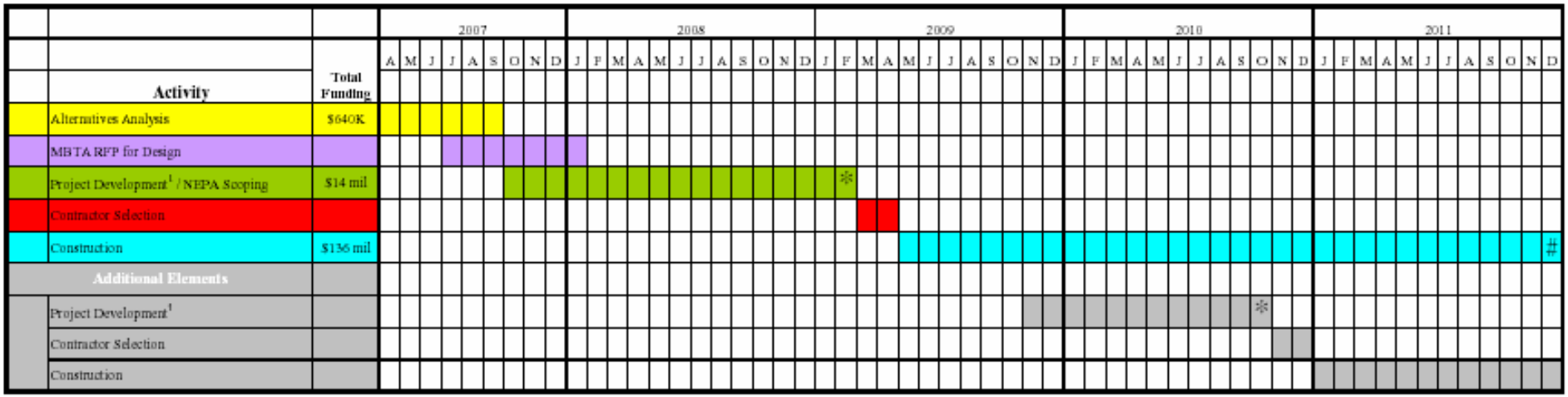
This level of Interagency cooperation is expected to continue as the Project progresses. However, as the Fitchburg Commuter Rail Line Improvements Project moves into the Project Development phase of the FTA Small Starts process, the MBTA will assume lead technical responsibility for all subsequent phases design and construction. The Executive Office of Transportation and Public Works, the MBTA and MART will enter into an Interagency Services Agreement and other appropriate contractual agreements to cooperatively advance the project through design and construction.

Although the area covered by the Fitchburg Line comprises several different transit agencies (MBTA and MART), the MBTA owns the line and the associated right-of-way. The MBTA is responsible for commuter rail service between Fitchburg and Boston and has the responsibility and personnel to carry out the design for the proposed improvements to the line.

The MBTA will lead the Project Development phase and will assign the project to the Assistant General Manager of Design and Construction. The project will be managed according to the organization shown on the Preliminary Project Management Chart shown in **Figure 10**. A design Project Manager and Deputy Project Manager will be assigned to manage all design activities.

The Design and Deputy PMs will be assisted with the staff of several Directorates within the MBTA. These include the Environmental Affairs, Railroad Operations, and Development groups. The Environmental Affairs Department will ensure NEPA requirements are met and the environmental process is carried out in accordance with the MBTA's usual procedures. The Railroad Operations Directorate and the Development Department have been heavily involved in the development of the Fitchburg Commuter Rail Line Improvement Program, and will continue to coordinate with Design and Construction PMs. This MBTA staff has the full range of design and engineering skills necessary to manage a major railroad design and construction, as evidence in the recently completed restitution of the Old Colony Commuter Rail Service along with the Greenbush Line service scheduled to restart this fall. In addition, the Massachusetts Bay Commuter Rail Company, which operates the line, has staff skilled in railroad operations and railroad engineering.

Figure 9: Project Timeline & Anticipated Funding Schedule



1 Project Development includes Preliminary Engineering, Final Design, and Construction Documents and does not include construction phase services

Completion of Small Starts Project Improvements

* Bid documents completed

The Design Project Manager will hire a multi-disciplined Architectural and Engineering firm to undertake the Project Development work. For Small Starts projects, Project Development includes Preliminary and Final Design elements. The MBTA plans to issue an RFP for these design services with the expectation, that the design work will be completed within one year from Notice to Proceed.

Local Financial Commitment

A financial plan is developed during the Alternatives Analysis to guide reviewers and decision makers. An understanding of the costs of not only constructing each alternative, but of operating and maintaining them on an annual basis is important in the evaluation process. A financial plan that is based on firm economic resources facilitates the selection and implementation of services and capital improvements of a corridor. The Fitchburg Commuter Rail Improvement Project has a financial plan which includes a review of the capacity of existing funding sources to support the capital and operating costs of each alternative. The associated plan will include the project's schedule and projected cash flow.

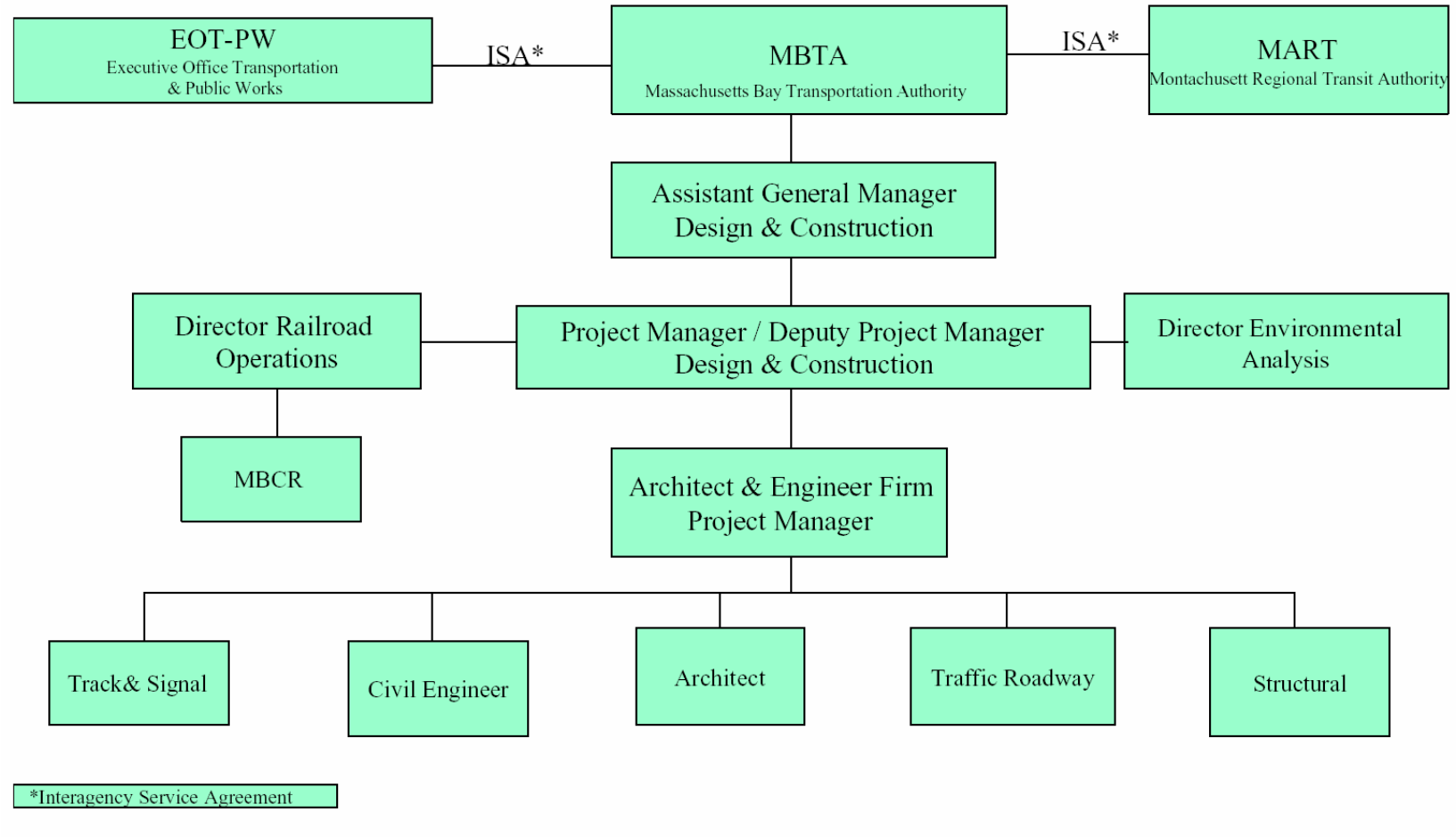
Financial Plan Summary

The Fitchburg Commuter Rail Line Improvement Project is expected to cost approximately $150 million for Design and Construction combined. Earlier sections of this report provided background on capital and operating cost estimates. All costs were further broken down into FTA mandated categories on the Standard Cost Category (SCC) worksheets included in **Appendix B**. The Fitchburg Project is seeking half of the required funds (approximately $75 million) from the Federal Transit Administration, through the Small Starts program. The local match (of 50% or $75million, whichever is lower) is anticipated to be provided by the Massachusetts Executive Office of Transportation and Public Works, through capital bond funds. The Small Starts Finance Template was completed on the basis of this information and is included in **Appendix A-5**.

Operating and Maintenance Costs < 5% Systemwide Costs

The Fitchburg Commuter Rail Line as it exists represents an important component of the overall public transit service provided by the Massachusetts Bay Transportation Authority. From a cost perspective however, Fitchburg service is a relatively minor contributor to the MBTA's over $1 billion annual operating expenses. The Fitchburg Line is only one of twelve commuter rail lines, run by the MBTA, which also provides rapid transit, light rail, bus rapid transit, and express and local bus service for the metropolitan Boston area.

Figure 10: Organization Chart For Project Development Phase



Furthermore, as the Fitchburg Commuter Rail Line Improvement Project does not propose any changes in service, the operating and maintenance costs are minimal. In fact, as shown in the **Operating and Maintenance** section of this document, the Fitchburg Improvements will actually result in an annual savings of about $14,000 for the MBTA. Per FTA guidance, the financial reporting requirements for Small Starts projects have been streamlined. Projects that can demonstrate that additional operating and maintenance cost to the agency of the proposed Small Starts project is less than 5 percent of the agency's operating budget, need not submit a Financial Plan.

The MBTA, as the responsible operator of the Fitchburg service, both now and in the Opening Year, has certified that the Improvement Project will not exceed 5% of the Agency's overall operating costs. A letter signed by the Deputy General Manager and Chief Financial Officer of the Massachusetts Bay Transportation Authority is included, certifying this information. The letter is included as **Appendix G** of this document. Further evidence of the expected Operating and Maintenance cost changes for the Fitchburg Commuter Rail Line Improvements Project is included in the Operating and Maintenance section of this report and as supporting evidence for the attached letter.

Evidence of Agency Financial Condition

The Massachusetts Bay Transportation Authority is the present and future operator of the Fitchburg Commuter Rail Line service. The MBTA was voted into law by the Commonwealth of Massachusetts in June of 1964, and today is the fifth largest mass transit system in the nation, with an average weekday ridership of approximately 1.1 million passenger trips. Since its establishment, the MBTA has continuously provided service to the Boston metropolitan area. The most recent independently audited statements of the MBTA are included as **Appendix G**, and document the stability and financial condition of this vital transit agency.

Supporting Financial Documentation

The Montachusett Regional Planning Commission is responsible for the Montachusett Regional Transportation Plan (RTP). In the 2007 RTP, FFY 2007-2010, the Fitchburg Commuter Rail Improvement Project was programmed under short range projects. On August 15, 2007, the Montachusett Metropolitan Planning Organization, (MPO) endorsed the Transportation Improvement Program (FFY 2008-2011). In this TIP document, for FFY 2008-2011 under the transit project listing, the Boston to Fitchburg Commuter Rail Study was scheduled.

The Fitchburg Commuter Rail Line Improvement Project remains in close coordination with the Executive Office of Transportation and Public Works, the Governor's Office and State Legislators. The Project Team has also been working closely with Congressman John Olver's office and is currently authorized for $2.6 million in federal funds for preliminary engineering. The Massachusetts Executive Office of

Transportation and Public Works is committed to seeking bond authorization for this Project in the state bond bill anticipated to be filed in the fall of 2007 with the Massachusetts State Legislature. The proceeds from the bond funds will be the local match (of 50% or $75million, whichever is lower) to the federal Small Starts Program funds requested.

The Fitchburg Commuter Rail Improvement Project has further earned the support of Massachusetts State Representatives and Senators representing communities along the Line. These Legislators have written correspondence showing their project support and intent to request state funding appropriation, which are included as **Appendix G** of this Report. Under the Small Starts program, this project is seeking $75 million of funding from the Federal Transit Administration, which would be an approximate 50% federal share.

Land Use Justification

Quantitative Land Use Information for Small Starts

Two copies of the completed template are included in **Appendix A-4**, one for the Base Year (2006) and one for the Opening Year (2013). All of the quantitative land use information covers the entire Boston metropolitan area as well as the additional towns in the Montachusett Regional Planning Council planning area. These additional towns are served by the Fitchburg Commuter Rail Line and were added to the Boston regional model to measure the Project.

Both Porter Square in Cambridge and the North Station terminal in Boston are important destination points for Fitchburg Line passengers. The Central Business District was defined to include the areas around these stations and within a half mile around the rapid transit stations accessible by a single seat ride from these transfer points. The attached map shows the Central Business District. Additional maps show population, household density and employment around the Fitchburg Line station areas both today and in the Opening Year.

Qualitative Land Use and Other Factors

The Fitchburg Commuter Rail Line is a long operational commuter rail corridor, running almost 50 miles between Fitchburg and Boston. The corridor already provides substantial commuter rail passenger service at 18 stations, and also serves as an active freight line. For the 13 communities with stations and 17 communities that the Line passes through, the railroad has long been a fixture, with a significant component of the land uses in these communities historically growing up around the rail line. The

proposed Improvement Project primarily involves the modernization of this infrastructure, will be confined to the existing right-of-way and will not include any new stations.

Existing Land Use

The Fitchburg Line provides service to 18 existing commuter rail stations in the 50-mile corridor between Fitchburg and Boston. No new stations are proposed as part of the Locally Preferred Alternative. The more urban communities have a higher concentration of stations, with many of these closely spaced. As the corridor progresses westward, stations are fewer and farther apart.

The station spacing is a reflection of the land uses in the towns in which the stations lie. As the corridor progresses westward, land patterns in the surrounding communities also become less dense. However, in reaching the farthest west communities of Fitchburg and Leominster, densities increase again as these communities are historic industrial centers, sited as they are on the Nashua River. This pattern is self-evident on the Project Vicinity maps, included as **Appendix C** of this report, which show aerial photos of the entire corridor.

Nevertheless, the Fitchburg Commuter Rail Line often runs through the densest and most historic sections of the communities through which it passes. The majority of the stations are located in the historic town centers and traditional downtowns of these communities. Many of these areas, with Concord as a prime example, are typical New England town centers, which are the historic model of the pedestrian friendly town centers planners are today trying to recreate. In fact, the Inventory of Historic Structures completed for the environmental component of the Project shows that many of these structures identified, are clustered around the existing stations, and even the town centers in which they lie have been recognized and protected.

The density around the existing stations is further shown on **Figures 11, 12, and 13**, which show respectively the population, employment, and household density around the stations. As can be seen in the figures, the densest population and employment concentrations are at North Station in Boston and Porter Square in Cambridge. Waltham is next, followed by Fitchburg. As described above, the population and housing densities are lower in the suburban stations, with lowest densities occurring in Lincoln and Weston. However, even where density around the stations is low compared to the rest of the Line, this density is typically higher than that found in the rest of the town.

Other Trip Generators

The majority of current Fitchburg Line riders use the line to arrive at the Central Business District and follow typical commuting patterns. The Fitchburg Line does

however provide access to a number of other destinations and non-work related venues. Access to these locations would also be improved as a result of the Improvement Project and provide substantial benefits outside even the traditional commuting peak periods. Downtown Boston is a destination in and of itself for many reasons beyond work. Boston is the cultural, historic, and entertainment center not just of the metropolitan area, but for all of New England. North Station, the terminus of the Fitchburg Line, also is home of the TD BankNorth Garden. The Garden is the home arena of the Boston Celtics of the National Basketball Association, the Boston Bruins, of the National Hockey League, and also hosts many other events, concerts, ice shows, and national sports competitions.

The stations along the Fitchburg line also provide direct service to a number of Colleges and Universities, including Brandeis University in Waltham (at the Brandeis/Roberts station) and Fitchburg State College in Fitchburg. Many historic buildings and cultural facilities are also located a short walk (or bike ride) away from the corridor, as the Inventory of Historic Resources identified hundreds of identified and protected facilities within the half mile corridor around the Line. Additionally, Fitchburg Station serves as a gateway to Mount Wachusett in North Central Massachusetts. Mount Wachusett provides perhaps the closest major ski area to Boston, and recently special “ski trains” have been designated, with connecting free bus service provided from the Fitchburg Intermodal Center to Mount Wachusett during ski season.

Parking

Parking is provided in various forms at the stations along the Fitchburg Commuter Rail Line. The Montachusett Regional Transit Authority recently completed an expansion of the parking facility at the Fitchburg Intermodal Center. Parking at other stations is often a mix of parking lots owned by the MBTA, MART, or the municipality. Some private parking facilities also exist near stations. Many stations also have are other intermodal connections to local bus service. Furthermore, a significant percentage of passengers either walk, bike or are dropped off at the Fitchburg Line stations. **Table 10** shows the parking, cost and intermodal connections by station.

Table 10: Parking and Station Facilities

	Station	Station Parking[6]	Observed Utilization	Cost	Bicycle Parking	Bus Service
Western	Fitchburg	412	31.3	$2	20	MART Buses, Fitchburg Intermodal Center
	N. Leominster	135	89.6%	$2	n/a	MART Buses
	Shirley	67	145%	Free	n/a	
	Ayer	133	98.5%	Free	14	
	Littleton/Rt. 495	49(95)	132%(57.9%)	Free($50 month)	12	
Suburban	South Acton	300	99.3%	$2.50, Free, Res. Only	83	
	West Concord	191	94.8%	$2	10	
	Concord	91	133%	Free	10	
	Lincoln	161	n/a	n/a	n/a	
Urban	Silver Hill	n/a	n/a	n/a	n/a	
	Hastings	8	100%	Free	n/a	
	Kendal Green	50	100%	n/a	n/a	
	Brandeis/Roberts	58	43.1%	n/a	4	MBTA Bus Route 553
	Waltham	45	100%	n/a	8	MBTA Bus Routes 70, 70A, 170, 505, 553, 554, 556, 558
	Waverley	None	n/a	n/a	8	MBTA Bus Routes 73, 554
	Belmont	None	n/a	n/a	8	MBTA Bus Routes 72, 74,75
	Porter Square	None	n/a	n/a	34	MBTA Red Line, MBTA bus Routes 77, 77A, 83, 96

Transit Supportive Plans and Policies

Massachusetts is highly invested in transit-oriented development. With the passage of the Smart Growth Zoning Law (Chapter 40R), funding and incentives are available to communities which focus on sustainable development and development that occurs in

[6] Includes MART, MBTA & town owned lots, not including HP spaces

the vicinity of major transit nodes. According to the Chapter 40R legislation, locations eligible for funding should meet one of the following criteria:

- The location is situated near transit stations, including rapid transit, commuter rail, and bus and ferry terminals.
- The location contains concentrated development, including town and city centers, other existing commercial districts in cities and towns, and existing rural village districts.
- The location (by virtue of its infrastructure, transportation access, existing underutilized facilities, and/or location) makes a highly suitable site for residential or mixed-use smart growth zoning districts.

All of the communities situated along the Fitchburg Line corridor would qualify under the above Smart Growth criteria. Proposed developments adjacent to the Fitchburg Line and especially near the stations would all be eligible for the state funding support through this initiative.

The city of Fitchburg, MA is notable example of a community investing in transit-supportive development. Like most stations in the corridor, Fitchburg Station is located in the heart of the city's historic downtown. Previously the location of industrial buildings, this site is rapidly changing to meet residents' demand for a modern lifestyle. The City, along with the Fitchburg Redevelopment Authority, is currently striving to revitalize this downtown area, by using economic incentives to draw retailers and developers, providing parking, and partnering with the local State College for planning. The recently completed Fitchburg Intermodal Center, with over 400 parking spaces, is a key component of the plan.

A bus exits the recently-completed Fitchburg Intermodal Center. New retail space can be seen in the storefronts on either side, with the multi-story garage in the background.

Concord, MA is another example of a community implementing transit-supportive development. Recent additions of mixed-use facilities and the development of new restaurants immediately adjacent to the train station are examples of what the town has

accomplished thus far. Other municipalities along the line, such as Ayer and Leominster are taking similar actions to stimulate transit-supportive growth.

Fiber Optic Connection

The need for providing a Fiber Optic connection along the Fitchburg Line was continually endorsed throughout the public history of the project. As a continuously owned corridor which penetrates deep into North Central Massachusetts, many have seen the Fitchburg Line Improvement project as a crucial opportunity to expand the Commonwealth's Broadband Infrastructure. Broadband, or high-speed Internet access, provides significant benefits to the Commonwealth. These benefits include easier access to employment opportunities; workforce training programs and educational resources; reduced demand on the Commonwealth's transportation systems through telecommuting; more efficient delivery of health care; and increased automation of transaction-based government services.

Expansion of Broadband access has been identified as a key Economic Development issue for the Commonwealth of Massachusetts, which just this summer unveiled a $25million Broadband Incentive Fund. In a press release announcing this effort, Massachusetts Secretary of Housing and Economic Development Dan O'Connell stated, The Patrick Administration recognizes the economic imperative of taking smart steps to close the digital divide that persists in part of our state."

By providing continuous runs for conduit and cable, the Fitchburg Line project represents a critical opportunity to expand Broadband access for the towns adjacent to the Line, and beyond. As can be seen in **Figure 14** many of the communities adjacent to the Fitchburg Line have limited service availability. The communities that are underserved, meaning that outside a one to two miles radius of the Verizon Office, have no broadband access, are: Fitchburg, Lunenburg, Westminster, Princeton, Carlisle and Billerica. Meanwhile, Concord, Lancaster and Harvard have access to only one broadband provider. Furthermore, as can be seen in the figure, the municipalities lying just west of Fitchburg are among the most underserved in the Commonwealth. Extending the Fiber Optic infrastructure as far west as Fitchburg, brings these communities much closer to potential service.

As Project Development begins, the MBTA will work with service providers, and other state agencies to ensure that the Fiber Optic network built as part of the Fitchburg Commuter Rail Line Improvement project is sufficient to meet all service needs and future goals. Opportunities for partnerships will be explored, and connections to adjacent towns and beyond will be built into the network. Additionally, WiFi access for Commuter Rail passengers will be made available. The Fitchburg Line will serve as the lone example, and possible prototype, of this service in the MBTA system. The fiber optic backbone is the crucial element for providing WiFi service, and no other line possesses this infrastructure.

Environmental Assessment

The Fitchburg Commuter Rail Line Improvement Project will modernize an existing commuter rail line to provide greatly improved service and reliability to riders along the almost 50-mile corridor between Fitchburg and Boston, Massachusetts. The opportunity to implement the Project quickly was a major factor in the decision to pursue Small Starts funding. With Small Starts funding caps, and an expedited process, it was concluded that the initial Project should focus on improving systemwide issues. Therefore, even though over $300 million of potential improvements had been previously identified, the Alternatives developed for Small Starts concentrated on systemwide improvements that would both minimize controversy and potential environmental impacts.

The improvements included in the Locally Preferred Alternative all would occur within the existing railroad infrastructure. Even the proposed double track segments only involve the reinstallation of track where it previously existed. The entire railroad right-of-way is owned by the Massachusetts Bay Transportation Authority, and has long been an operating railroad for freight and passenger service. In fact no additional service changes are proposed as part of the Locally Preferred Alternative, so that when complete, the only intended difference is the improved speed and reliability of train travel on the Fitchburg Line.

Once the Locally Preferred Alternative was selected, the Project Team took the first steps towards initiating the state and federal environmental processes, including the preparation of a Categorical Exclusion (CE) under the National Environmental Policy Act (NEPA). Beginning the NEPA process is one of the FTA requirements for entrance from the Small Starts Alternatives Analysis phase into Project Development (design).

In order to ensure eligibility for a Categorical Exclusion, the Project Team prepared environmental, historic, wetlands, and other information about the Fitchburg Line Corridor. The Locally Preferred Alternative also was presented at several public

meetings throughout the corridor to gather public input about the viability and potential impacts of the Project. Finally, state and federal environmental agencies were invited to an initial meeting to present the LPA and discuss other potential Scoping requirements

Epsilon Associates was hired to undertake a review of the historic resources within 200 feet of the centerline of the right-of-way of the Fitchburg Commuter Rail Line. The review included a compilation of all assets listed in the State and National Registers of historic Places as well as the Inventory of Historic and Archaeological Assets of the Commonwealth on file at the Massachusetts Historical Commission. These assets were compiled in tabular form and plotted on a series of maps using the GIS mapping system.

Additionally, GIS maps were prepared showing the Fitchburg Line commuter rail corridor within the context of all water protection related features. The maps prepared identify the Fitchburg Line corridor as well as the one-half mile and one mile buffer zones around the tracks. Maps were prepared using the most recent data available on MassGIS by the Montachusett Regional Planning Authority, which is the Commonwealth's Office of Geographic and Environmental Information. The maps show all designated wetlands, floodplains, public water supplies, some of which abut the existing Fitchburg Commuter Rail Line corridor.

Lastly, an initial Scoping meeting was held on Wednesday, August 29th. The meeting was co-hosted by the Montachusett Regional Transit Authority and the Massachusetts Bay Transportation Authority. Invited to the meeting were representatives from the Massachusetts Department of Environmental Protection, the Massachusetts Historical Commission and the Army Corps of Engineers, along with Federal Transit Administration staff. The meeting was to present an overview of the Project and the proposed scope and methods for the environmental filing.

As the Project will primarily involve upgrades to the existing infrastructure, within the currently operating railroad right-of-way, specific comments were minimal. Information was requested and is being prepared regarding showing the Fitchburg Corridor within the context of known habitats of endangered and protected species. The Project Team will continue to coordinate with state and federal environmental agencies as we complete the CE checklist for the proposed Fitchburg Commuter Rail Line Improvement project. As agencies review further the information being provided, the Project Team will address additional questions at this stage, or further compile and incorporate comments in the upcoming design and construction phases. The complete CE Checklist, with supporting documentation will be submitted to the Federal Transit Administration under separate cover.

Before and After Study

The primary goals of the Fitchburg Commuter Rail Improvement Project are to reduce travel times and improve service reliability between Fitchburg and Porter Square. The secondary goals of the Fitchburg Commuter Rail Line Improvement Program are to alleviate congestion on Route 2 and support the areas economic development goals.

Given the current condition and long term constraints of Route 2, the Fitchburg corridor, especially its western end communities, have limited travel options to the Boston job market. Presently, both Route 2 and the Fitchburg Commuter rail Line suffer from deficient infrastructure and unreliable travel times. Improved service and reliability on the Fitchburg Commuter Rail Line should entice a number of drivers to switch from highway to rail for their commute to the Boston/Cambridge job market.

Forecast of Travel Time and Reliability

To estimate the future-year travel time with the track improvements in place, the Project Team used the railroad simulation, Rail Traffic Controller (RTC) as documented in the Study Methodology section of this report.

Based on the RTC results, the Locally Preferred Alternative (LPA), which included mostly system wide upgrades, showed a significant improvement to the running times. The simulation of the LPA gave end-to-end travel times that were typically 10-11 minutes faster in the modeling scenarios than for the No Build. The proposed improvements in Alternative 1 would extend the region covered by a one-hour commute to Porter Square by 1-2 stops. For local trains, this typically extended it from Littleton/Ayer west to Shirley, and for express trains, from Shirley to as far as Leominster. At least two express trains were even able to reach Porter Square from Fitchburg in an hour's time.

After Study Scope

To determine if the decrease in travel time was achieved as a result of the improvement project the Project Team will review the Massachusetts Bay Commuter Railroad (MBCR) train calibrations by evaluating the MBCR travel logs to determine the travel times for each train throughout the day as well as the on-time reliability of each train. The travel logs will be analyzed for a period of 14 days to achieve an adequate sample size. The travel time and reliability data will be compared to the original projected results.
Deliverable: Memorandum of actual travel time and reliability of Fitchburg commuter rail line in 2014.

To determine if congestion on Route 2 was alleviated as a result of the improvement program, we will complete travel time runs between Fitchburg station and Alewife station after the improvements are completed in 2014. We will compare the 2014 travel

time runs to the travel time runs which we completed between Fitchburg station and Alewife station during the 2006 conditions analysis. To create an accurate comparison between the 2006 and 2014 travel time runs, we will factor in the proposed roadway improvements along Route 2 and also account for the generation population growth rate in the area to the 2006 travel time runs. If the 2014 travel times are less that the adjusted 2006 travel time runs, then it will be determined that the congestion in proportion to population growth and roadway improvements has been reduced.
Deliverable: Memorandum regarding congestion on Route 2 in 2014.

To determine if ridership increased as a result of the improvement program, ridership counts will be conducted to determine the number of passengers using the Fitchburg line on a daily basis in 2014. The 2014 ridership counts will be compared to the 2006 ridership counts to determine the percent change in ridership. To account for general population growth in the area the 2006 population and 2014 population for the communities using the Fitchburg line will be compared to determine the percent change in population. If the commuter rail ridership percent change is shown to grow at a faster rate than the population percent change, then it will be determined that the ridership in proportion to population growth has increased.
Deliverable: Memorandum of ridership of the Fitchburg commuter rail line in 2014.

To determine if commuters have been influenced to use the commuter rail service as a result of the improvement program, on-board surveys will be conducted asking passengers if they recently changed their mode of transportation or moved to the area as a result of the rail improvements, which include faster travel times and better reliability.
Deliverable: Memorandum of the results of the on-board passenger surveys.

To determine whether the commuter rail share of the transportation modes in the communities with access to the Fitchburg line has increased, data will be collected from CTPS and/or MART in 2014. The 2014 commuter rail mode share will be compared to the 2006 commuter rail mode share along the Fitchburg line to determine if the mode share has increased as a result of the improvement project.
Deliverable: Memorandum of commuter rail mode share in 2014 within the communities served by the Fitchburg commuter rail line.

Capital Costs
Capital costs for the Fitchburg commuter rail line are $150 million. The budgeted capital cost will be compared to the actual capital cost at project close-out.
Deliverable: Memorandum regarding the capital cost of the Fitchburg commuter rail line in 2014.

Operating Costs

Operating costs of the improved service are forecast to result in a modest reduction in net operating expenses of approximately $14,000 annually. Cost increases are expected from increased fuel consumption, 114,335 gallons per year, and the additional of two mechanics to maintain the in-cab signals. Saving are expected from a reduction of one laborer for overall line maintenance and four and a half full-time equivalent staff at the Waltham Tower, which will be eliminated. Fuel usage and staffing levels will be compared to determine if the expected operating cost estimates were met.
Deliverable: Memorandum of operating costs of the Fitchburg commuter rail line in 2014.

Conclusion

The Fitchburg Commuter Rail Line Improvement Project will modernize an existing commuter rail line to provide greatly improved travel time and reliability to riders and commuters in the 50 mile long corridor extending from Fitchburg to Boston. The Alternatives Analysis process has resulted in the selection of a Locally Preferred Alternative that enjoys significant public support and the ongoing cooperation of the transportation funding and operating agencies of the Commonwealth. The Locally Preferred Alternative fills a demonstrated need for transportation improvements in a growing corridor, without impacting historic or environmental resources. The Fitchburg Commuter Rail Line Improvement Project has also demonstrated that it will increase the reliability of existing service while reducing operating and maintenance costs.

The Alternatives Analysis Report has presented the current operating characteristics of Fitchburg Service, and a history of the community desire and agency planning for potential improvements. The Purpose and Need section documents the problems with existing service and the growth and congestion issues within the corridor as currently:

- The Fitchburg Line has the oldest infrastructure in the MBTA system
- The Fitchburg Line is the longest in terms of both distance and travel time.
- The Fitchburg Line has one of the worst on time performance records in the MBTA system.
- The Fitchburg Line serves a region with limited commuter options.
- The Montachusett region is one of the few Massachusetts areas with significant population growth.

The operating and funding transportation agencies worked cooperatively throughout the Alternatives Analysis process to develop the Locally Preferred Alternative. All agencies were participant in the development of the Alternatives, preparation of cost estimates, and in the development of the Study Methodology. The Rail Simulation

software allowed the Project Team to fully evaluate the individual improvements on the Line, and will ultimately be turned over to the MBTA to assist their ongoing commuter rail operations planning efforts.

As a result of input from FTA staff, an alternative reporting methodology was developed to measure the User Benefits of the project. Rail simulation results were exacting enough that benefits to travel time saved by existing riders alone provided enough User Benefits to achieve a Medium project rating. As one of the first Small Starts projects nationally, this collaboratively-developed methodology can serve as an example for future projects, as it fits the FTA mandate to streamline the reporting and evaluation process under this initiative.
Based on existing riders alone, the $150 million Alternative produced over 945 hours of passenger travel time saved a day. When factored annually, and with the FTA's 20-year 1.5 growth factor, a Cost Effectiveness rating of $23.95 is achieved. Alternative 1 was then refined into a Locally Preferred Alternative which will further improve systemwide performance for the same $150 million. The Alternatives Analysis report further demonstrates that the LPA will actually result in reduced operating and maintenance costs for Fitchburg Service, due to both the improved travel time and the overall infrastructure upgrade of the Line.

In short, this Alternatives Analysis Report has clearly demonstrated the eligibility and need for the Fitchburg Commuter Rail Line Improvement Project. When complete, the Project will provide the following benefits:

- Modernized, state of the art infrastructure allowing 80 mph travel speeds
- 945 hours/day Travel Time benefits for Existing Riders alone
- Service reliability increase from 83% to over 95% on-time performance
- Significantly enhanced passenger experience
- Support statewide and regional economic development goals
- Reduced operating and maintenance costs, even while attracting new riders

The Alternatives Analysis report provides all of the documentation and forms required by the Federal Transit Administration in an application for Small Starts funding. The Locally Preferred Alternative further achieves sufficient rating on all of the criteria used by the FTA to evaluative projects in preparing a funding recommendation. The Fitchburg Commuter Rail Line Improvement Project should be recommended for funding by the FTA based on its performance in the following evaluative criteria:

Cost Effectiveness
Build Alternative 1 achieved a **Medium Cost Effectiveness** rating, with a **$23.95** ratio of user benefits/cost based on travel time saved by existing riders alone. Undoubtedly, the proposed improvements would further entice new passengers -- many diverted from

auto -- and provide additional user benefits with no added costs to the Project. The Study Methodology section shows that even when conservatively estimating this diversion the user benefit ratio could be improved to below $14, which could achieve a Medium High rating.

Local Financial Commitment

The Fitchburg Commuter Rail Line Improvement Project carries a total cost just below $150 million. The project is seeking approximately $75 million through Small Starts funding, which would be matched by $75 million of state funding for a 50/50 share of the overall Project costs. A reasonable plan to secure funding in the state bond bill anticipated to be filed in the fall of 2007 with the Massachusetts State Legislature was presented along with letters of Legislative support. As the Fitchburg Improvements enter the Project Development (design) stage, control will be transferred to the Massachusetts Bay Transportation Authority who has the demonstrated plan, expertise, and financial stability capacity to carry it out. The Fitchburg Line Improvements further achieve an operating savings for the MBTA, while even existing service represents less than 5% of the Agency's overall operating budget. Therefore, the Fitchburg Commuter Rail Line Improvements project anticipates qualifying for **High rating for Local Financial Commitment** under the simplified financial evaluation criteria for Small Starts.

Other Factors

Given the longstanding commuter rail service on the Fitchburg Line, the infrastructure improvements proposed as part of the Locally Preferred Alternative will not substantially alter the character of the surrounding towns that it serves. However, as demonstrated in the Purpose and Need and Land Use sections of this report, upgrades are sorely needed to benefit existing riders, provide better service to areas with limited commuting options, and support the continuing growth of the Study Area communities. Improving travel time and reliability will continue make the Montachusett region an attractive housing alternative for commuters, contributing to statewide affordable housing goals. Additionally, the inclusion of conduit and fiber optic cable will support the statewide initiative to expand broadband access by providing a direct route to connect many of the unserved and underserved communities of the Commonwealth. The corridor-wide fiber optic installation will also allow WiFi service to be offered both for passengers on board the service and potentially for customers directly along the corridor.

The Fitchburg Commuter Rail Line Improvement Project clearly performs well on the criteria by which the FTA rates projects for Small Starts funding. The project has demonstrated a history of community and agency support that has been evident through the Alternatives Analysis process, and will be carried through the design and construction. The recommended Locally Preferred Alternative represents the most cost

effective and achievable series of improvements for all present and potential users of the Fitchburg Line service. The LPA will provide significant travel time and reliability benefits while reducing operating costs. The Project Team stands ready to complete the design and construction of the proposed improvements and eagerly anticipates the FTA rating and funding that will allow the Fitchburg Line to progress into Project Development.