FEDERAL RAILROAD ADMINISTRATION

High-Speed Intercity Passenger Rail Track 2 Program

MA Knowledge Corridor

SERVICE DEVELOPMENT PLAN

October 2, 2009

Submitted by Massachusetts Executive Office of Transportation and Public Works

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1. INTRODUCTION

The Massachusetts Executive Office of Transportation and Public Works (EOT), in conjunction with the Vermont Agency of Transportation (Vtrans); Pan Am Southern Railroad (PAS); and Amtrak, is proposing the development of intercity passenger rail service in the I-91 Knowledge Corridor, which extends from White River Junction, Vermont, through Western Massachusetts to New Haven, Connecticut, where it connects with Amtrak's Boston, Massachusetts, to Washington, DC, Northeast Corridor. The project improvements discussed in this service development plan will benefit the Commonwealth of Massachusetts.

The MA Knowledge Corridor Program/Restore Vermonter development project involves a near term and long term vision for passenger rail in the Knowledge Corridor.

- **Near Term Plan:** Realignment of the Vermonter and the construction of a bikeway tunnel.

- **Longer Term Plan:** Enhanced intercity service with additional train frequencies for the Knowledge Corridor, as well as station development, Positive Train Control, and rail infrastructure improvements that will facilitate this long term vision.

The near term efforts are described completely in the application for funding through the Track 2 Corridor Programs of the Federal Railroad Administration's (FRA's) High-Speed Intercity Passenger Rail (HSIPR) Program, as well as this Service Development Plan. FRA HSIPR funding is being sought to fund the realignment of the Vermonter; the Commonwealth of Massachusetts intends to fund the tunnel construction.

The importance and value of this Corridor was identified through a study sponsored by the Pioneer Valley Planning Commission (PVPC), in conjunction with the Executive Office of Transportation and Public Works (EOTPW). That study has determined that the expansion of intercity passenger rail service in the I-91 Knowledge Corridor, between White River Junction, VT and New Haven, CT, has the potential to be a major component in producing economic revitalization, spurring job creation, improving air quality, increasing overall mobility and reducing vehicular traffic congestion.

The completion of these two near term infrastructure projects will enable consideration of additional corridor enhancements including enhanced intercity service, improved safety measures (e.g., Positive Train Control), and other infrastructure improvements. Detail related to these enhancements is included in Section 3 of this plan.

1.1 Knowledge Corridor Program / Restore Vermonter

The first phase of this corridor development project[1] is to relocate the Amtrak intercity passenger train, known as the Vermonter, from the New England Central Railroad back to its former route on the Pan Am Southern between Springfield and East Northfield in Massachusetts. Currently,

[1] Funding for the first phase of the corridor development project has been requested in the Track 1a ARRA application submitted by EOT this year.

the Vermonter operates daily between St. Albans, Vermont, and Washington, D.C. The routing of the Vermonter in Vermont and south of Springfield would remain unchanged.

It is anticipated that initial service would include station stops at the former Amtrak station at Northampton and the new intermodal station at Greenfield, with a potential for additional stations in the future. Direct passenger rail service to Amherst, Massachusetts, on the current route of the Vermonter, would be replaced with a bus link to the Northampton station.

In addition to realignment of the Vermonter, this first phase of the corridor development project also will include the construction of a bikeway tunnel to improve safety and access for pedestrians and bicyclists walking and riding near the railroad.

This application for FRA HSIPR funding is intended to build on the improvements made in the process of relocating the Vermonter and constructing the tunnel and to provide sufficient infrastructure and operational capacity for additional intercity passenger train service, specifically:

- One additional daily round trip between White River Junction, Vermont, and New Haven, Connecticut.
- Two additional daily round trips between Greenfield, Massachusetts, and New Haven, Connecticut.
- The opening of an additional passenger station in Holyoke, Massachusetts.

The project would include improvements to the existing rail line, including crosstie replacement, rail replacement, rehabilitation of grade crossings, reactivation of passing sidings and portions of double track, upgrading of switches, improvements to signal and communications systems, surfacing and alignment of track, and improvements to bridges and station platforms. The capital elements of this corridor development program are addressed in Section 3 of this Service Development Plan.

The schedule for both the relocated Vermonter and the enhanced intercity service are contained in Section 2 of this plan.

The expansion of passenger rail service along the Knowledge Corridor is anticipated to contribute significantly to the economic revitalization of the region; improve air quality by reducing pollutants associated with automobile travel; and, reduce traffic and congestion. The benefits associated with this project are described completely in Section 6.

1.2 Related Enhancements

It is worth noting that there are infrastructure plans and projects currently underway that are independent of the projects being proposed in the FRA HSIPR Track 2 application but have implications on passenger rail service in the Knowledge Corridor. These enhancements are part of the overall vision for the Knowledge Corridor. The following sections provide information related to those efforts.

1.2.1 Vision for the New England High-Speed and Intercity Rail

In the near term, the New England states expect to advance several High Speed and Intercity Passenger Rail initiatives, enhancing both passenger and freight service across the region.

Connecticut, Massachusetts, and Vermont will develop corridor plans for the Boston to New Haven and Boston to Montreal segments of the Northern New England High Speed Rail Corridor via the Inland Route through Worcester and Springfield. Maine, New Hampshire, Vermont and Massachusetts will develop corridor plans for the northern half of the Northern New England High Speed Rail Corridor, which extends from Boston to Portland and beyond and from Boston through Concord, New Hampshire, Vermont, terminating in Montreal. The overall vision for New England is described at http://www.mass.gov/Agov3/docs/PR071309.pdf.

The investments in the Knowledge Corridor, proposed in the FRA HSIPR Track 2 application, could contribute significantly to the future development of high speed rail in the region.

1.2.2 New Haven-Hartford-Springfield Rail Corridor

This project will provide commuter service in this corridor and offer greater train frequency. Track improvements and extensions will be made to the existing rail, including double tracking. The project is currently in the environmental impact phase. Funding for elements of this project has been requested through the Track 1a application process.

1.2.3 Vermonter/NECR Passenger Rail Improvement Project

Rail track work will be completed and bridges will be improved along the New England Central Railroad in Vermont for the Vermonter service. Funding for this effort was solicited through the Track 1a application process.

1.2.4 Union Station Revitalization

Union Station, the 1926 train station located in downtown Springfield, as well as the adjacent area, is undergoing renovation and revitalization currently. The effort involves the restoration of the rail station, located on Frank B. Murray Street, and the development of an abutting vacant lot on Main Street. After revitalization is complete, Union Station could again become a busy passenger terminal, offering both intercity rail service and connecting bus service.

1.2.5 Greenfield Intermodal Transportation Center

The Greenfield Station will be integrated with the Greenfield Intermodal Transportation Center being built adjacent to the railroad right of way. The center is currently in final design, and construction is expected to begin in January 2010 and occur through the year. Operations will begin in 2011. The center is primarily designed to provide better services to bus passengers in Greenfield. It will provide an indoor waiting area, restrooms, a ticketing area, and a taxi area.

1.3 Project History

The Connecticut River Valley has long served as a connection between New York and Eastern Canada and is a critical rail transportation corridor for New England. Some of the earliest north-south railroads in North America connected the cities and towns along the Connecticut River, providing the first rail links between Boston, New York, and Montreal. Different segments of the rail corridor were constructed and owned by different railroad companies, a condition that persists to this day.

The Knowledge Corridor describes a cluster of communities between Springfield, Massachusetts, and White River Junction, Vermont, located along I-91 within the Connecticut River Valley. This corridor encompasses the rail line that EOT is seeking to improve and

consists of high-density communities in addition to a multitude of important cultural, educational, business, and medical facilities. It is an important cultural and economic backbone for New England.

Expansion of rail services along the Knowledge Corridor could provide significant economic revitalization and investment, and in 2008, the Pioneer Valley Planning Commission (PVPC), with support from VTrans and EOT, began studying possible future passenger rail options. These options were intended to reduce travel time, maximize access, and provide viable transportation alternatives within the Knowledge Corridor. The PVPC study objectives were to improve mobility and promote economic development (PVPC, 2009). Three major rail service options were included in the study:

- Relocating existing Amtrak service back to the Connecticut River Line between Springfield and East Northfield, Massachusetts.
- Evaluating the potential for commuter rail service from Springfield north.
- Evaluating the potential for expanded intercity passenger rail service in the area from New Haven, Connecticut, to White River Junction, Vermont.

The findings from that study have led to the EOT Track 1a and Track 2 applications and the intercity passenger rail service development plan contained herein.

1.4 Project Corridor

The project corridor consists of the existing Pan Am Southern rail line from East Northfield to Springfield, Massachusetts, a distance of 49 miles passing through the communities of Holyoke, Northampton and Greenfield. Pan Am Southern owns this rail right-of-way and currently operates approximately four to six daily freight trains over the line. Average length per freight train is approximately 20-30 cars.

Rail and ties on the rail line are generally in fair to poor condition, and ballast and drainage are generally in good condition. The condition of rail varies, and it is anticipated that the need to replace rail in support of passenger service will be driven by the need to eliminate joints to reduce maintenance and improve ride quality. Most of the special work on the PAS track is jointed, quite old and in some cases has reached the end of its serviceable life. It can be expected that there will be a need to add or replace a significant number of ties, if passenger service is to be reintroduced in the corridor. This would facilitate an increase in train speed and improve the overall health and condition of the tie population. A number of crossing services have reached the end of their serviceable lives and should be replaced in anticipation of renewed passenger service to improve ride quality (both for railroad and highway users) and reliability while reducing anticipated maintenance expenditures.

1.5 Purpose and Need/Rationale

The purpose of the MA Knowledge Corridor Restore Vermonter project is to improve existing passenger rail service in the Knowledge Corridor and to add additional service north of Springfield through Massachusetts and into Vermont. The improvement to the existing service entails relocating the Vermonter to a route that better serves the major population centers within the corridor and reduces travel time for all Vermonter service travelers. By doing so, this project

will also increase the sustainability, cost effectiveness and attractiveness of intercity passenger rail service in western Massachusetts and Vermont longer term.

In addition to these service improvements, this project is anticipated to:

- Produce economic revitalization, including job creation, in economically distressed areas;
- Improve air quality;
- Increase overall mobility; and
- Reduce traffic congestion.

Each of these factors is discussed in Sections 6 and 7 of the plan.

1.5.1 Restore Vermonter

The primary component of this program, and the project for which FRA HSIPR funding is being sought, is the realignment of the Vermonter to its former route. The project will improve the long term viability of passenger service north of Springfield by putting that service on a rail line that has the potential to attract the maximum number of passengers and has ideal locations for additional passenger stations in Greenfield and Holyoke, thus creating greatly improved access to the services offered.

The proposed route relocation is approximately 11 miles shorter and eliminates a reverse movement at Palmer, Massachusetts, as well as a segment of the present-day trip over the heavily-utilized major CSX east-west freight line between Palmer and Springfield. Travel time is estimated to be reduced by approximately 25 minutes for each train. Ridership on the relocated route is projected to increase by approximately 23 percent.

1.5.2 Bicycle and Pedestrian Tunnel

A second element of the FRA HSIPR Track 2 application project is to construct a bikeway tunnel under the mainline in Northampton, and EOT is funding the tunnel project using its financial resources. Construction of the tunnel is a critical safety issue. It will promote safety for passengers and rail operators, by providing a separation between the trains and the pedestrians and bicyclists. Based on data provided by the City of Northampton, 1,800 bicyclists and pedestrians per day are anticipated to utilize the tunnel once complete. Currently, 1,000 to 1,400 individuals utilize the bikepath over which the tunnel will be constructed.

2. SERVICE AND OPERATING PLAN

In developing the Service and Operating Plan for an expanded Knowledge Corridor intercity passenger rail service, EOT considered a number of service scenarios in determining the improvement plan that would provide the most attractive service offering and produce the most transportation benefit to the corridor and the region. The scenarios that were considered included:

- Relocation of the present-day Vermonter as a stand alone service.
- Addition of a second daily round trip over most of the current route of the Vermonter.
- Development of a mixed commuter-intercity service totaling eight daily round trips, with five of those round trips only going as far as Greenfield, Massachusetts, and the other three round trips providing service into Vermont. This scenario also included an increase in maximum operating speeds for these trains from 60 mph to 79 mph.
- Extending an additional two round trips from the eight round trip scenario into Vermont, also at the higher maximum operating speed.
- Five daily round trips running the length of the Knowledge Corridor from White River Junction, Vermont, to New Haven, Connecticut.

2.1 Service Plan

The reductions of route miles and running time afforded by the proposed service changes, combined with the operation of trains on the more densely populated Pan Am Southern route between Springfield and East Northfield, present opportunities for significant improvement in crew and equipment utilization.

The I-91 Knowledge Corridor Rail Operations Modeling Study, which is provided as a supplemental document to this application, describes the assumptions, observations and conclusions drawn from a rail operations modeling study of passenger and freight trains on the I-91 Knowledge Corridor rail line. This study used the Rail Traffic Controller (RTC) simulation tool[2] to observe trains operating on this rail line, both in its existing and proposed configurations over a representative one-week period. The purpose of this study was to verify and analyze:

- The feasibility of several proposed passenger train schedules;
- The impacts to existing freight operations;
- The adequacy of the current and proposed physical plant, including track geometry and siding lengths and locations, for the proposed schedules;
- Where delays occur in the trains' schedules and to understand possible causes;
- Train meet-and-pass points and provide insight into how changes in schedule or track arrangement may improve operational reliability and passenger train running times.

After careful analysis and simulated operation of various scenarios, the service plan and schedule shown below in Table 1 was decided upon as the expanded, improved intercity passenger rail service that would offer the most benefit and be the most attractive to the potential ridership market in the Knowledge Corridor. It was also the most cost-effective solution.

[2] Licensed to HDR, Inc. By Berkeley Simulation Software.

As shown in Table 1, this Service Plan includes the improved, relocated Vermonter running daily in each direction between St. Albans, Vermont, and Washington, DC, and featuring a 25-minute shorter end-to-end travel time. The Vermonter would be a late morning/early afternoon train going southbound through the Knowledge Corridor and an afternoon/early evening train coming back northward through this area.

In addition, a second daily round trip serving the entire length of the Knowledge Corridor would be offered. This new round trip, running between White River Junction, Vermont, and New Haven, Connecticut, would depart southbound in the early morning from White River Junction and arrive in New Haven at noon, allowing passengers traveling to a variety of destinations to arrive at those destinations in the morning. The northbound leg of this round trip would depart New Haven in the middle of the afternoon, arriving back in White River Junction in the evening.

Finally, service would also include two daily round trips between a new multi-modal transportation terminal currently under construction in Greenfield, Massachusetts, and New Haven, Connecticut. The first southbound trip from Greenfield would depart very early in the morning, arriving in New Haven by 9:00 a.m. The second trip would be a late morning train arriving in New Haven in the early afternoon. The northbound legs of these round trips would depart New Haven, respectively, prior to 9:00 AM, thus providing a morning train going north, and after 7:00 PM, allowing for passengers to get back home to points in the Knowledge Corridor in the evening.

Table 1: Relocated Vermonter and Amtrak New Haven-White River Junction Shuttle Trains

Southward							Northward					
479	**475**	**55**	**473**	**493**	**495**		**490**	**470**	**56**	**474**	**476**	**494**
		11:43		7:35		**White River Jct. 185.57**			18:01	20:19		
		12:03 12:04		07:55 07:56		**Windsor 171.45**			17:43 17:42	20:01 20:00		
		12:14 12:15		08:06 08:07		**Claremont 163.34**			17:33 17:32	19:51 19:50		
		12:28		8:20		**Walpole 149.51**			17:20	19:38		
		12:33 12:35		08:25 08:27		**Bellows Falls 146.34**			17:14 17:12	19:32 19:30		
		12:52		8:44		**Putney North 133.90**			16:56	19:14		
		13:08 13:09		09:00 09:01		**Brattleboro 122.54**			16:40 16:37	18:58 18:57		
		13:22		9:14		**East Northfield 111.70**			16:22	18:42		
		13:37 13:39	11:29	09:29 09:31	6:05	**Greenfield 98.10**	11:07		16:06 16:04	18:26 18:24		21:51

		13:47	11:37	9:39	6:13	**South Deerfield 90.45**	10:53		15:55	18:15		21:42
		14:02 14:03	11:52 11:53	09:54 09:55	06:28 06:29	**Northampton 79.10**	10:47 10:46		15:44 15:43	18:04 18:03		21:31 21:30
		14:06	11:56	9:58	6:32	**Mt. Tom 76.68**	10:37		15:39	17:59		21:26
		14:14 14:15	12:04 12:05	10:06 10:07	06:40 06:41	**Holyoke 69.90**	10:34 10:33		15:31 15:30	17:51 17:50		21:18 21:17
19:05	15:50	14:35 14:45	12:25 12:35	10:27 10:37	07:01 07:11	**Springfield 62.00**	10:13 10:03	12:00	15:10 15:00	17:30 17:20	18:31	20:57 20:47
20:30	17:15	16:10	14:00	12:02	8:36	**New Haven 0.00**	8:38	10:35	13:22	16:00	17:06	19:22

Note: Time shown at Springfield is arriving and leaving passenger station. Time between Springfield and Holyoke includes ten minutes for the reverse movement needed for access between the station and the Pan Am Southern line. Times shown represent actual running time from 79 mph TPC output. No recovery time is included.

In addition to the new station at Greenfield, all of these trains would provide service to another new passenger rail station in Holyoke.

2.1.1 Freight

Currently, the rail corridor services 6 trains averaging 20 cars between 3 and 5 days per week. A seventh train with 30 cars is expected to begin service in 2010. Based on data collected for the benefit-cost analysis described in subsequent sections, the realignment of the Vermonter will result in a greater number of carloads servicing the corridor. Specifically, 175 cars will be added, as a result of the track improvements associated with the Vermonter relocation. The realignment will not increase the number of freight trains providing service, but freight traffic will continue to utilize the corridor between 3 and 5 days per week with trains double in length once the Vermonter is realigned. Table 2 below presents the freight information.

Table 2: Freight

Freight Line	Days Per Week	Current Cars	Future Cars	Additional Cars
ED-2	5	20	40	20
EDPL	3	20	40	20
PLED	3	20	40	20
Mt Tom Coal Train	5	30	75	45
EDWJ	3	20	40	20
WJED	3	20	40	20
EDCT (2010)	5	0	30	30
Total		130	305	175

The analysis of the impact of various scheduling scenarios on the existing freight operations is provided in the supplemental documents provided with this application.

2.2 Operating Plan

Working closely with Amtrak, EOT has been able to determine that the Service Plan described in the preceding section can be provided without the acquisition or re-assignment of additional passenger rail equipment. The Vermonter round trip will continue to utilize the equipment already assigned to that train and Amtrak has determined that the White River Junction daily round trip and the two Greenfield daily round trips can be provided by shuffling the current assignments of the train sets involved in providing the four daily round trips between New Haven and Springfield; this is referred to as the "shuttle" service.

The implication of this is that the Service Plan will be providing a more efficient, cost-effective use of this passenger rail equipment, creating *516* daily train miles of additional transportation service using existing equipment. The revenue service time for equipment in New Haven – Springfield shuttle service will improve substantially as shown in Table 3.

Table 3: Equipment Utilization Summary

Current Equipment Utilization			
Service Day Miles		496	
Average Service day use	47%		53%
Average Calendar day use	16%		22%
Proposed Equipment Utilization			
Service Day Miles		1012	
Average Service day use	64%		36%
Average Calendar day use	35%		21%
Service Day Improvement		516	
Service Day Improvement	17%		-17%
Calendar Day Improvement	19%		0%

Tables 4 and 5 show the details of the improvement.

Table 4: Current Equipment Utilization

Set	Train	Initial	Final	Leave	Arrive	Hours	Distance	Layover time
1	490	New Haven	Springfield	8:38	10:10	1:32	62	
								5:55
	475	Springfield	New Haven	16:05	17:35	1:30	62	
								1:50
	494	New Haven	Springfield	19:25	20:50	1:25	62	
					Day totals	4:27	186	7:45
					Service day use	36%		64%
					Calendar day use	19%		32%
2	495	Springfield	New Haven	7:10	8:35	1:25	62	
								1:55
	470	New Haven	Springfield	10:30	12:00	1:30	62	
					Day totals	2:55	124	1:55
					Service day use	60%		40%
					Calendar day use	12%		8%
3	493	Springfield	New Haven	10:30	12:00	1:30	62	
								5:15
	476	New Haven	Springfield	17:15	18:45	1:30	62	
								0:35
	479	Springfield	New Haven	19:20	20:46	1:26	62	
					Day totals	4:26	186	5:50
					Service day use	43%		57%
					Calendar day use	18%		24%
					Service Day Miles		496	
					Average Service day use	47%		53%

Average Calendar day use	16%		22%

Table 5: Proposed Equipment Utilization

Set	Train	Initial	Final	Leave	Arrive	Hours	Distance	Layover time
1	490	Springfield	Greenfield	8:38	11:07	2:29	98	
								0:22
	473	Greenfield	New Haven	11:29	14:00	2:31	98	
								2:00
	474	New Haven	White River Jct	16:00	20:19	4:19	186	
					Day totals	9:19	382	2:22
					Service day use	80%		20%
					Calendar day use	39%		10%
2	495	Greenfield	New Haven	6:05	8:36	2:31	98	
								1:59
	470	New Haven	Springfield	10:35	12:00	1:25	62	
								3:05
	475	Springfield	New Haven	15:05	17:15	2:10	62	
								2:07
	494	Springfield	Greenfield	19:22	21:51	2:29	98	
					Day totals	8:35	320	7:11
					Service day use	54%		46%
					Calendar day use	36%		30%
3	493	White River Jct	New Haven	7:35	12:02	4:27	186	
								5:04
	476	New Haven	Springfield	17:06	18:31	1:25	62	
								0:34
	479	Springfield	New Haven	19:05	20:30	1:25	62	
					Day totals	7:17	310	5:38
					Service day use	56%		44%
					Calendar day use	30%		23%
					Service Day Miles		1012	
					Average Service day use	64%		36%

Average Calendar day use	35%		21%

There are currently two Amtrak crew districts on this route. One crew district operates trains between New Haven and Springfield. The other operates trains between Springfield and St. Albans. Freight railroads have utilized negotiated interdivisional crew agreements for over 35 years. The details vary, but essentially, such agreements allow staffing of trains over two adjoining districts with a single crew, with the sum of the work allocated to employees of the two districts as directed by the agreement. Amtrak would negotiate such an agreement for the proposed service, allowing a crew to operate a train for its entire trip between New Haven and Greenfield or White River Junction. Amtrak anticipates that there are efficiencies to be realized in operating crew utilization when the expanded service begins.

Another important element of rail service that was carefully considered in the development of the Operations Plan for the Knowledge Corridor was the future of freight service on this rail line. Detailed discussions were held with the owner of the line, Pan Am Southern, to ascertain the current levels of freight traffic on the line, the reasonably foreseeable future prospects for this traffic, the extent to which both the freight service and the proposed passenger service could be accommodated on the existing infrastructure, and the capacity enhancements that would be required for each of the various passenger scenarios described above, as well as an expanded freight service in the future.

The findings from this element of the analysis were that, while there is only expected to be modest growth in the number of daily freight trains, there is anticipated to be a growth in excess of 100 percent in the number of cars per train and tonnage handled over the next 20 years from an average of 20-30 for most trains to at least 40 or more. While there is some flexibility in the times at which these trains operate and the amount of occupancy of the main line that their work will require, there are infrastructure improvements that must be completed to allow both the passenger and the freight services to operate reliably and efficiently on this rail line at projected future levels.

The need for expanded capacity and infrastructure improvements on this rail line are described in the following section.

2.3 Project Management

EOTPW owns and oversees active railroad corridors and is the umbrella organization for transportation agencies with significant experience in building rail projects and in administering Federal funds. EOTPW has overseen significant repair and rehabilitation projects on its rail lines over the past 20 years, with the support of consultants and other experienced staff at agencies within the transportation agency (including the Massachusetts Bay Transportation Authority (MBTA), and other agencies). In carrying out projects under this service development plan, EOTPW expects to augment its internal capacity with staff and other expertise from the MBTA and the Massachusetts Highway Department. EOTPW will develop specific Project Management Plans for each project or phase under the service development plan. The MBTA has managed numerous complex commuter rail development and extension projects (including the recent Old Colony and Greenbush expansion projects) and regularly undertakes maintenance and capital

improvement projects (estimated annual value of $125m) along its commuter rail network, including portions of the network shared with intercity passenger rail services operated by Amtrak.

A complete Project Management Plan has been developed and is provided as a supplemental document to this application.

2.4 Project Schedule

The near term Restore Vermonter and tunnel construction will occur in 2010 and 2011. The proposed intercity service enhancements, once these near term efforts are completed, are anticipated to occur between 2014 and 2016.

Preliminary engineering and NEPA efforts for the Springfield Interlocking Improvements would occur in 2015. In 2016, final design and construction for those improvements would be conducted. The Passing Siding at Northampton preliminary engineering and NEPA efforts would occur in 2015 and in 2016, final design and construction would be completed. Preliminary engineering and NEPA efforts for the Holyoke Station would occur in 2015, with final design and construction taking place in 2016. It is anticipated that the preliminary engineering and NEPA work for the Positive Train Control would be conducted in 2014. Final design and construction will occur in 2015.

3. PRIORITIZED CAPITAL PLAN

There are three categories of capital investment related to the overall Knowledge Corridor rail improvement plan: projects needed for increased speed, projects needed to accommodate additional traffic, and projects needed for passenger service. In addition, there are investments related to the tunnel design and construction, as well as investments that will be required to accomplish the longer term vision for the corridor.

The investment for the tunnel is included in the FRA HSIPR Track 2 application discussion. The Commonwealth of Massachusetts will be providing funding for the tunnel. The additional, longer-term enhancements, which are described in subsequent sections, will improve the overall corridor but are in the early stages of development and not included in the Track 2 application.

3.1 Near Term Plan: Restore Vermonter and Bicycle Tunnel

As described in the introduction of this Service Development Plan, the near term infrastructure improvements in the Knowledge Corridor include the realignment of the Vermonter and the construction of a bikeway tunnel.

3.1.1 Restore Vermonter

The relocation of the existing Vermonter service from NECR to PAS between Springfield and East Northfield involves only speed increase and passenger service projects on the PAS segment of the route by rehabilitating this line and restoring it to a solid Class 3 operating condition, with maximum operating speeds of 60 mph for passenger trains and 40 mph for freight trains between Springfield and East Northfield, Massachusetts. To accomplish that objective, the project includes the following major work elements:

- Installation of new continuous weld rail;
- Replacement of cross ties throughout the entire 49-mile route;
- Rehabilitation of grade crossings;
- Upgrading of switches;
- Enhancements to the signaling and communications systems, including preparations for the installation of Positive Train Control as mandated by the Rail Safety Improvement Act of 2008;
- Surfacing and alignment of the track;
- Structural improvements of the rail infrastructure and strengthening of rail bridges; and
- Restoring the Northampton station and completion of the Greenfield station.

3.1.2 Bikeway Tunnel

Construction of the bikeway tunnel is a critical safety issue. It will promote safety for passengers and rail operators, by providing a separation between the trains and the pedestrians and bicyclists. The tunnel will be constructed under the mainline in Northampton.

3.2 Longer Term Plan: Enhanced Intercity Service

The realignment and tunnel construction described in the application will lay the groundwork for the possibility of enhanced intercity service within the Knowledge Corridor. In addition to the restoration of the Vermonter to its original route, a longer term plan for the service includes additional service and station development in Holyoke. The additional service would consist of extending northward three round-trip trains that currently run between New Haven, Connecticut and Springfield, Massachusetts. One train would travel to White River Junction, Vermont and the other two would extend from New Haven to Greenfield. The projects required to accommodate this service are described in subsequent paragraphs. Positive Train Control is also planned longer term and is described below.

3.2.1 Enhanced Intercity Service

The second potential future phase of the program will enhance intercity rail operations within the Knowledge Corridor. The anticipated service envisions extending the New Haven – Springfield shuttle service to Greenfield and White River Junction and will require the following projects:

- Track and signal improvements on the NECR line between East Northfield and White River Junction including:
    - Installation of new continuous weld rail;
    - Replacement of cross ties throughout the entire 49-mile route;
    - Rehabilitation of grade crossings;
    - Upgrading of switches;
    - Enhancements to the signaling and communications systems, including preparations for the installation of Positive Train Control as mandated by the Rail Safety Improvement Act of 2008;
    - Surfacing and alignment of the track; and,
    - Structural improvements of the rail infrastructure and strengthening of rail bridges.

- Preparation of the Holyoke station for passenger use;

- Constructing a siding at East Northfield and connecting the south end of the elevator track at North Hatfield to facilitate local freight switching in this area and to allow for leaving through cars clear of the main track while switching is being done;

- Constructing additional auxiliary trackage at Holyoke and Northampton to hold through cars while switching operations are being conducted; and

- Constructing a siding at East Deerfield, also to allow for switching operations at this location without occupying the main track.

Cost estimates to complete the projects listed above have not been finalized, but order of magnitude estimates have been developed and are described below.

The Passing Siding at Northampton preliminary engineering and NEPA efforts would occur in 2015, at an estimated cost of $750,000. In 2016, $4 million would be required to complete final design and construction.

For the Springfield Interlocking Improvements, which would reconfigure the interlocking to improve access to and from the Connecticut River Line to station platforms, it is estimated that $750,000 would be required for preliminary engineering and NEPA. Those efforts would occur in 2015. In 2016, final design and construction would be conducted, at an estimated cost of $5 m million. By the end of 2016, it is anticipated that four trains will start to provide service.

The current expectation for the Holyoke Station is that the former station building will be restored as the anticipated station location. The municipality purchased the building late in the development of this project, and this acquisition may help facilitate restoration of the station. The City of Holyoke will have to work with EOT on project development, to enable the restoration to go forward. Preliminary engineering and NEPA efforts would occur in 2015, at a cost of $1 million. Final design and construction efforts would take place in 2016 at an estimated cost of $6 million.

3.2.2 Positive Train Control

As part of the longer term development plan for the Knowledge Corridor, Positive Train Control will be installed. If there is a signal indication and the engineer of the train fails to respond, this system will force an automated response; it will either slow down or completely stop.

Although final estimates have not been developed, it is anticipated that the preliminary engineering and NEPA work will require $2 million in resources and be conducted in 2014. Final design and construction will occur in 2015, at a cost of $10 million.

3.3 Capital Costs

Capital costs for both the Restore Vermonter project and the proposed intercity service enhancements are summarized in Table 6 (below). The costs related to the enhanced intercity service are order-of-magnitude costs only.

Table 6: Capital Costs

Project	**Capital Costs ($ Millions)**
Realignment of Vermonter	$72.8
Construction of Bikeway Tunnel	$2.25
Restore Vermonter	**$75.1**
Northampton Passing Siding	$4.75
Springfield Interlocking Improvements	$5.75
Holyoke Station	$7
Positive Train Control	$12
Enhanced Intercity	**$29.5**
TOTAL COSTS	**$104.6**

4. RIDERSHIP AND REVENUE FORECAST

As mentioned previously, a study was sponsored by the Pioneer Valley Planning Commission (PVPC), in conjunction with the Executive Office of Transportation and Public Works (EOTPW), to analyze various service scenarios. Three primary passenger rail service scenarios have been analyzed for the Knowledge Corridor.

- Realignment of the Vermonter;
- Commuter rail service evaluation from Springfield north; and
- Evaluation of the potential for expanded intercity passenger rail service in the area from New Haven, Connecticut, to White River Junction, Vermont.

Rail ridership was forecast for each of these scenarios as part of the study and refined to match the schedule, operating and train frequencies associated with this application. This data serves three purposes. First, it helps to describe the likely traffic for the proposed service realignments and enhancements. Second, it is used to help estimate the benefits and costs of the projects proposed in this application. Finally, it enables an estimation of revenue should the Vermonter be realigned and/or enhanced intercity service be pursued.

4.1 Definitions of Study Areas

Although the study area of the project for other purposes (e.g. engineering, costing, etc.) concerned only the Conn River Line between Springfield and East Northfield (a distance of 49 miles entirely within the Commonwealth of Massachusetts), for the purposes of understanding the affected market of trips, the study area coverage needed to extend to include the entire through length (i.e. one-seat ride) of the Amtrak Vermonter from St. Albans, Vermont, to Washington, DC. Since some of the service improvements being considered involve improvements in travel times in Massachusetts, clearly any traveler on the intercity service traveling from points south of Springfield to points north of Springfield (or, in fact, anyone traveling from points in Vermont to any point south of Brattleboro (i.e. into Massachusetts and beyond)) would be impacted by the potential improvements and warranted analysis in the model. In order to keep the analysis manageable, however, the trips on the Vermonter and other intercity services NOT entering Massachusetts were not included. As an example, the model makes no attempt to model all rail trips between New York City and Hartford, although the model does take into account the travelers physically on the train between those two points who are heading to or from Springfield and points north.

The model displays results expressed for each and all of the station cities along the proposed route. For simplicity's sake, all stations between Washington, DC, and New York are grouped into one station describing "New York and South." Similarly, the Vermont stations between St. Albans and Bellows Falls are grouped into one station known as "Bellows Falls and North." The remaining stations are treated individually, so that the universe of stations analyzed in the model, and for which a station-to-station trip matrix is developed, is as follows:

- Bellows Falls, VT and North
- Brattleboro, VT
- Greenfield, MA (proposed)

- Northampton, MA (proposed to replace present Amherst station)
- Amherst, MA (proposed for replacement by Northampton)
- Holyoke, MA (proposed)
- Springfield, MA
- Windsor Locks, CT
- Hartford, CT
- Berlin, CT
- Meriden,CT
- Wallingford, CT
- New Haven, CT
- Bridgeport, CT
- Stamford, CT
- New Rochelle ,NY
- New York, NY (and points south)

4.2 Ridership Model Design

A custom forecasting tool was developed to capture ridership and revenue estimates for the proposed realignment of the current Vermonter and for offering enhanced intercity service. This custom tool was designed to take advantage of applicable data and network features where available from different existing demand models and frameworks, such as the PVPC regional travel demand model, the Massachusetts Statewide Travel Demand model, intercity travel pattern models used by Amtrak, and the 2000 Decennial Census. A complete technical memorandum describing the forecasting process is provided in the supplemental documents included with this application.

In general, the model was designed to be market-based by focusing computations around two basic distinct groups of potential trip-makers in the corridor. The two primary markets are intercity trips (those involving an origin or destination outside the primary study area) and work/commuter trips (those whose origin and destination are both inside the primary study area or its nearby commuter markets. While both of these groups is discussed in the Ridership Technical Memorandum provided in the supplemental documents, only intercity is being discussed in this system wide plan. While analysis was conducted for commuter service, the benefit-cost results suggested that this service may not be economically justifiable.

The intercity market includes all of the stations defined above, and is largely calibrated based on current Amtrak trip patterns. The intercity market is viewed as one for longer-distance trips to and from the Pioneer Valley/Knowledge Corridor region along the general route of today's Vermonter service. The potential east-west market (East to Boston, west toward Albany) is served by one train daily, the Boston Section of the Lake Shore Limited, and is not analyzed as part of this analysis.

The forecasting tool for the intercity market was developed to be an incremental (pivot point) type model based off of current 2008 Amtrak ridership statistics for the Vermonter service. The existing service provides the best proxy for how the service can be expected to operate in the near future.

4.3 Proposed Services Analyzed: the Cases

For the purposes of the Knowledge Corridor Passenger Rail feasibility study conducted for PVPC, several alternatives (i.e., cases) were conceived and enumerated. These cases were developed to represent incremental changes to the level and type of passenger rail service in the region. For the purposes of this application, these cases were refined to match the schedule and operating assumptions of the service being proposed.

The base case, Case 0, represents the present Amtrak system as it operates today, with one "Vermonter" train per day in each direction traveling over the CSX (Springfield to Palmer) and NECR (Palmer to East Northfield) with station stops at Springfield and Amherst.

Case 1a represents the single change to the system of re-routing the present day Vermonter service to use the Pan Am Railways Conn River line between Springfield and East Northfield. This change realigns the service onto its historical routing, when the train operated all the way to Montreal as the Montrealer, and replaces the station stop at Amherst with one in Northampton last used in the early 1980s. In addition, new station stops at Holyoke and Greenfield are included in this analysis. Despite the additional two stops, the route is 11 miles shorter and the assumed operating speeds allow a time savings of 43 minutes versus Case 0 between Springfield and Brattleboro. Service is assumed to continue operating all the way through (one-seat ride) to Washington. The realignment removes a time-consuming "reverse move" at Palmer, and the need to operate two locomotives or a cab car, to allow double-ended operation. Backup into Union Station is still required.

Case 2 expands on Case 1a to add three trains to the existing Vermonter service. This means four trains per day will run per day, relatively evenly spaced throughout the day. The commuter market can be expected to respond to some degree to the level of service provided in this case. With the additional service, the forecast for this case contains three major elements: Intercity market trips, commuter market trips, and induced demand trips.

A complete description of the case development is provided in the technical memorandum included in the supplemental documents of this application.[3]

4.4 Forecast Results

A set of forecasts was run for the opening/implementation years (2012 to 2015, depending on the case), and for the long-term year 2030. The following tables summarize the results for the opening year and long-term year 2030. It should be noted that the 2030 forecasts include not only the effects of the changes in regional demographics between 2015 and 2030, but also the impact of the economically induced trips.

[3] Although a third case analyzing the potential for commuter service was included in the ridership estimation conducted for PVPC, it is not included in this application. The costs of the commuter option compared to the relatively modest additional ridership and benefits resulted in a benefit-cost ratio well below 1.0. As a result, EOT is no longer pursuing this service level.

Table 7: Forecast Results, 2015

	0. Base (Existing)	1a. Vermonter Move	2. Enhanced Intercity
Brattleboro	16	21	39
Greenfield	---	12	41
Northampton	---	28	114
Amherst	19	---	---
Holyoke	---	13	46
Springfield	101	101	438
Total St. Albans to NY	415	513	1,371
% Increase Over Existing		24%	231%

Source: HDR

Table 8: Forecast Results, 2030

	0. Base (Existing)	1a. Vermonter Move	2. Enhanced Intercity
Brattleboro	17	22	41
Greenfield	---	12	70
Northampton	---	29	195
Amherst	21	---	---
Holyoke	---	13	65
Springfield	106	106	519
Total St. Albans to NY	436	536	1,760
% Increase Over Existing		23%	304%

Source: HDR

4.5 Summary of Ridership Findings

The forecasting approach described above was applied for the cases described earlier to generate a series of forecasts of likely regional ridership response to changes in the passenger rail service in the Pioneer Valley region. Key findings of this analysis include the following:

- There is significant opportunity to improve Vermonter service simply by transitioning the route over to the Conn River Line. Even with no other services added, the improvements in running time for those headed north of Springfield, combined with the opportunity to

serve three significant activity nexus while losing service to only one, generate respectable ridership gains and set the important basis for future growth.

- The net impact of terminating the Vermonter service in New Haven, implementing an efficient cross-platform timed transfer, and replacing a time-consuming engine change does not appear to have a significant impact on user perception of train performance or corresponding ridership. While it remains to be seen exactly how the market will react to such a change, it is likely that the increased displeasure associated with the transfer can be offset by improvements in running time and frequency. The impact of improved on-board amenities or space availability were not explicitly analyzed as part of this effort, but could also offset the negativity of a transfer. That said, there is a significant enough market from Springfield and points north to New York that the retention of some limited through service could be considered
- Improvements to the line in Connecticut, in terms of service frequency and speed, have been proposed by ConnDOT. The implementation of these services could have a significant positive impact on the viability of passenger service North of Springfield as well.
- Although a head-to-head mode comparison was not part of the analysis, there is nothing in the above analysis to suggest that the rail service will prosper at the expense of private intercity or transit bus service in the region. In fact, opportunities exist for joint or coordinated services and fares which can possibly create even more trips overall. It is beyond the scope of this analysis to evaluate such policies.
- Ridership is projected to increase significantly from the Case 0 to the Case 2. Specifically, ridership will increase by 231 percent in 2015. By 2030, ridership will increase 304 percent.

4.6 Revenue Projections

Using the ridership estimates described in the previous section, revenue was calculated and projected for the MA Knowledge Corridor Restore Vermonter element of the corridor project, as well as the enhanced intercity longer-term element of the project. Revenue projections were based on ridership numbers, current fare revenue, and annual growth rate of 3.5 percent.

Ridership induced revenue for the Realignment of the Vermonter is shown in the following table. Ridership increases from 97.4 thousand passengers to 118.2 thousand passengers by 2022. Revenue increases from $5.5 million in 2012 to $5.7 million in 2022.

Table 9: Ridership and Revenue Estimates – Restore Vermonter

	2012	2017	2022
Ridership	96,539	114,986	116,324
Revenue	$5,378,684	$5,460,810	$5,542,937

Table 10 provides revenue and ridership information related to the proposed enhanced intercity service.

Table 10: Ridership and Revenue Estimates – Enhanced Intercity

	2012	2017	2022
Ridership	96,539	200,614	293,585
Revenue	$5,378,684	$11,057,942	$14,851,240

As shown in the table, ridership in 2012 is 96,539 passengers. By 2022, passengers reach 293,585. Revenue in 2012 is $5.4 million and $14.8 million by 2022.

5. ASSESSMENT OF BENEFITS

This section describes the benefits of the proposed MA Knowledge Corridor Restore Vermonter project, as well as the benefits related to enhanced intercity service. The benefits described in this section relate to the custom benefit-cost analysis conducted for the project. Economic impacts and a discussion of economic distress in the region is discussed in subsequent sections. The project restoring the Vermonter and constructing a bikeway tunnel is analyzed, as is the enhanced intercity service that could be pursued longer term.

5.1 Benefits from Transportation Improvements

Six categories of benefits were measured for this assessment, including important benefits to riders generated as a result of the realignment and enhanced intercity service. In addition to rider related benefits, however, the study measured the secondary congestion reduction benefits. These benefits are significant and include reduced highway maintenance costs, reduced emissions and environmental benefits, accident reduction benefits, as well as reduced highway congestion by removing autos and freight trucks from the roadway. Benefits related to bicycle riding are also included in the analysis. All benefits are measured in comparison to a scenario keeping the rail service on the existing route. The categories of benefits, due to the proposed transit investments, include the following:

- **Benefits to New Riders:** These are the benefits for induced rail passengers who are projected to use the service after the improvement. This benefit is measured by the difference between the generalized cost of highway and rail travel for each origin-destination pair, accounting for travel time, vehicle operating costs, rail fare, and an amenity factor. The vehicle operating cost savings account for fuel, oil, depreciation, tire wear, and maintenance and repair. The amenity factor incorporates the increased comfort and quality of the time spent travelling by rail.

- **Benefits to Freight:** These benefits stem from improved freight rail service (higher speeds) along the corridor and result in an increase in the amount of freight shipped by rail, which leads to decreased shipping costs as estimated by the change in costs per ton-mile between truck and rail (accounting for trade-offs with travel time and reliability).

- **Economic Development Benefits:** These benefits result from enhanced rail service enhancements. With increased service levels, it is expected that there will be induced economic development in terms of jobs and population, primarily in the Central Business Districts surrounding the station areas. Induced development leads to increased ridership, which in turn results in increased user benefits, measured similarly to the benefits to "new riders," as described above.

- **Congestion Reduction Benefits:** These benefits are due to reduced auto and truck Vehicle Miles Traveled (VMT), based on estimates of increased passenger and freight traffic on rail. The reduction in VMT relieves congestion for those vehicles remaining on the highway, resulting in reduced travel time (VHT). Additionally, there are emission savings produced from the reduction in auto and truck VMT. Emissions measured

include VOC, CO, CO2, NOX, SO2, and PM10, varying by auto and truck. Finally, the reduction in auto and truck VMT results in a savings of pavement maintenance costs. The reduction of accident costs, like other variable costs, is dependent on the reduction of vehicle-miles. The reduction in vehicles on the road is combined with a multiplier, which is a weighted average of fatal, injury, and property damage only (PDO) accidents.

- **Bicycle Benefits:** Health benefits associated with choosing to bike, rather than drive, accrue both to the individual and to society as a whole. Health benefits due to active transportation are measured in this Benefit-Cost Analysis. Because the vehicles associated with these individuals are now removed from the highway, emissions and accidents are reduced, as well as the vehicle operating costs. Benefits associated with these vehicles being removed from the highway are estimated as described in the Congestion Reduction Benefits section.

A complete discussion of the benefits and costs measured in this analysis, as well as the methodology, is provided in the supporting technical documents.

5.1.1 Benefit-Cost Analysis

An economic evaluation was conducted to assess the feasibility of the Restore Vermonter and enhanced intercity projects. By comparing the costs and benefits, it gives an indication of whether or not the project will be worthwhile in the sense that the benefits exceed the costs. For this analysis, the cost to build and operate represents the foregone value of an alternative investment. The benefits of the project refer to the improvement in the social well-being delivered by the project.

To be deemed economically feasible, projects must pass one or more value benchmarks: the total benefits must exceed the total costs of the project on a present value basis; and/or the rate of return on the funds invested should exceed the cost of raising capital, often defined as the long-term treasury rate or the social discount rate. A fundamental tenet of the benefit-cost analysis approach is that only those benefits that are directly attributable to the implementation of rail service and are incremental to that service are accounted for.

In the analysis, benefits are estimated for current and future users on an incremental basis; that is, the change in welfare that consumers and, more generally, society derive from access to the realigned passenger rail service as compared to the current situation. As in most transportation projects, the benefits derived from the implementation of infrastructure projects, are actually a reduction in the costs associated with transportation activities. For example, the reduction of costs due to the passenger rail service affects users differently, depending on their preferences and the way the project changes their individual transportation costs.

Generally, benefits are measured as the creation of economic value from changes in the quantity of final uses and the quality (time spent, comfort, reliability, among other factors) of the services provided to the users. For example, the total transportation costs for riders between Greenfield and Springfield include the value of the total time spent commuting, plus the expenses associated with operating the vehicles used for the commute, plus other externalities, such as the cost of pollution generated by the specific level and composition of traffic. The benefits of a project are,

therefore, the cost reductions that may result from its implementation. These cost reductions may come in the form of average time saved by users, reductions in the operating expenses, reduced costs of unreliability, reduction of pollution, or more generally, a combination of these effects.

5.1.2 Principles

The following principles guide the estimation of benefits and costs:

- Only incremental benefits and costs are to be measured
    - The incremental benefits of the project include the transportation cost savings for the users of the service as a result of the implementation of the transportation improvements.
    - The incremental costs of project implementation include initial and recurring costs. Initial costs refer to the capital costs incurred for design and construction of a list of enhancements that will increase the maximum speed limit on the existing tracks and improve rail stations along the corridor. Recurring costs include incremental operating costs, as well as administration and marketing expenses.

      Incremental in this situation means that costs above and beyond those currently incurred are considered. Any investments or operating costs required for the operation of the existing freight track are not viewed as costs associated with this project.
- Benefits and costs are valued at their opportunity costs.
    - The benefits stemming from the implementation of the transportation improvement are those above and beyond the benefits that could be obtained from the best transportation alternative. For instance, the transportation costs savings for users are measured relative to the best existing alternative, the highway. The benefit is the net cost saving in transportation costs relative to the best alternative.
    - The cost imputed to the project will only include those incremental costs that represent opportunity costs to the funding entities. Expenditures are considered foregone opportunities to invest in the next-best alternative.

5.1.3 Valuation

All benefits and costs are estimated in 2009 dollars. The valuation of benefits makes use of a number of assumptions that are required to produce monetized values for all non-pecuniary benefits. The different components of time, for instance, are monetized by using a "value of time" that is assumed to be equivalent to the user's willingness to pay for time savings in transit. For the analysis, the "value of time" varies depending on trip purpose. Premiums to the value of time are also measured by incorporating comfort, reliability and other characteristics associated with the quality of the trip. Other estimates used in the monetization of benefits include, for

example, the cost of operating a vehicle (e.g., maintenance, repair, and depreciation) and the cost per ton of pollution.

Annual costs and benefits are computed over a long-run planning horizon and summarized by a lifecycle cost analysis. The project is assumed to have a useful life of at least 30 years; the time horizon of the analysis. Construction costs are assumed to occur within the first two years of implementation of the project, but operating costs are incurred throughout the project's time horizon. Similarly, benefits accrue during the full operation of the project.

5.1.4 The Opportunity Cost of Capital

The opportunity cost associated with the delayed consumption of benefits and the alternative uses of the capital for the implementation of the project is measured by the discount rate. All benefits and costs are discounted to reflect the opportunity costs of committing resources to the project. Calculated real discount rates are applied to all future costs and benefits as a representation of how the public sector evaluates investments. A 7% real discount rate is used in the analysis.[4]

5.1.5 Risk Analysis

Uncertainty in the estimation of costs and benefits is addressed through risk analysis. Risk analysis principally involves quantifying the uncertainties in the variables that affect the costs and benefits associated with the project. Quantification involves defining probability distributions of possible values for each of these variables. Data used to quantify uncertainty comes in part from research and in part from discussions with experts. The distributions of cost and benefit factors are inputs to the benefit-cost model, which is then solved using statistical simulation. The simulation process, often referred to as "monte carlo simulation" varies all factors simultaneously so that interrelationships between variables are more realistically handled and the impacts of these variables on the final results are considered jointly. The results include all possible estimates according to their probability of occurrence as defined by the input distributions. In addition, the analysis identifies which parameters are the key influences on result uncertainty.

Because risk is inherent in any forecast of costs and benefits, this analysis includes both a formal risk analysis of all key parameters and assumptions, as well as sensitivity testing to determine the impact of a few key variables in the analysis. Examples of the risk variables that use low-to-high ranges include the value of travel time, average speed on rail and highway corridors, fuel prices, cost of emissions, shipper costs and tons per car for freight benefits.

5.2 Capital and Operating Costs

Capital and operating costs for the proposed realignment, bikeway tunnel, and related enhancements are provided in the following sections. Costs for the related enhancements are estimates only; it is anticipated that these costs will be further refined.

[4] Real, in this sense, means that future flows of costs and benefits are discounted by 7% annually *after accounting for inflation*. This is the discount rate that has been designated for FRA grant applications. A discount rate of 3% was also applied as an alternate scenario, per FRA guidelines.

5.2.1 MA Knowledge Corridor Restore Vermonter Project Related Costs

Capital costs of the realignment are those costs that will be incurred to replace rail ties and make the Pan Am Southern corridor viable for passenger service, and potentially high speed rail in the future. It is estimated that construction related to the realignment will cost approximately $75.1 million over two years and will allow for the current service level of one train in each direction daily at speeds of up to 60 miles per hour. The bikeway tunnel will cost an estimated $2.25 million, with $2 million in construction and $250,000 toward design costs. It is assumed that 60 percent of the total project costs will be incurred in 2010 and 40 percent in 2011.

Operation and maintenance costs are those expenses associated with the annual operation of the passenger rail service. These costs include the costs of labor to operate the system, leasing of the vehicles and machinery, routine and special maintenance of the tracks, among others.

As the cost-benefit analysis examines information from an incremental perspective, the reduction in length of the trip will actually lead to a reduction in operating costs. This is measured in terms of the reduction in subsidy that Vermont pays for operations of the service. The realignment reduces the length of the trip by approximately 11 miles in each direction. Based on the operating costs provided by the Vermont Agency of Transportation, they pay a subsidy of approximately $17.22 per mile per trip for the Vermonter Service.

5.2.2 Costs of Longer Term Enhancements

For the Springfield Interlocking Improvements described in earlier sections of this plan, it is estimated that $750,000 would be required for preliminary engineering and NEPA. Those efforts would occur in 2015. In 2016, final design and construction would be conducted, at an estimated cost of $5 million. The Passing Siding at Northampton preliminary engineering and NEPA efforts would occur in 2015, at an estimated cost of $750,000. In 2016, $4 million would be required to complete final design and construction. Preliminary engineering and NEPA efforts for the Holyoke Station would occur in 2015, at a cost of $1 million. Final design and construction efforts would take place in 2016 at an estimated cost of $6 million. Although final estimates have not been developed, it is anticipated that the preliminary engineering and NEPA work for the Positive Train Control will require $2 million in resources and be conducted in 2014. Final design and construction will occur in 2015, at a cost of $10 million. For the enhanced intercity service and related improvements, the analysis assumes annual operating costs of $4.9 million.

5.3 Operating Cost

Operation and maintenance costs are those expenses associated with the annual operation of the passenger rail service. These costs include the costs of labor to operate the system, leasing of the vehicles and machinery, routine and special maintenance of the tracks, among others.

As the cost-benefit analysis examines information from an incremental perspective, the reduction in length of the trip will actually lead to a reduction in operating costs. This is measured in terms of the reduction in subsidy that Vermont pays for operations of the service. The realignment reduces the length of the trip by approximately 11 miles in each direction. While the reduction in mileage will save some on operating cost per train mile, there is also a fee to be paid for usage of the Pan Am Southern track. This savings balances out to approximately zero. Since this is an

incremental analysis, operating costs for the realigned service do not change and are thus not explicitly included in the analysis. Expected cost of the expanded service is approximately $45 per train mile. The service would provide an extension of existing shuttles, one all the way to White River Junction, Vermont, which is approximately 124 train miles, and two extensions north to Greenfield, which is approximately 36 miles. These will each be a daily roundtrip, 365 days per year resulting in slightly more than 106,000 train miles annually.

Operating costs of the Northampton Bike Tunnel will be entirely paid by a third party and are thus not considered in this analysis.

5.3.1 Total Benefits and Costs

Total benefits and costs are the aggregation of each of the individual categories of benefits and costs discussed previously. These totals are used to give an indication of the feasibility of the projects. The expected benefits exceed the costs when the benefit-cost ratio is greater than one. Net benefits begin to accrue once the benefits of the project surpass the costs in a given year.

Benefits increase in proportion to increases in the number of riders who switch to rail, as well as with the amount of savings each rider achieves on average by switching from other modes. As the savings of using the rail service increase over time, so does ridership. Due to the very slow, and in some areas negative, population growth, the increase in ridership due to the realignment is not as high as it might otherwise be. That said, the realignment is expected to lead to an increase in ridership that otherwise would not occur.

For the purpose of estimating the costs and benefits, it is assumed that the construction will occur over the course of two years prior to the opening of the service along the new line, and that service will begin in the year 2012. Operating and maintenance costs occur annually, while construction costs are only incurred in the first two years. Benefits increase annually as well with an increase in ridership.

Figure 1 demonstrates the cumulative costs and benefits of the realignment, indicating that the cumulative benefits of the realignment exceed the cumulative costs of construction and operation in 2027. Beyond this point, net benefits begin to accumulate. Figure 2 provides a similar graphic for the enhanced intercity scenario, indicating that benefits exceed costs starting in 2022.

Figure 1: Cumulative Costs and Benefits of Realignment

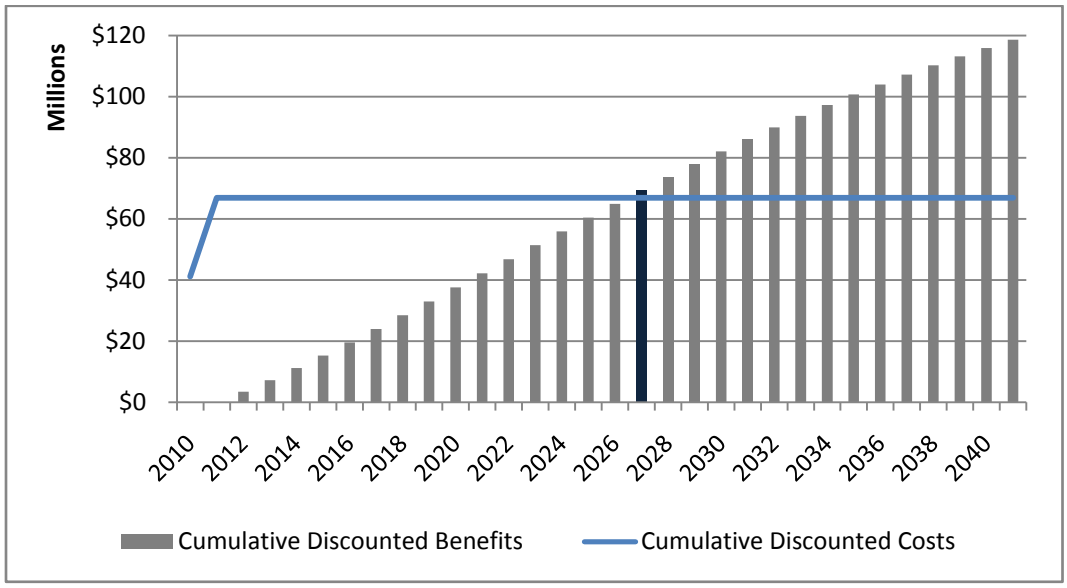
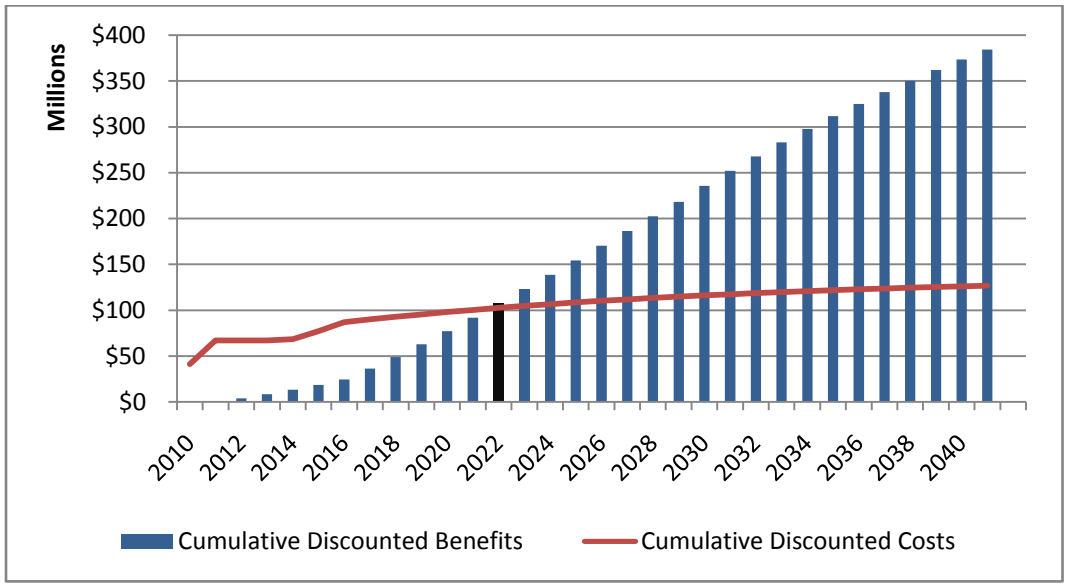


Figure 2: Cumulative Costs and Benefits of Enhanced Intercity Service



The risk-adjusted median net present value of the realigned passenger service is $52.9[5] million from construction beginning in 2010, carrying through operations to 2041. Construction costs are

[5] The median risk adjusted results are slightly different than the general median results which are also presented. The net present value is $52.9 million in the risk analysis, and $51.7 million as the non-risk median. The difference arises primarily due to the non-symmetric ranges on some variables.

incurred only in the first two years, and benefits begin accruing at the completion of construction in 2012. The benefit-cost ratio associated with the realignment of the Vermonter is 1.8. Table 11 summarizes the results of the benefit-cost analysis.

Risk adjusted total benefits of the realignment are $378.8 million at the median value, with a 10% probability that total benefits will exceed $432.4 million and a 90% probability that they will exceed $333.6 million.

For the enhanced intercity service level, the risk-adjusted median net present value of benefits is $1,172.4 million accounting for operations along the realigned service from 2012 to 2016, necessary improvements taking place in 2015 and 2016, and expanded service beginning in 2017 and carrying through until the end of the benefit period in 2041. The benefit-cost ratio associated with the enhanced intercity service is an impressive 3.0. Table 12 summarizes the benefit-cost results of this enhanced service.

Risk adjusted total benefits of the enhanced service are $1,401.0 million at the median value, with a 10% probability that total benefits will exceed $1,760.4 million and a 90% probability that they will exceed $1,131.7 million.

Table 11 provides the results of the enhanced intercity service benefit-cost analysis.

Table 11: Benefit-Cost Summary of Realignment

BENEFITS	
Travel Time Savings - Existing Riders	$32.7
User Benefits - Induced Riders	$16.7
Reduced Emissions	$5.8
Reduced Highway Maintenance	$32.6
Congestion Relief Benefits	$152.7
Northampton Bike Tunnel Benefits	$64.1
Freight Shipping Cost Savings	$69.2
TOTAL BENEFITS	$373.8
PV of Total Benefits	$118.6
COSTS	
Capital Costs	$75.1
Annual O&M Cost Change	$0.0
PV of Costs	$69.0
Net Present Value (NPV)	$51.7
Benefit-Cost Ratio (BCR)	**1.8**

Table 12: Benefit-Cost Summary of Enhanced Intercity Service

BENEFITS	
Travel Time Savings - Existing Riders	$32.7
User Benefits - Induced Riders	$236.0
Reduced Emissions	$23.5
Reduced Highway Maintenance	$33.8
Congestion Relief Benefits	$890.3
Northampton Bike Tunnel Benefits	$64.1
Freight Shipping Cost Savings	$69.2
TOTAL BENEFITS	$1,349.6
PV of Total Benefits	$384.2
COSTS	
Capital Costs	$104.6
Cumulative O&M Costs	$123.4
PV of Costs	$126.6
Net Present Value (NPV)	$257.6
Benefit-Cost Ratio (BCR)	**3.0**

5.3.2 Benefit-Cost Ratios (BCR)

The ratio of discounted benefits to discounted costs measures the value of each dollar invested in the project. At the median outcome, one dollar invested in the realignment project generates $1.80 in benefits and the same dollar invested in the expansion of service generates $3.00. There is a 10% probability that the value per dollar invested in the realignment project is above $2.20 and a 90% probability that it is above $1.50. According to the benefit-cost analysis with the 7% discount rate, there is a 99.9% probability that there will be a positive return on investment. There is a 90% chance that the return on investment for the expansion of services will exceed $2.50 and a 10% chance that it will exceed $4.00.

As an alternative, a 3% discount rate was also used. In this case, the benefit-cost ratio for the realignment is 3.0, at the median, indicating a $3.00 return for every dollar input. There is a 10% probability that the value per dollar invested will exceed $3.46 and a 90% probability that it will exceed $2.65. For the expanded service, the median return on one dollar of investment is $4.55 with a 10% probability that the value per dollar invested will exceed $5.70 and a 90% probability that it will exceed $3.70. This analysis was done to estimate the long term benefits associated with the project. Because of the long time horizon, the use of a higher discount rate penalizes the long term benefits. When using the lower discount rate for this project, net benefits will always exceed net costs.

6. ECONOMIC IMPACT ANALYSIS: CREATION AND PRESERVATION OF JOBS

Investment in the Knowledge Corridor is anticipated to produce significant near-term economic stimulus and job creation benefits in the Pioneer Valley region and nationally. Longer term, future investments will also lead to more job creation and longer-term economic development benefits. This section describes both the near term and longer term benefits of the proposed Knowledge Corridor passenger rail development plan.

6.1 Near Term Economic Impacts and Job Creation

The short-term construction activity will provide a variety of construction, manufacturing and supporting industry job opportunities and labor income with most, if not all, project expenditures supplied domestically.

A customized economic impact analysis was conducted for this rail and tunnel investment, tailoring the expenditure categories to the major construction labor and material expenditures, consistent with the capital cost budget. Major expenditures include steel rail, ties (wood products), pavement, and ballast, as well as other materials related to the realignment and the tunnel construction. This analysis was conducted using the IMPLAN economic impact modeling system. IMPLAN is a nationally-recognized economic model; for example, it was selected by the US Department of Agriculture to estimate job creation due to American Recovery & Reinvestment Act (ARRA) investments. The economic impact analysis includes estimates of multiplier and total impacts based on direct, indirect, and induced impacts.

The construction is assumed to occur entirely in 2010 (60% of purchases) and 2011 (40%), with a total cost of $75.1 million dollars. Direct jobs are estimated to be 217 in 2010 and 150 in 2011 for a total of 367 jobs during construction (See Table 13). The total short-term job creation, including multiplier effects, is estimated to be 742 jobs in 2010 nationwide with another 510 jobs in 2011 for 1,252 job years.

Table 13: Total Economic Job Impacts

Year	Construction Cost ($ million)	Direct Jobs	Indirect Jobs	Induced Jobs	Total Jobs
2010	$44	217	220	305	742
2011	$31	150	151	209	510

In addition to the job impacts, the realignment will result in the following national economic impacts (see Table 14):

- The total sales, or output, by national industries will increase by $222 million during the 2010 and 2011 construction period;

- The total labor income resulting from direct, indirect, and induced jobs will create an additional $67 million in national income for 2010 and 2011; and
- The construction phase is anticipated to contribute $102 million in value added or Gross Domestic Product (GDP), which represents the total economic activity as a dollar concept, to the national economy.

Table 14: Total Economic Impacts

Total Economic Impacts	2010	2011	Total
Jobs	742	510	n/a
Output (Sales) - Millions $	$132	$90	$222
Labor Income - Millions $	$40	$27	$67
Value Added (GDP) - Millions $	$61	$42	$102

Although the majority of the activity and expenditures are construction related, there are several other industries that benefit including: architectural engineering and related services. The following table provides economic impact estimates for project-related industries.

Table 15: Detailed National Industry Impacts

		Millions of Dollars		
	Job Years	Labor	Output	Value Added
Architectural and engineering services	41	$3.02	$4.780	$3.04
Iron and steel manufacturing	31	$3.43	$31.27	$7.04
Engineered wood member and truss mfg	32	$1.35	$5.45	$2.08
Maintenance and repair construction	40	$1.89	$3.95	$1.97
Construction	219	$11.03	$26.16	$11.89
Management	44	$3.59	$6.43	$3.87

The Council of Economic Advisors provides an alternative estimate of one job created or saved per $92,136 of government spending from ARRA. Using the CEA method, a total of 815 job years would be created, which is lower than the 1,252 jobs estimated by the customized analysis. This suggests that the project will create more jobs per dollar of expenditure than the “average” investment. This is likely due to the fact that the capital investment is focused on construction activity and materials routinely supplied by U.S. businesses.

6.2 Longer Term Economic Development Benefits

The realignment of rail service along the I-91 Knowledge Corridor in the Pioneer Valley of Massachusetts has the potential to provide economic development impacts for the cities along the corridor that will have station stops as well as the broader region. The expansion of intercity service in the corridor will further increase these potential benefits. In order to assess the economic development potential related to rail improvements, a thorough examination of the conditions in the region, as well as the potential for development based on available land and other resources was considered.

6.2.1 Economic Development Approach

The economic development analysis was based on multiple sources of information (economic and land use data, prior studies, stakeholder interviews, etc.) and a risk analysis modeling approach that: 1) explicitly accounted for uncertainty and risk factors; 2) incorporated refinements and review by local stakeholders and experts; and 3) generated most likely results along with a confidence-interval based range of low to high impacts. These impacts were developed to serve two key objectives: providing induced development growth as an input to ridership estimates; and identifying and measuring the near- and long-term local and regional job and population effects of rail development initiatives. The results of the economic development analysis for this application was adjusted to reflect an enhanced intercity service utilizing four trains, rather than the five trains assumed for the analysis conducted for PVPC.

6.2.2 Economic Development Benefits Attributable to Enhanced Intercity Service

Aggregate results indicate a most likely result of about 2,160 jobs and a population of 5,760 in the Pioneer Valley by 2030 under the enhanced intercity service scenario. The economic development impacts are not immediate as the results are significantly lower for 2015, reflecting the time needed to fully realize and leverage the economic development opportunities provided by rail. Almost 70 percent of the job impact is in the four station cities in the enhanced scenario (i.e., Greenfield, Northampton, Holyoke and Springfield) with 42 percent of the population effect, roughly consistent with current development patterns.

A summary of key findings includes:

- Enhanced service will most likely have the greatest impact in Northampton due to the characteristics of the city.
- The development impacts in 2015 are likely to be significantly smaller than those in 2030, due to the amount of time it generally takes for development to occur as well as the necessary time for the region to overcome its broader development and growth obstacles to fully leverage the benefits of rail.
- The induced job and population growth potential related to rail could help the region become more in line with growth in the rest of Massachusetts, and is consistent with the state's efforts to boost economic opportunities in Gateway Cities.
- The economic risk modeling estimates that there is a 90% chance that the region as a whole can expect development impacts in terms of employment and

population of at least 1,200 jobs and 2,400 new residents by 2030 under enhanced intercity service.

The improved rail service along the Knowledge Corridor is anticipated to provide employment and population impacts, the level of which will depend upon many factors, including the level of service, the timeframe in which the service is restored, and the region's ability to leverage rail improvements.

The employment and population impacts for the enhanced intercity service scenario are presented in Table 16 below for 2015 and 2030, including the low to high risk ranges. Additionally, Figure 3 provides a comparison with the most likely employment and population impacts for year 2030. In terms of most likely development, Northampton is expected to have the largest population impacts, partly due to the strong desire for alternative transportation in the area, attracting a range of 446 to 1,768 new residents by 2030. Springfield is also expected to see a fairly large impact with nearly 800 new residents under the most likely scenario, while Holyoke and Greenfield are expected to experience slightly less population growth attributable to rail service. Considering the results of the risk analysis, Enhanced level rail service is estimated to induce between 2,446 and 10,063 new residents for the Corridor region as a whole by 2030, and between 1,214 and 3,998 jobs.

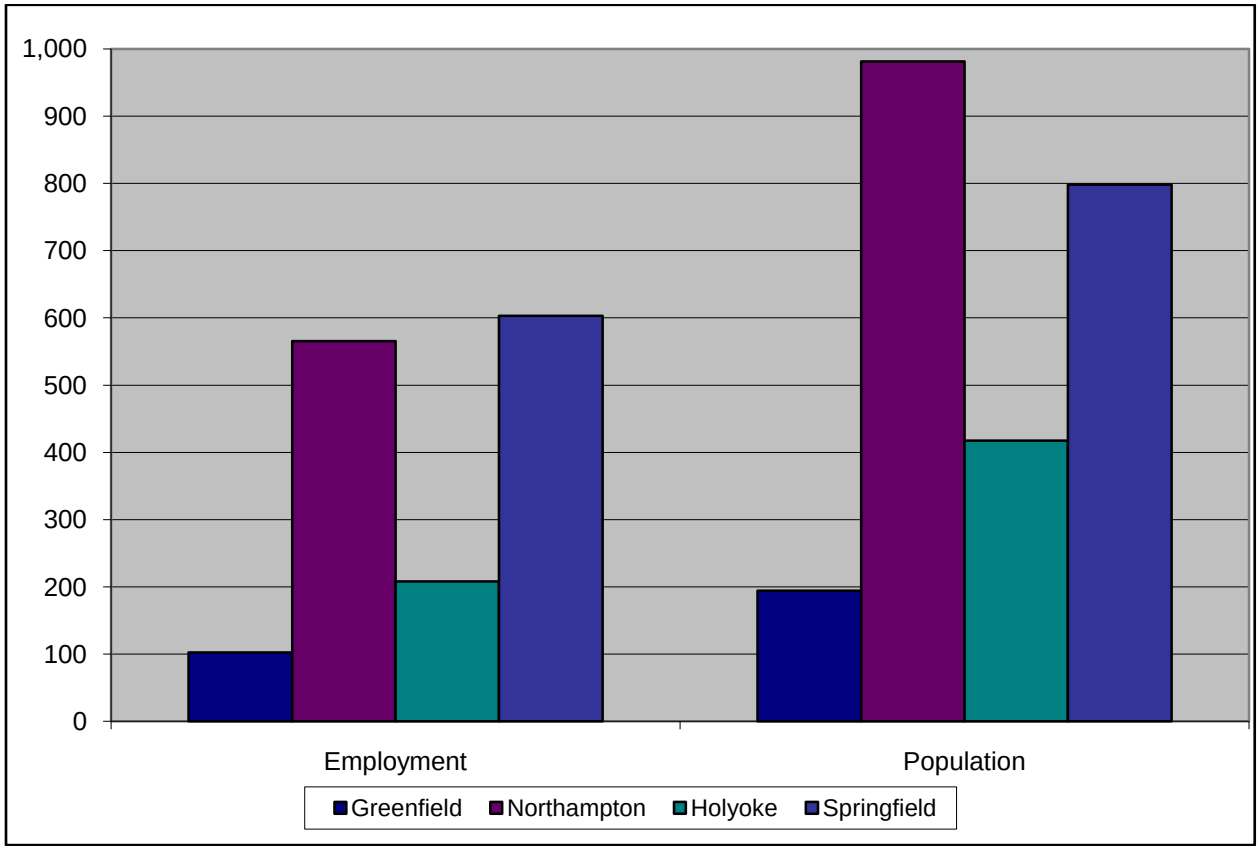
Table 16: Induced Employment and Population Attributable to Enhanced Service

	Employment						Population					
	2015			2030			2015			2030		
	10%	50%	90%	10%	50%	90%	10%	50%	90%	10%	50%	90%
Greenfield	11	26	44	44	102	175	18	49	90	72	194	361
Northampton	73	142	245	292	566	979	112	246	442	446	982	1,768
Holyoke	23	52	98	91	208	389	44	105	183	177	418	732
Springfield	82	151	249	327	603	994	94	200	362	378	798	1,446
Rest of Franklin County	11	30	55	44	122	219	67	150	270	270	597	1,082
Rest of Hampshire County	62	70	206	247	282	824	134	362	671	536	1,445	2,685
Rest of Hampden County	42	70	105	168	279	418	142	333	570	567	1,330	1,990
TOTAL	*304*	*541*	*1,002*	*1,214*	*2,162*	*3,998*	*612*	*1,443*	*2,589*	*2,446*	*5,763*	*10,063*

Source: HDR Calculations.

Figure 2 shows the employment and population benefits that are estimated to be induced in 2030.

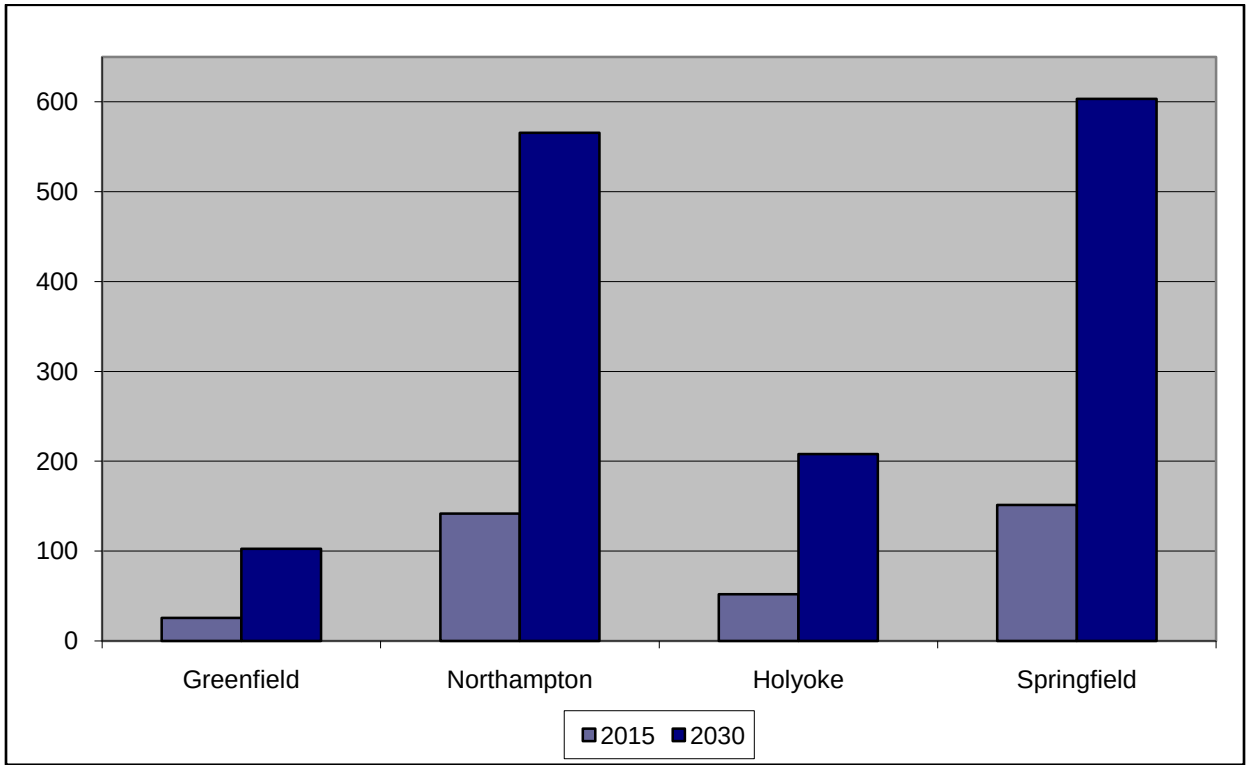
Figure 3: Induced Employment and Population in the Enhanced Scenario: 2030



Source: HDR Calculations.

Figure 4 below presents the most likely job results in 2015 and 2030 for the four station cities. Northampton and Springfield are expected to experience the highest increase in employment, with a most likely estimate of more than 700 new jobs in each city attributable to enhanced rail service by 2030.

Figure 4: Induced Employment Impact in the Enhanced Scenario: 2015 and 2030



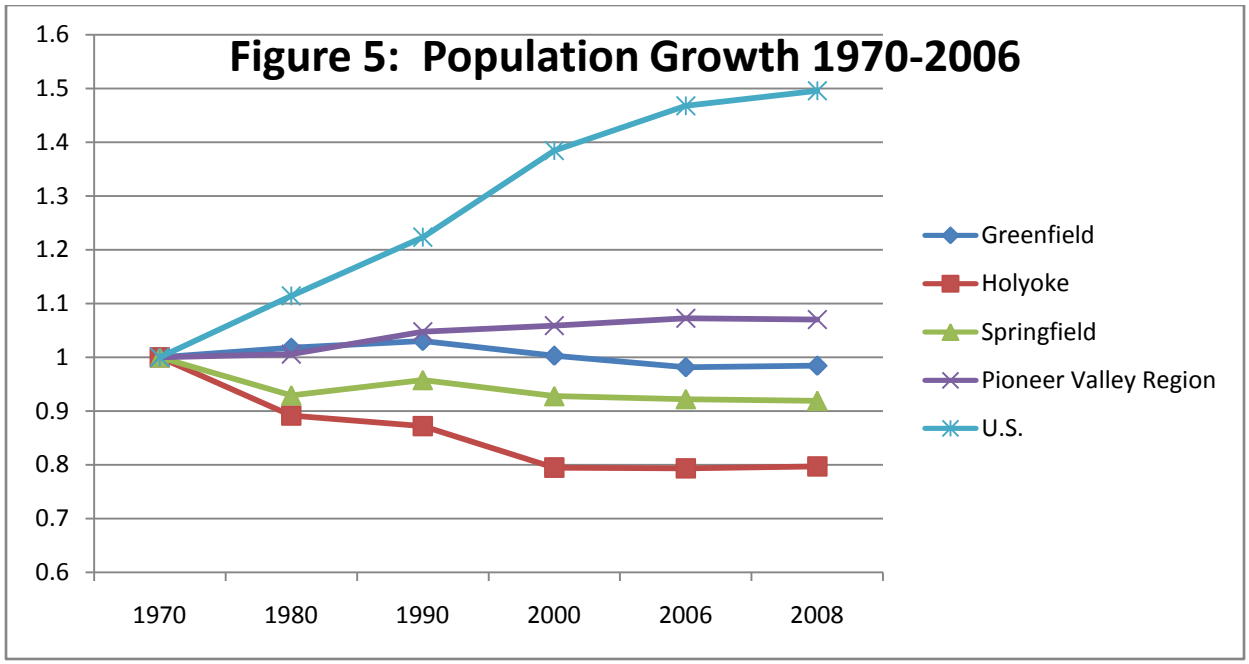
Source: HDR Calculations

A technical memorandum discussing the economic development benefits in greater detail is provided as a supplemental document to this application.

6.3 Economic Distress and Opportunities in the Pioneer Valley

The federal EDA designation criteria are not met at the county-level for the Pioneer Valley region. However, the region has experienced virtually no growth in recent decades and two of the region's larger cities are clearly economically distressed – Springfield and Holyoke. As evidence:

The Pioneer Valley's population has only grown by 7.1 percent since 1970 in comparison to the U.S. which grew by 50 percent. Holyoke and Springfield have experienced significant population decreases with 20.3 percent and 8.1 percent declines, respectively (see Figure 5).



Source: U.S. Census Bureau

Springfield's unemployment rate was 8.5 percent, and Holyoke's was 8.3 percent compared to the U.S. average of 6.3 percent over the past 2 years; neither has experienced any growth in the number of private jobs since 1960; and both have high poverty rates.

The Pioneer Valley region has experienced a decline in key sectors since 2001: Information Technology lost nearly a quarter of its workforce; Financial Services and Professional & Technical Services both experienced losses; and, Manufacturing has lost one of every five jobs in the sector since 2001.

In terms of near-term job opportunities for the Pioneer Valley region, direct jobs are estimated to be 146 in 2010 and 86 in 2011, largely due to construction labor. The full regional economic impact, including multiplier effects is approximately 350 new jobs in 2010 and 200 jobs in 2011, along with a stimulus of $25 million dollars in income over the two years.