NORTHERN TIER PASSENGER RAIL STUDY

Final Report

November 2024

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ACKNOWLEDGMENTS

The preparation of this report has been funded in part through grant[s] from the Federal Highway Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(b)] of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official view or policies of the Massachusetts Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

CHAPTER 1: EXECUTIVE SUMMARY

Introduction

The Massachusetts Department of Transportation (MassDOT) was directed by the Massachusetts Legislature to conduct a feasibility study to examine the benefits, costs, and investments necessary to implement new passenger rail service that would be a competitive travel option along the Northern Tier, connecting North Adams, Greenfield, and Boston.

In fulfillment of the directive, the Northern Tier Passenger Rail Study aimed to:

- Engage the Working Group, study stakeholders, and the public;
- Assess historic, current, and forecasted future conditions;
- Develop and examine potential service alternatives that could connect communities along the corridor; and
- Identify potential recommendations and next steps.

Figure 1.1: Study Process

The study process illustrates a series of steps that build upon each other to develop a set of potential passenger rail service alternatives using a two-phased approach; these alternatives were evaluated against the study goals and objectives using criteria that measured the effectiveness of the service alternatives.

In collaboration with the Working Group, stakeholders, and the public, the following goals and objectives were identified for the study:

Goal: Promote transportation equity
Objectives:

- Increase mobility options between Western and Eastern Massachusetts
- Improve connectivity and reliability
- Enhance safety

Goal: Support economic development along the Northern Tier corridor
Objectives:

- Improve connectivity and access to destinations (e.g., jobs and services, academic institutions, tourist attractions, etc.)
- Support the advancement of relevant economic development-related policies, plans, and designations
- Minimize impacts to freight rail operations

Goal: Minimize impacts on public health and the environment from transportation
Objectives:

- Improve public health outcomes
- Minimize air/noise pollution and greenhouse gas emissions
- Minimize or avoid impacts to cultural or natural resources

Seven evaluation criteria were utilized to evaluate the ways in which the service alternatives met the outlined goals and objectives:

- Mobility and access
- Economic impact
- Social equity and fairness
- Impacts on rail capacity
- Environmental and cultural resources
- Cost effectiveness
- Safety and air quality

Alternatives Development and Evaluation

To illustrate a range of possible options for new intercity rail service along the corridor, alternatives were developed and evaluated based on the established goals, objectives, and evaluation criteria, as well as identified challenges and opportunities. Using a two-phase alternatives development approach, the process began with the development and evaluation of two service alternatives representing lower investment and higher investment scenarios. With feedback from the Working Group and the public, the two potential initial services alternatives were refined, and four additional alternatives were developed and assessed as part of Phase 2.

Alternatives Development

Phase 1 of the alternatives development process began with an assessment of existing right of way conditions and travel patterns in order to develop the initial two service alternatives. Each alternative consists of a combination of infrastructure and service characteristics including stations, service structure, frequency of service, travel times, and physical improvements (outlined in Figure 1.2).

Figure 1.2: Service Characteristics

Ingredient	Range of Options
Stations	• Increase or decrease number of stations • Locations could change
Coverage Area	• Limited to Massachusetts vs. extended into Vermont and New York
Service Structure	• Direct service to Boston vs. transfer to other services (e.g., MBTA Commuter Rail, Valley Flyer)
Frequency of Service	• Increase or decrease number of daily trains
Span of Service	• Full day service vs. commuter peak • Daily vs. seasonal
Travel Time Between Stations	• Existing freight train speeds to full high-speed rail (slow to very fast)
Physical Improvements	• Incremental State of Good Repair, full reconstruction in existing alignments, new alignments

Physical Improvements

Physical improvements are the construction of track and other system upgrades (e.g., signal) to increase train speeds or improve operations. Examples of this include replacement of railroad ties and realigning track curves. All of the alternatives assume that Northern Tier passenger rail service would share the corridor with MBTA Commuter Rail service and PAS freight service. Another infrastructure element is the rail vehicle fleet. All infrastructure improvements are assumed for the PAS trackage between Fitchburg and North Adams; no improvements were assumed for the MBTA Fitchburg Line. Both alternatives include a train storage facility in North Adams.

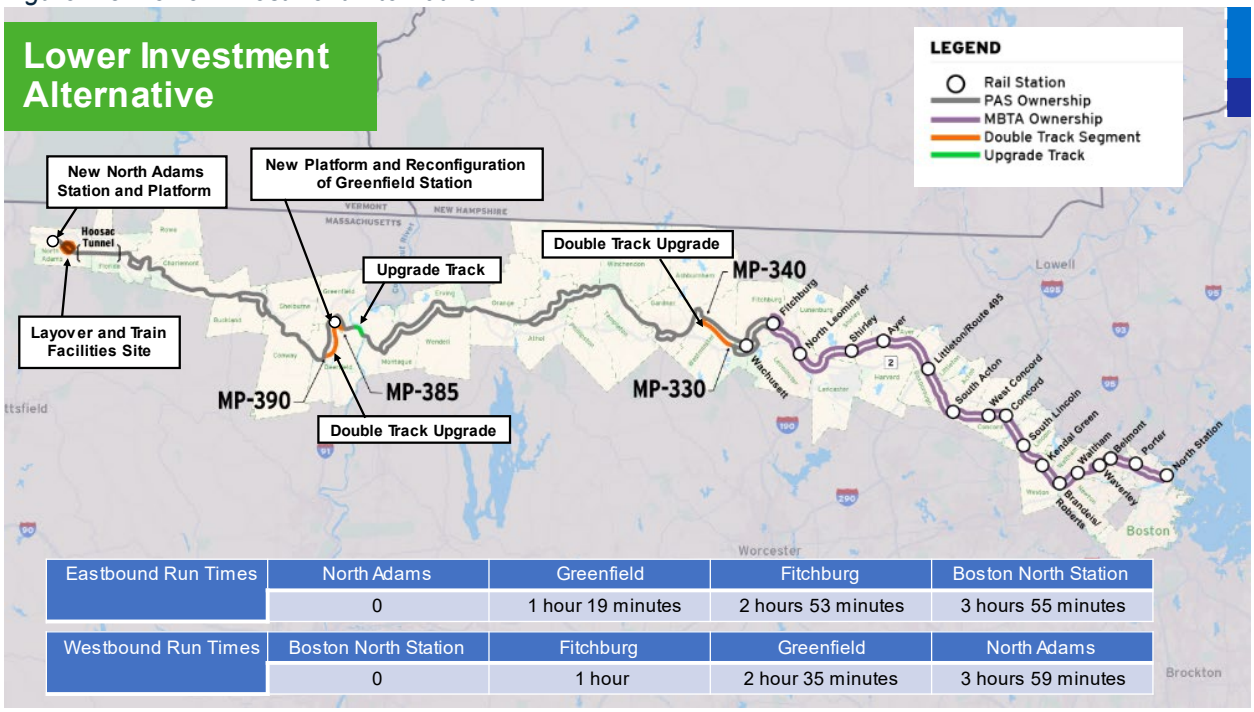
Phase 1 Alternatives

As part of Phase 1, two initial alternatives were designed to demonstrate the types of service that could result from different levels of infrastructure investment. Alternative 1 (the lower investment alternative) minimizes the level of infrastructure investment, while Alternative 2 (the higher investment alternative) identifies investments that could enable travel times equivalent to motor vehicle travel times from North Adams to Boston. The main elements of the initial service alternatives are similar with some key exceptions. The trains serve Boston North Station, Fitchburg, Greenfield and North Adams. The same rolling stock, comparable to the Amtrak Valley Flyer trains, is assumed for both alternatives. Both alternatives have five round trips per day, seven days per week serving similar trip purposes.

Alternative 1: Lower Investment

Improvements included in Alternative 1 are the minimum steps necessary to operate passenger trains, eliminate the low-speed segments that would have significant impacts on travel times, and create additional track capacity to accommodate planned operations, as shown in Figure 1.3. Alternative 1 would take 3 hours and 55 minutes traveling from North Adams to Boston North Station.

Figure 1.3: Lower Investment Alternative



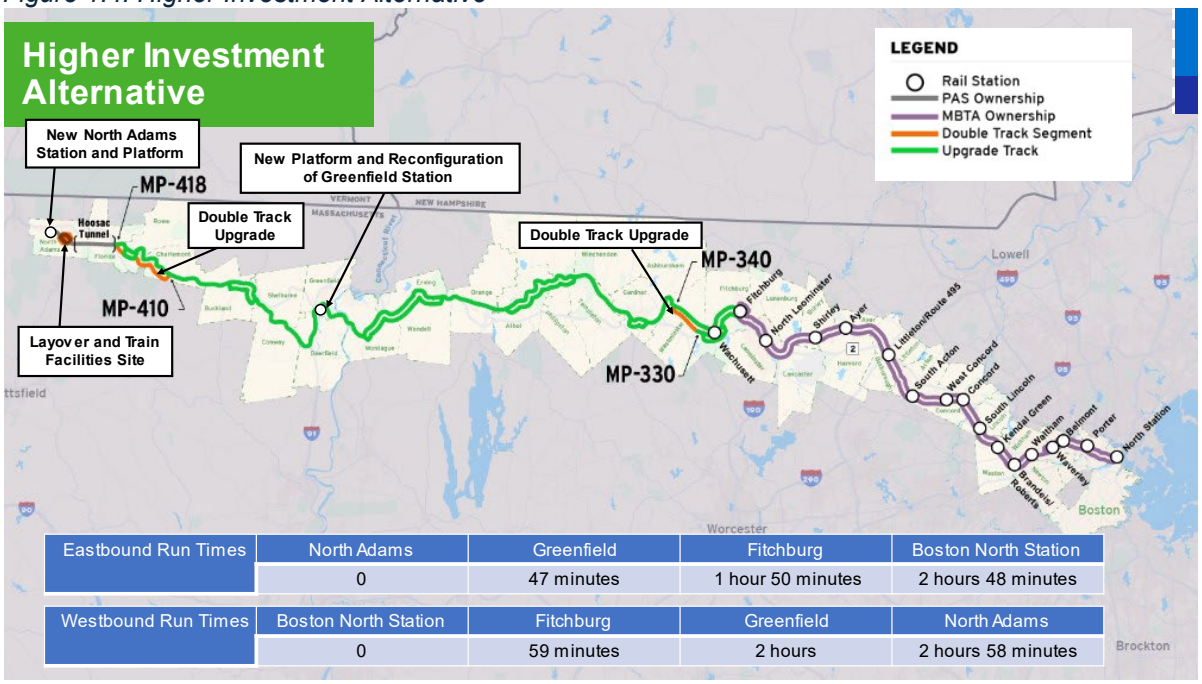
Eastbound Run Times	North Adams	Greenfield	Fitchburg	Boston North Station
	0	1 hour 19 minutes	2 hours 53 minutes	3 hours 55 minutes

Westbound Run Times	Boston North Station	Fitchburg	Greenfield	North Adams
	0	1 hour	2 hour 35 minutes	3 hours 59 minutes

Alternative 2: Higher Investment

The infrastructure improvements in Alternative 2 includes further track improvements to support superelevation and increase the track class to support enhanced capacity from Fitchburg to North Adams. Additional double tracking is built in Westminster, Rowe, and Charlemont. These improvements improve trip time and efficiency. Alternative 2 would take 2 hours and 48 minutes from North Adams to Boston North Station, as shown in Figure 1.4.

Figure 1.4: Higher Investment Alternative



Eastbound Run Times	North Adams	Greenfield	Fitchburg	Boston North Station
	0	47 minutes	1 hour 50 minutes	2 hours 48 minutes

Westbound Run Times	Boston North Station	Fitchburg	Greenfield	North Adams
	0	59 minutes	2 hours	2 hours 58 minutes

Phase 2 Alternatives

The Phase 1 service alternatives and the evaluation results were presented at a public workshop in January of 2023. Following an overview of the study process, the public workshop featured three modules that reviewed the alternatives development process, the evaluation of Phase 1 alternatives and a lookahead to Phase 2.

Each module included a presentation followed by discussion, questions, and answers. Poll questions were used to engage workshop attendees about trip purposes, service benefits, and tradeoffs related to the potential characteristics of four additional service alternatives to be developed in Phase 2, including stations, frequency of service etc.

During and following the public workshop, stakeholders provided feedback on the Phase 1 alternatives and input for the development of the Phase 2 service alternatives. Requests included additional stations (e.g., Shelburne Falls and Porter Square); a connection to Albany, NY; electrification of the passenger rail service; and seasonal stops.[1] The characteristics of the Phase 2 alternatives were developed based on the feedback received.

Overview of Phase 2 Alternatives

Alternative 2 was a base for the four additional service alternatives. Phase 2 service alternatives each provide five round-trips, seven days per week. Each alternative uses coaches comparable to those used on the Valley Flyer service. The schedule times for the trains in each alternative are also similar. All alternatives use diesel locomotives except for Alternative 3, which uses electrified locomotives. Alternatives 3, 4, and 5 provide a one-seat ride on five round trips per day serving a variety of trip purposes. Alternative 6 requires a transfer between the Northern Tier and MBTA Commuter Rail services at Fitchburg. Infrastructure improvements between Fitchburg and North Adams are comparable in magnitude and impact but vary by location. Stations vary for all Phase 2 alternatives. A North Adams layover is included in all alternatives except Alternative 5 Albany.

All Phase 2 alternatives include upgrades of the track from Class 3 to Class 4, crossing renewals, bridge rehabilitation, signal replacement and Positive Train Control, new stations and platforms particular to each alternative, and a new platform and reconfiguration of Greenfield Station.

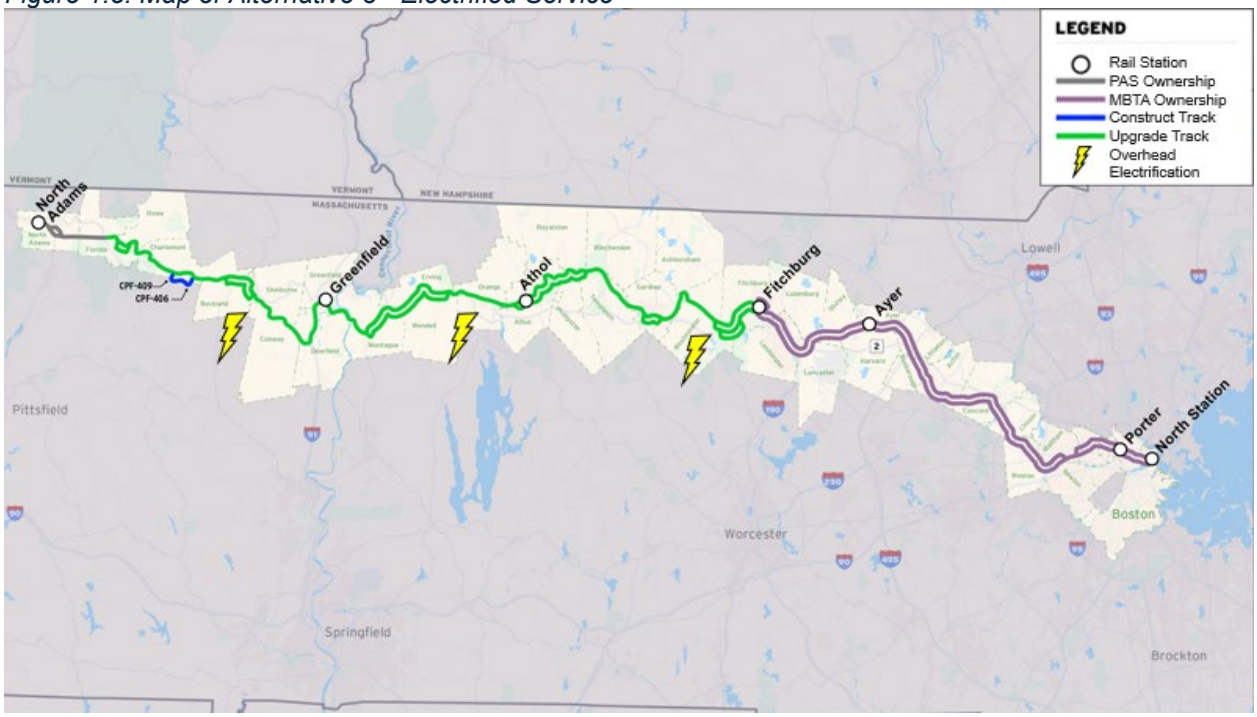
The added station stops would allow for more travel within the corridor and serve major job centers such as Devens (via Ayer Station) and Kendall Square in Cambridge (via MBTA Red Line service from Porter Station).

Alternative 3: Electrified Service

Alternative 3 includes electrification of the right-of-way between Fitchburg and North Adams with overhead catenary system and associated power substations. This alternative assumes that electrification from Fitchburg east would be completed by the MBTA. Alternative 3 would include North Adams, Greenfield, Athol, Fitchburg, Ayer, Porter, and North Station as station stops. Other infrastructure improvements would include new double track in Charlemont. Travel time from North Adams to Boston would be 2 hours and 50 minutes.

[1] Seasonal stops are added to the schedule to support seasonal attractors (e.g., weekend stops at Wachusett during the ski season.

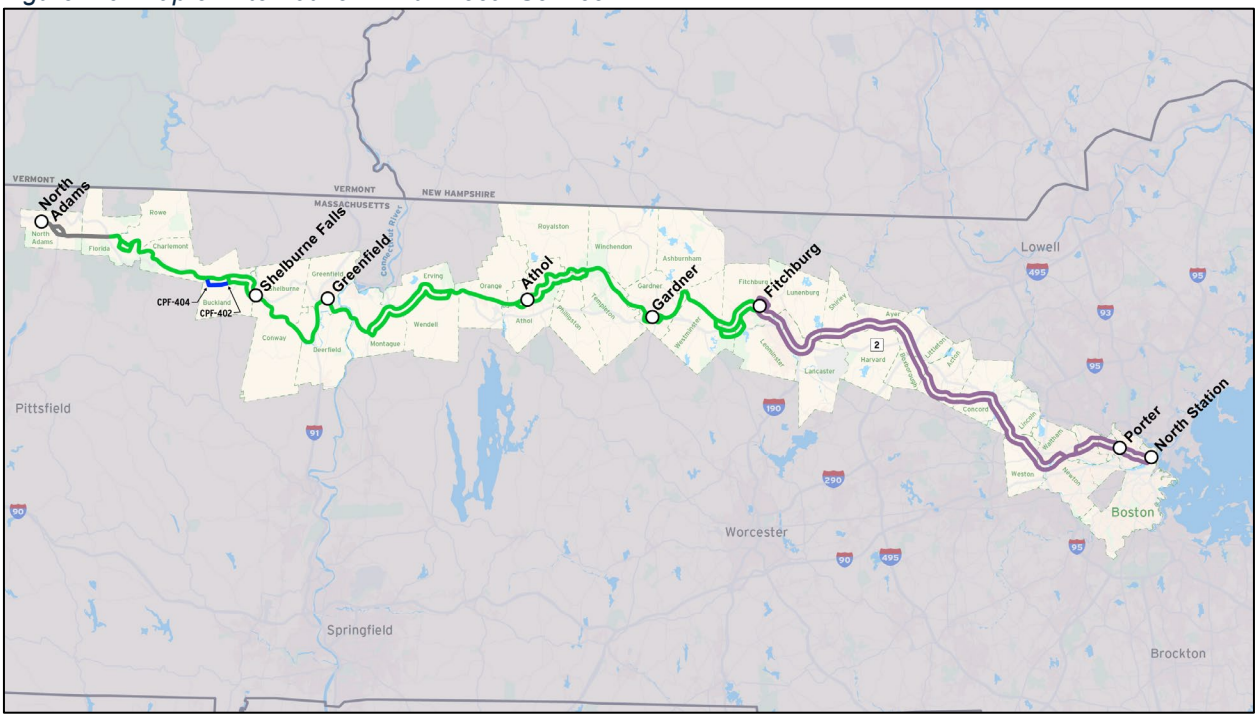
Figure 1.5: Map of Alternative 3 - Electrified Service



Alternative 4: Full Local Service

Alternative 4 would add stops at Shelburne Falls, Athol, Gardner, and Porter. Travel time from North Adams to Boston would be 2 hours and 59 minutes. Other infrastructure improvements would include a new double track in Charlemont.

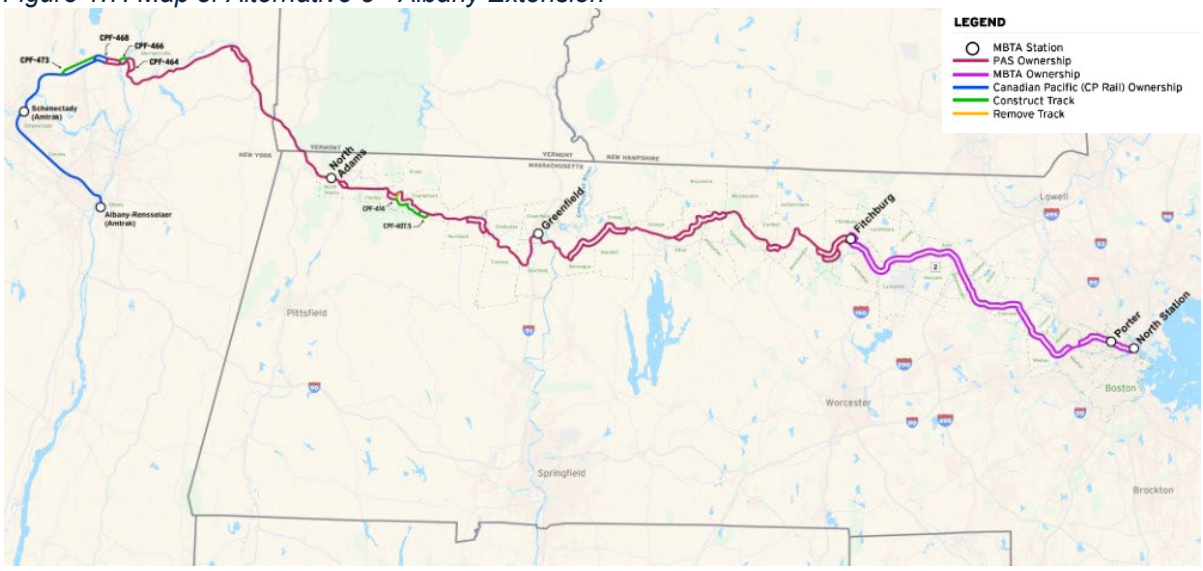
Figure 1.6: Map of Alternative 4 - Full Local Service



Alternative 5: Albany Extension

Alternative 5 assumes limited track additions for New York State. Instead of starting at North Adams, this service would run from Albany, New York, to Boston North Station. It also includes stops at Schenectady, NY, North Adams, Greenfield, Fitchburg, and Porter. The schedule would be optimized for transfers to other rail services at Albany/Rensselaer. Travel time from North Adams to Boston would be 2 hours and 49 minutes. Travel time from Albany, New York, to Boston North Station would be 4 hours and 34 minutes. Operating speeds between North Adams and Albany, NY are not included. Equipment for this service would layover at the existing Amtrak facility in Rensselaer, NY.

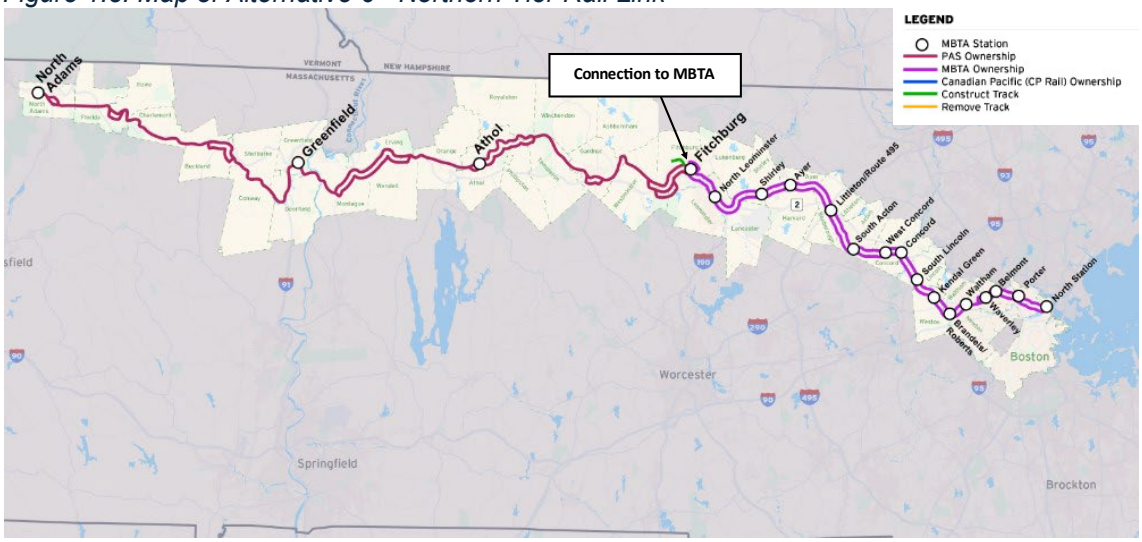
Figure 1.7: Map of Alternative 5 - Albany Extension



Alternative 6: Northern Tier Rail Link

Alternative 6 is a two-seat ride with a connection between Northern Tier trains and MBTA Commuter Rail Trains at Fitchburg. This alternative would add a stop at Athol. Travel time from North Adams to Boston would be 3 hours and 22 minutes.

Figure 1.8: Map of Alternative 6 - Northern Tier Rail Link



Evaluation of Phase 2 Alternatives and Refinements of Analysis

Refinement is a critical component of the study process. Based on comments and questions from the Working Group and the public, clarifications, and updates to the assumptions for ridership forecasting, cost estimation, and other elements were made. The refinements to the Phase 1 alternatives and the Phase 2 alternatives development and evaluation were presented at Working Group and public meetings in October of 2023.

Figure 1.9: Evaluation Summary

Evaluation Criteria	Alt. 1 – Lower Investment	Alt. 2 - Higher Investment	Alt. 3 – Electrified Service	Alt 4. - Full Local Service	Alt. 5 - Albany Extension	Alt 6. – Northern Tier Rail Link
Frequency	5 Trains per day	5 Trains per day	5 Trains per day	5 Trains per day	5 Trains per day	5 Trains per day
Coverage Area and Populations Served	North Adams, Greenfield, Fitchburg, North Station	North Adams, Greenfield, Fitchburg, North Station	North Adams, Greenfield Athol, Fitchburg, Ayer, Porter, North Station	North Adams, Shelburne Falls, Greenfield Athol, Gardner Fitchburg, Porter, North Station	Albany (NY) Schenectady (NY) North Adams, Greenfield, Fitchburg, Porter, North Station	North Adams, Greenfield, Fitchburg, MBTA Commuter Rail Stations (via Transfer at Fitchburg)
Eastbound Travel Times North Adams to Boston	3 hours, 48 mins	2 hours, 48 mins	2 hours, 50 mins	2 hours, 59 mins	2 hours, 49 mins	3 hours, 22 mins
Greenfield to Boston	2 hours, 31 mins	2 hours, 0 mins	2 hours, 4 mins	2 hours, 8 mins	2 hours, 2 mins	2 hours, 34 mins
Maximum Speeds	60 mph (PAS), 80 mph (MBTA)	60 mph (PAS), 80 mph (MBTA)	60 mph (PAS), 80 mph (MBTA)	60 mph (PAS), 80 mph (MBTA)	60 mph (PAS), 80 mph (MBTA)	60 mph (PAS), 80 mph (MBTA)
Environmental Impacts	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal
Passenger Rail Impacts	None	None	None	None	None	None
Freight Rail Impacts	Minimal delay estimated	Minimal delay estimated	Minimal delay estimated	Minimal delay estimated	Delays west of North Adams TBD	Minimal delay estimated
Community/Safety Impacts Grade Crossings Impacted	69 crossings	69 crossings	69 crossings	69 crossings	119 crossings	69 crossings

* The average time travel by car between North Adams and Boston is 2 hours and 48 minutes, between Greenfield and Boston 2 hours and 8 minutes
* Schedules were built with the goal to minimize conflicts with freight rail service and to create no conflict with MBTA service

Figure 1.10: Evaluation Summary

Evaluation Criteria	Alt. 1 – Lower Investment	Alt. 2 - Higher Investment	Alt. 3 – Electrified Service	Alt 4. - Full Local Service	Alt. 5 - Albany Extension	Alt 6. – Northern Tier Rail Link
Estimated Annual Ridership	65,880 to 111,460	100,780 to 148,200	196,520 to 304,200	168,040 to 255,460	100,340 to 149,160	3,900 to 23,900
Capital Cost Per Mile	$6,187,280	$11,064,097	$20,609,150	$11,200,458	$8,803,744	$10,969,819
Capital Cost Per Rider	$7,882 to $13,336	$10,601 to $15,589	$9,620 to $14,891	$6,225 to $9,464	$13,161 to $19,565	$65,176 to $399,413
Operating and Maintenance Cost Per Rider	$ 265 - $449	$ 200 - 294	$97 - $151	$116 - $176	$311 - $462	$1,941 – 4,950
Transportation Cost Savings[1] Low Ridership	$734,353	$3,756,019	$6,274,625	$5,840,958	$3,784,831	$140,113
High Ridership	$1,932,315	$4,749,951	$8,151,215	$7,617,419	$4,846,631	$714,576
Annual VMT Reductions Low Ridership	3,481,260	7,651,340	11,868,826	11,531,674	7,749,424	283,408
High Ridership	6,040,280	10,539,688	17,322,166	16,694,040	10,834,998	1,952,786
Economic Impacts from Construction[2] Output (in millions)	$1,206 over 3 years	$2,263 over 4 years	$4,298 over 4 years	$2,337 over 4 years	$2,834 over 4 years	$2,285 over 4 years
Peak Employment (direct, indirect + induced)	2,679 jobs	3,763 jobs	7,167 jobs	3,980 jobs	4,745 jobs	3,857 jobs

Notes:

1. Defining Transportation Cost Savings: Parking, fuels, tolls, etc.
2. Alt. 1 duration is 3 years due to smaller scale of infrastructure modifications

Figure 1.11: Total Capital and Operations & Maintenance Costs

Alternative	Total Capital Cost	Total Annual Operations and Maintenance Cost*
Alternative 1 – Lower Investment	$878,593,696	$29,584,447 ($256 - $449 per rider)
Alternative 2 – Higher Investment	$1,571,101,755	$29,584,447 ($200 - $294 per rider)
Alternative 3 – Electrified Service	$2,926,449,410	$29,584,447 ($97-$151 per day)
Alternative 4 – Full Local Service	$1,590,465,076	$29,584,447 ($116 - $176 per rider)
Alternative 5 – Albany Extension	$1,963,234,923	$46,388,580 ($311 - $462 per rider)
Alternative 6 – Northern Rier Rail Link	$1,557,714,406	$19,305,989 ($1,941 - $4,950 per rider)

Note: Annual Operating and Maintenance Costs calculated based on length of operating service

A Benefit-Cost Analysis is a common methodology, often used in federal funding processes, for evaluating the impacts of a potential investment through an economic lens. For the Northern Tier, key benefits include safety, avoided emissions, and property value increases. Project costs include

the capital costs necessary to construct the service, and operations and maintenance costs.[2] The benefit-cost analysis quantifies some aspects of the relative merits of the alternatives.

Figure 1.12: Benefit-Cost Analysis

Benefit-Cost Metric	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
O&M Net Savings	- $265.7	- $238.5	- $206.5	- $223.5	- $387.4	- $182.5
Safety Benefits	$2.3	$3.8	$6.1	$6.2	$3.8	$0.1
Avoided Road Wear and Tear	~$0.0	$0.1	$0.1	$0.1	$0.1	~$0.0
Avoided Congestion	$2.0	$3.3	$5.4	$5.4	$3.3	$0.1
Avoided Emissions (except CO2)	- $0.2	- $0.1	$0.1	- $0.1	- $0.2	- $0.1
Avoided Emissions (C02 only) *	$0.8	$1.3	$2.4	$2.2	$1.3	~$0.0
Property Value Increase	$21.9	$20.5	$27.9	$42.6	$20.5	$31.9
Total Benefits	- $238.8	- $209.5	- $164.5	- $167.0	- $358.7	- $150.6
Total Costs	$542.1	$941.7	$1,701.3	$953.4	$1,177.8	$964.5
Net Present Value	- $780.9	- $1,151.2	- $1,865.8	- $1,120.4	- $1,536.5	- $1,115.1
Benefit-Cost Ratio	**- 0.44**	**- 0.22**	**- 0.10**	**- 0.18**	**- 0.30**	**- 0.16**
O&M Net Savings	- $265.7	- $238.5	- $206.5	- $223.5	- $387.4	- $182.5

* Discounted at 3% rate
Note: In millions of 2021 $
Note: A ratio of 1.0 or higher makes a project more competitive for discretionary grants under current federal rules

Each of the six alternatives could provide economic benefits for the region, in proportion to the magnitude of the total project costs. Schedules and service that attract riders could be created to minimize interference with existing freight and passenger rail service. Most of the alternatives remain primarily within the existing right-of-way, which should minimize environmental permitting issues.

Key Findings

The following travel patterns were identified along the corridor.

- The majority of daily trips stay within the segment of the Northern Tier corridor from which they originate.
- The East segment shows a strong orientation toward communities in and around Boston. The Central segment shows Fitchburg, Leominster, and Gardner as the top three destinations for trips originating in the segment. The West segment has a strong north-south orientation for trips, suggesting that many people living in the region travel to Pittsfield and Springfield for work, medical care, or other trip purposes.
- West of I-495, travel in the corridor is predominantly by motor vehicle use.
- Typical travel time between North Adams and Boston ranges from 2.5 to 3 hours.

With respect to the potential service alternatives, while all of the service alternatives provide

[2] The conventional BCA approach using Federal guidance results in negative benefits due to the requirement to count operating and maintenance (O&M) costs as disbenefits, rather than as costs. For ease of understanding the outcome of the BCA, this modified approach counts O&M as costs rather than disbenefits.

connectivity, mobility, and transportation choice in the Northern Tier corridor, Alternative 3 (Electrified Service) and Alternative 4 (Full Local Service) achieve the highest ridership levels of the six potential alternatives. Alternative 3 is estimated to have its estimated annual ridership range between 196,520 and 304,200 riders. Alternative 4 is estimated to have its estimated annual ridership range between 168,040 and 255,460 riders.

Higher ridership levels represent more reductions in vehicle miles travelled (VMT) and equate to reduced automobile emissions and crashes. Alternatives 3 and 4 also lead this ridership-based metric of the six service alternatives examined.

Alternative 3, with its extensive electrification infrastructure, has the highest total capital cost with accompanying economic benefits.

The community and safety impacts are the same for all alternatives except the Albany Extension Alternative 5, which has more grade crossings over its longer route. The other alternatives have the same number of crossings and trains and therefore the same safety exposure.

The lowest annual cost of operations and maintenance per rider are associated with Alternative 3 and Alternative 4. These alternatives are more expensive to design and build, but more cost effective to operate and maintain because they are estimated to have the highest ridership of the six alternatives.

Stakeholders have expressed support for Alternative 3 and Alternative 4, as well as Alternative 5 (Albany Extension) and have expressed interest in additional stops along the corridor (e.g., Williamstown and Charlemont).

Conclusions

While the fundamental scale of ridership and cost is established, more work would be needed to further develop the markets, ridership, costs and benefits from a transportation planning perspective. The benefit-cost analysis detailed in Chapter 4 indicates the challenges presented in applying for and receiving federal funding under current discretionary grant program criteria.

This assessment reveals a complex set of opportunities and challenges with these key conclusions:

1. Based on current demographic and economic trends, much of the projected ridership is concentrated east of Fitchburg.
2. Due to the timeline for implementing any passenger rail service corridor, mobility improvements should be explored that could provide connectivity in the shorter term. Coordinated regional and municipal planning to support rail service implementation should be undertaken.
3. The rail along the Northern Tier corridor is a strategic asset for the entire Commonwealth and should be treated as such. Given the competitive options for freight service that this route offers, the societal and environmental benefits of freight rail, as well as utility for mitigating increasing climate risks, ensuring a long-term future for this route is warranted.

Recommended Next Steps

Stakeholders recognize the importance of and the opportunities for the Northern Tier region to help advance economic and transportation development that benefits the entire Commonwealth.

Therefore, a series of next steps should be considered to continue enhancing regional mobility and connectivity.

Funding would be necessary to enact these recommendations.

Continue to improve understanding of travel demand along the Northern Tier corridor, corridor segments, and linkages to key regional destinations - In particular, the analysis identified two important gaps: key drivers of travel demand in the corridor and the New York City travel market to northern Berkshire County.

More granular and current Northern Tier travel data, including any COVID-19 pandemic-induced changes, would be beneficial. This could include a closer examination of traffic associated with communities in Vermont and New Hampshire and with area academic institutions. Understanding the Albany market could affect the potential for western section of the Northern Tier.

Advance planning efforts at the intersection of economic development needs and opportunities and serving travel demand - The creation of a coordinated economic development strategy for the Central and Western sections of the Northern Tier would provide a platform to realize sustainable economic growth in the region by leveraging investment in intercity public transportation.

Explore scheduled motor coach service to Northern Tier corridor destinations - Motor coach service can be a relatively low cost means of improving mobility and developing demand for any future rail service.

Evaluate alternative phasing or implementation strategies - Most of the Northern Tier corridor is served by regional transit authorities, with a focus on serving the needs of their immediate service area. In May of 2024, MassDOT awarded a Regional Transit Innovation Grant (RTIG) to a joint effort by Berkshire Regional Transit Authority (BRTA), Pioneer Valley Transit Authority (PVTA), and Franklin Regional Transit Authority (FRTA) which aims to rehabilitate seven buses and operate a commuter bus network to increase regional connectivity between BRTA, PVTA, and FRTA. Such enhancements and further coordination among these services would improve intra-corridor mobility and connectivity, while also offering the potential for improved efficiency.

Evaluate express service between Fitchburg and Boston - Implementation of express service between Fitchburg and Boston could offer a relatively low-cost option to initiate upgraded public transportation and perhaps open access to other sources capital funding for projects such as eliminating the single-track operation through Waltham.

Monitor corridor freight use and trends to explore needs/opportunities for public investment - Federal grant funding offers potential opportunities to advance improvements along the Pan Am Southern corridor, including needed potential projects such as Hoosac Tunnel renewal, bridge strengthening, clearance projects to allow double-stack service, Ayer intermodal terminal improvements, and investments that may mitigate severe damage from flooding caused by climate change. Underlying such an effort will be close coordination with Pan Am Southern ownership, and in the context of a coordinated strategy for rail system improvements on the two east west main lines.

Develop strategies for improving rail connections within the corridor to support economic development, transportation equity, and minimizing impacts to public health/environment - A successful strategy to develop a Northern Tier passenger rail service would require all of these entities and groups to communicate and coordinate effectively, as funding and permitting entities

look for unified support for projects. Host railroads and operators apply their resources and efforts to projects with credible strategies and plans.

Policy decisions and strategy are the required next steps to determine if and how the Commonwealth will proceed. These require, at a minimum, continuing effective communication and coordination across all stakeholders.

The existing Compass Rail plan anticipates enhancing connectivity and transportation equity across the Commonwealth. The connection between Greenfield, Springfield, and Boston is in the implementation stages and could be a mechanism to achieve increased west-east mobility.

CHAPTER 2: INTRODUCTION

The Northern Tier Passenger Rail Study is a conceptual planning study assessing rail service alternatives along the North Adams-Greenfield-Boston corridor.

The Massachusetts Department of Transportation (MassDOT) was directed by the Massachusetts Legislature to conduct a feasibility study to examine the benefits, costs, and investments necessary to implement new passenger rail service that would feature the speed, frequency, and reliability necessary to be a competitive option for travel along the Northern Tier of the Commonwealth, connecting North Adams, Greenfield, and Boston.
As excerpted from the fiscal year 2020 budget legislation:

SECTION 84. *Notwithstanding any general or special law to the contrary, the Massachusetts Department of Transportation shall conduct a feasibility study of rail access between the cities of North Adams and Boston.*

> *The study shall examine and evaluate the costs and economic opportunities related to establishing rail service between the cities of North Adams and Greenfield and the cities of Greenfield and Boston including, but not limited to: (i) the projected capital costs; (ii) the projected operating costs and revenue estimates; (iii) the projected ridership levels; (iv) the prospect of operating rail service on existing rights of way and other operational issues; (v) an estimate of the environmental impact and benefits; (vi) an analysis of community impact and benefits; (vii) the potential sources and availability of federal, state, local, and private sector funding; and (viii) the resulting economic, employment, social, and cultural benefits to Franklin and Berkshire counties and the commonwealth as a whole.*

In fulfillment of the directive, the Northern Tier Passenger Rail Study aimed to:

- Engage the Working Group, study stakeholders, and the public;
- Assess historic, current, and forecasted future conditions;
- Develop and examine service alternatives that could potentially connect communities along the corridor; and
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Figure 2.1: Study Process

The study process illustrates a series of steps that build upon each other to develop a set of passenger rail service alternatives using a two-phased approach; these alternatives were evaluated

against the study goals and objectives (described in further detail in the following section) using criteria that measured the effectiveness of the service alternatives. The evaluation criteria have associated measurements that translate goals and objectives into data supporting recommendations on alternatives and next steps for stakeholders and policy makers.

Public Engagement

The Northern Tier Passenger Rail Study involved a robust public involvement process which engaged the study's Working Group and the public through various channels.

Working Group

A Working Group comprised of local, regional, and statewide stakeholders was convened to provide knowledge, expertise, and perspectives based on their respective organizational affiliations and experiences; review study materials and provide feedback; serve as conduits for broader public involvement; and share information with their respective organizations or institutions. Working Group meetings were open to the public and provided opportunities for public comment.

Elected officials, as well as representatives from regional planning and transit agencies, chambers of commerce, advocacy organizations, industry leaders, and additional stakeholders were invited to participate in the Northern Tier Passenger Rail Study Working Group and include:

- Federal, State, and Local Elected Officials
- Federal Railroad Administration
- Western Massachusetts Office of the Governor
- Massachusetts Executive Office of Housing and Economic Development
- 1 Berkshire
- Berkshire Regional Transit Authority
- Berkshire Regional Planning Commission
- North Central Massachusetts Chamber of Commerce
- Franklin Regional Transit Authority
- Franklin Regional Council of Governments
- Montachusett Regional Planning Commission
- Montachusett Regional Transit Authority
- Metropolitan Area Planning Council
- Massachusetts Bay Transportation Authority
- Massachusetts Association of Railroads
- Pan Am Railways
- CSX Transportation
- Transportation for Massachusetts
- TransitMatters
- Fitchburg Line Working Group
- MassDevelopment

As the study began during the COVID-19 public health emergency, all formal meetings were conducted virtually with appropriate accommodations for accessibility. Four virtual Working Group meetings were held in December 2021, June 2022, October 2023, and March 2024. These meetings provided a forum for the Group to discuss priorities, ask questions, and share feedback.

Public Meetings

In addition to the Working Group meetings, three virtual public meetings and a virtual public workshop were held at key study milestones to present information and garner feedback.

At the first public meeting held in July 2022, the agenda included a presentation of the study background and proposed goals and objectives, which included a poll to better understand the attendees' top priorities for the study; a review of past efforts; a discussion of the current

conditions of the corridor; and detail on next steps for the study.

In January 2023, a public workshop was held to present the first phase of the alternatives development. The workshop included three modules: Alternatives Development Approach and Methods, Evaluation of Phase 1 Alternatives, and Looking Ahead to Phase 2. Each module concluded with a series of polling questions and discussions for attendees.

The second public meeting in October 2023 provided a study overview and review of the public workshop, a presentation on the Phase 2 alternatives development and evaluation, and an explanation of next steps.

In March 2024, the third public meeting was held to share an overview of the study's background, review the study alternatives, outline issues and opportunities to consider, present draft recommended next steps and draft implementation plan, and garner feedback.

All Working Group and public meeting presentations and meeting summaries, as well as video recordings, were made available on the study website. Documents posted on the website in electronic format were made accessible in compliance with Section 508 of the U.S. Rehabilitation Act of 1973, the Massachusetts General Law Chapter 272 Section 98/98A, and Web Content Accessibility Guidelines.

Stakeholder Briefings

The Northern Tier Passenger Rail Study team held or attended targeted meetings to brief elected officials, regional leaders, and other stakeholders on the study over the course of its duration.

Engagement Tools and Strategies

A Northern Tier Passenger Rail Study website was created and maintained to host information, including a study overview, meeting information and materials, relevant study documents, and contact information. The study website also contained a section where visitors could sign up to receive study updates via email and submit comments and questions through an online comment form. This comment form was hosted through the Public Involvement Management Application (PIMA), a virtual platform used to manage public engagement and study communications. Comments received via PIMA are included in the Appendix. All comments and questions received through the online comment form, email, at meetings, or by letter, were recorded and responses were provided when requested.

PIMA was also used to develop and maintain the study’s stakeholder database of over 700 subscribers and to send individual and group emails, including meeting notices. Working Group and public meetings were also advertised via press releases and social media posts.

E-newsletters were disseminated to provide additional information relevant to the Northern Tier Passenger Rail Study including meeting recaps, study process information, and background information on key passenger rail planning and operations-related topics.

Outreach Efforts to Environmental Justice (EJ) Populations

MassDOT’s Public Participation Plan, Engage (MassDOT’s mapping tool for outreach), and available demographic census data guided the public participation process. Language services, including American Sign Language (ASL) and Communication Access Realtime Translation (CART) services, were secured for a public meeting and the public was able to submit requests for

accessibility accommodations or specific language interpretation services in advance of each meeting. The study's online comment form also presented commenters with the option to auto-translate the form into several languages.

Study Goals and Objectives

With the legislation serving as a foundation, and in collaboration with the Working Group, stakeholders, and the public, the following goals and objectives were identified for the study:

Goal: Promote transportation equity
Objectives:

- Increase mobility options between Western and Eastern Massachusetts
- Improve connectivity and reliability
- Enhance safety

Goal: Support economic development along the Northern Tier corridor
Objectives:

- Improve connectivity and access to destinations (e.g., jobs and services, academic institutions, tourist attractions, etc.)
- Support the advancement of relevant economic development-related policies, plans, and designations
- Minimize impacts to freight rail operations

Goal: Minimize impacts on public health and the environment from transportation
Objectives:

- Improve public health outcomes
- Minimize air/noise pollution and greenhouse gas emissions
- Minimize or avoid impacts to cultural or natural resources

Seven evaluation criteria were utilized to evaluate the ways in which the service alternatives met the outlined goals and objectives:

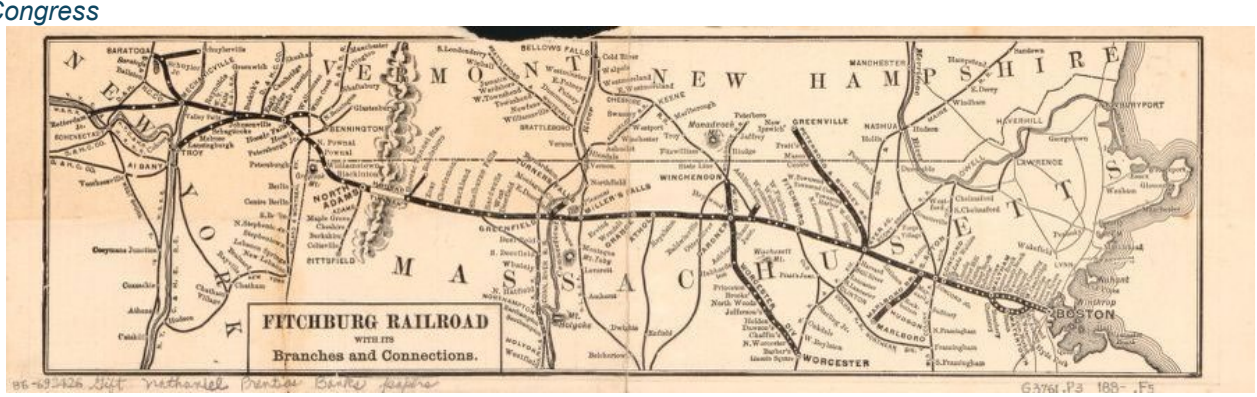
- Mobility and access
- Economic impact
- Social equity and fairness
- Impacts on rail capacity
- Environmental and cultural resources
- Cost effectiveness
- Safety and air quality

Study Context

The Northern Tier corridor follows the historical Fitchburg Railroad alignment which began in Boston and extended west to North Adams, then crossed southwestern Vermont and entered New York State. The route was surveyed and constructed in the 1840s to the 1870s and includes the Hoosac Tunnel, the longest tunnel east of the Rocky Mountains, which passes beneath the Hoosac Range – an extension of Vermont's Green Mountains. By proceeding through the mountains instead of over them, the Northern Tier corridor avoids some of the steeper grades required by other routes.

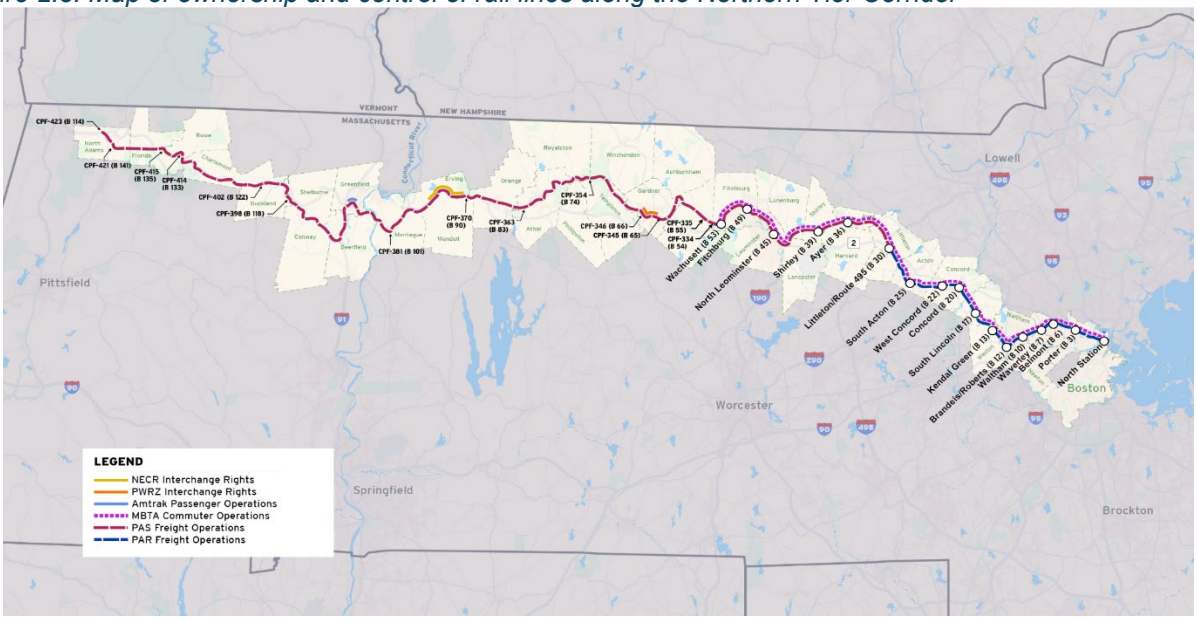
Figure 2.2: Map of the Fitchburg Railroad, circa 1880s - Nathaniel Prentiss Banks map collection, Library of

Congress



Passenger rail serviced the corridor from the late 19th century until the mid-20th century. The Massachusetts Bay Transportation Authority (MBTA) maintains passenger rail service at the eastern end of the corridor. Originally restoring commuter rail service to Gardner in 1980, the terminus later shifted to Fitchburg, and then to the current terminus at Wachusett Station in the City of Fitchburg. The Northern Tier corridor from Boston North Station to North Adams extends over 140 route miles and consists of 229.43 track miles when including all controlled track, such as double track and controlled sidings. The current Northern Tier corridor is generally divided into two segments and uses commuter rail and freight, with some overlap of service, ownership, and control. More detailed information on the existing conditions of the corridor is provided in Chapter 3.

Figure 2.3: Map of ownership and control of rail lines along the Northern Tier Corridor



Previous studies relevant to the study corridor are summarized in the following section. The geographic areas for these studies ranged from the individual municipalities to the counties of Central/Western Massachusetts and contiguous regions in Vermont and Connecticut, as well as Massachusetts statewide and across the Northern New England states. The studies were organized into three major categories:

- Passenger rail studies and other rail and transportation studies
- Regional/municipal transportation plans/studies

- Economic and development studies

Passenger Rail Studies and Other Rail and Transportation Studies

East-West Passenger Rail Study (2021)

The East-West Passenger Rail Study evaluated the potential for implementing passenger rail service from Boston to Springfield and Pittsfield. The report detailed the development and analysis of six potential service alternatives, including the costs, benefits, and investments necessary to advance each concept. The East-West Passenger Rail Study recommended next steps, including coordination and discussion with the host (owner) freight railroad, CSX, which is also part owner of the Northern Tier right of way. Other next steps included more detailed study of economic and community benefits and impacts, the development of a white paper to better understand the governance options for expanded passenger rail in Western Massachusetts, and the evaluation of funding sources and strategies.

Economic Benefits of Regional Rail Investment in Metro Hartford-Springfield (2021)

The Economic Benefits of Regional Rail Investment in Metro Hartford-Springfield study made the business case for completing two proposed rail improvements in the Connecticut Valley region by presenting an analysis examining the economic potential of the Hartford-Springfield region and the ability of enhanced passenger rail service to help achieve that potential. The study examined the completion of the bi-state Hartford Line and potential implementation of the East-West Rail project in Massachusetts.

Other area rail studies that highlighted the value of potential regional connections and the challenges of serving areas with low population density were reviewed. These studies included the *2017 Central Corridor Passenger Rail Feasibility Study* and the *2018 Massachusetts Rail Plan.*

Northern New England Intercity Rail Initiative (NNEIRI) Study (2016)

In 2016, the NNEIRI study examined the opportunities and impacts of more frequent and higher speed intercity passenger rail service on two major rail corridors, the Inland Route (from Boston to Springfield, then continuing to New Haven, Connecticut) and the Boston-to-Montreal Route (from Boston to Springfield, then continuing to Montreal). NNEIRI focused on using east-west service in Massachusetts as a route to the north-south services to New Haven and Montreal, and documented interest in rail transportation and the growing urban and elderly populations.

A Tier 1 Environmental Assessment (EA) for passenger rail improvements in the NNEIRI Corridor was conducted and determined there would be no significant environmental impacts from the NNEIRI Study.

Regional/Municipal Transportation Plans/Studies

Attracting Visitors by Passenger Rail to Franklin County, MA (2017)

The Franklin Regional Council of Governments conducted the study to evaluate travel opportunities following the restoration of passenger rail service to Greenfield in December 2014. Amtrak's Vermonter train serves Greenfield, connecting it to St. Albans, New York City, Philadelphia, and

Washington, D.C. The study documented additional trip opportunities for the new stations in Northampton and Holyoke.

The study concluded that local transportation connections must be accompanied with efforts to enhance the region as a destination:

- Facilitate local transportation options to connect people from the Greenfield station to accommodations and attractions.
- Promote passenger rail service as an option for visitors traveling to the region at the state and local level.
- Continue to promote Franklin County and its assets as a destination for metropolitan-based tourists who live on the Vermonter route and who seek a vacation getaway.

The report also reviewed studies of potential passenger groups and generational travel trends.

Franklin County Regional Transportation Plan 2020

The *2020 Regional Transportation Plan* (RTP) provided a vision for the region and prioritized its needs. The Plan focused on the importance of providing safe, efficient, and resilient mobility for residents and freight, while considering the rural character of Franklin County. The Plan detailed the region's current and future demographic, socioeconomic, and land use patterns, and emphasized several goals including providing residents with transportation option alternatives to the single occupant vehicle, strengthening the local economy and industries, and improving the region's livability and resiliency.

In June 2023, the *2024 Franklin County Regional Transportation Plan* was released, which updated its regional demographic and economic profile, and recommended priorities.

Working Towards the Future (2020)

Working Towards the Future provides a blueprint for the Montachusett region to achieve a multi-modal transportation system that balances the varying needs of its population within the fiscal outlook. The Plan's recommendations include expanded transit, pedestrian, and safety improvements to help the aging population; expanding mode options for the region's commuters; maintaining State of Good Repair (SGR) of the region's infrastructure; extending MBTA Commuter Rail service to Gardner; improving safety and monitoring congestion on the roadway network; and monitoring and assessing environmentally vulnerable infrastructure.

The Plan includes recommendations for MBTA Commuter Rail service to serve key populations more effectively:

- Increase available parking at the Shirley, Ayer, and Littleton Commuter Rail stations.
- Extend train service to Gardner.
- Improve Handicapped accessibility at Shirley and Ayer Train Stations.
- Explore the possibility of a regional facility in the Devens Enterprise Zone.

Journey to 2050, the update of the Montachusett Regional Transportation Plan was endorsed by the MPO in August 2023. The Plan details an analysis of the region and demographic projections, and outlines regional trends, recommendations, and action items.

Economic and Development Studies

Economic Impacts of Fitchburg State University and the Fitchburg Theater Renovation (UMass Donahue Institute, 2021)

The *Economic Impacts of Fitchburg State University and the Fitchburg Theater Renovation* report quantifies the contribution of Fitchburg State University (FSU) and its alumni to the Massachusetts economy at about $283 million in economic activity as well as 1,776 jobs in fiscal year 2019.

The study anticipates that FSU's spearheading of the initiative to restore the Fitchburg Theater will contribute to the vibrance of the downtown Fitchburg area and introduce economic benefits for the region and the Commonwealth, supporting 43 jobs and $5.3 million in output on an annual basis. FSU is using other components of the Theater Block, including a game studio for FSU seniors in the game design program and the interdisciplinary ideaLab that is used for small business training. Other parts of the building are being renovated for commercial and gallery space.

The study concluded Fitchburg's constellation of downtown development projects, including the Theater, will allow the City to capitalize on its mix of affordability and availability of space for businesses to attract investors and potential residents.

Downtown Business District Assessment and Market Analysis (City of Greenfield, 2021)

This assessment and market analysis of the City of Greenfield's downtown business district informs future revitalization activities and supports an update of the Downtown Revitalization Plan.

The report includes an assessment of real estate and business conditions, a market analysis, and a summary of findings. It documents approximately 251 businesses in Downtown Greenfield and analyzes ownership and types of business such as service, retail, and restaurant, concluding that Downtown is a major employment center with an estimated 2,200 employees.

The existing John W. Olver Transit Center is located within the Greenfield downtown district, which includes approximately 34,778 residents making up 15,446 households.

Devens Economic Profile and Contributions (MassDevelopment, 2020)

Devens, an Army Base until the 1990s, is a center for manufacturing and distribution industries. Occupying the towns of Ayer, Harvard, and Shirley, its space offers opportunities for business expansion with access to highways, and passenger and freight rail services.

According to the *Devens Economic Profile and Contributions* report, the area accounts for 14,000 jobs and contributes upwards of $3.8 billion annually to the Massachusetts economy. As a major employment hub, Devens attracts workers from across the state, southern New Hampshire, and beyond.

Key Findings

The studies assessed provide valuable insight into factors affecting transportation investment and travel decisions. Key takeaways of this review are as follows:

- There is no previous corridor-wide evaluation of travel conditions along Route 2, which is the primary roadway corridor connecting North Adams, Greenfield, and Boston.

- Most transportation planning in the corridor has focused more on local travel.
- Previous studies identify a need for additional transportation options to enhance safety, mobility, and connectivity, and support economic development.
- There is an opportunity for passenger rail service to tie into economic development efforts throughout the study area.
- A better understanding of travel pattern changes due to COVID-19 is needed.

Building upon the goals and objectives of the study, as well as previous efforts, and with the input of the Working Group and the public as a guide, Chapter 3 documents the existing conditions along the Northern Tier corridor including demographic and employment baseline and trends, and current travel markets. Other areas of study include physical characteristics of the rail corridor, right-of-way ownership, the regulatory environment, and governance factors.

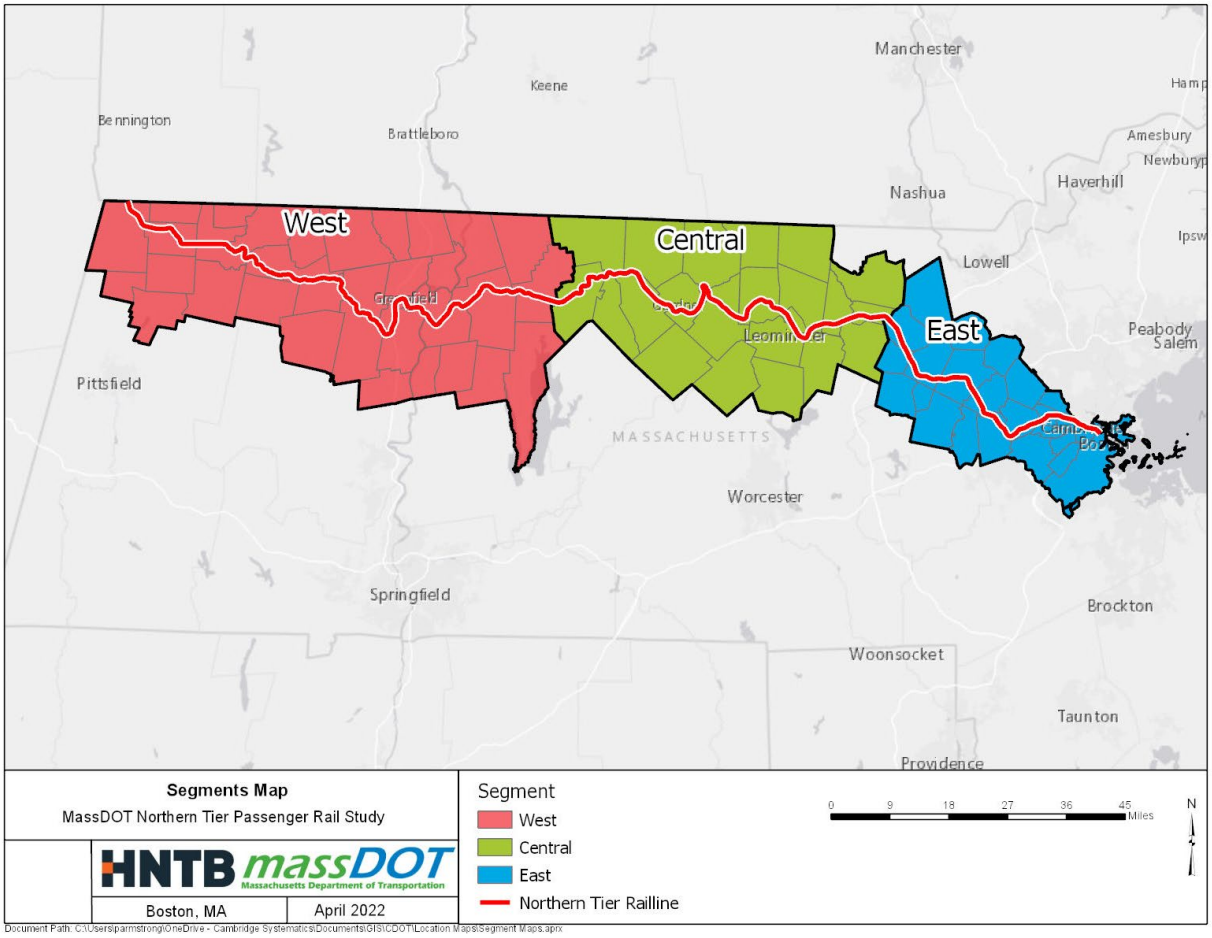
CHAPTER 3: EXISTING CONDITIONS

Central to evaluating the feasibility of implementing passenger service is understanding the existing and projected future conditions along the Northern Tier corridor. This includes the physical conditions on the roadway and rail system and physical and institutional conditions on the existing rail infrastructure. Underpinning the assessment is gaining an understanding of any potential markets that may be served by the potential service.

This chapter reviews past demographic, employment, and travel trends along the corridor to establish baseline projections through 2040. The baseline projections are used to estimate possible changes to travel demand that might arise from the service alternatives.

The analysis divides the region into three segments – West, Central, and East (see Figure 3.1). The West segment includes northern Berkshire and Franklin Counties and includes the cities of Greenfield and North Adams. The Central segment includes the Montachusett region with population centers such as Fitchburg, Leominster, Gardner, and Athol. The East segment includes the population centers of Boston and Cambridge along with their western suburbs.

Figure 3.1: Map of Northern Tier segments



Freight and Passenger Operations

The Northern Tier right-of-way has two owners. The Fitchburg Line, extending from Boston North Station to the City of Fitchburg, is owned by the Massachusetts Bay Transportation Authority (MBTA). Pan Am Southern LLC (PAS), a Class 2 railroad, owns the corridor west of Wachusett (the MBTA property in Fitchburg) to the state line with Vermont and beyond. Pan Am Southern is equally owned by two Class 1 freight railroads, CSX Transportation (CSX) and Norfolk Southern Railway (NS). CSX acquired its share of ownership through the purchase of Pan Am Railways Inc. (PAR), which was approved by the Surface Transportation Board in 2022. CSX has exclusive freight operating rights over much of the MBTA system that emanates from North Station, including the Fitchburg Line from Boston to Ayer. From Ayer to Fitchburg, Pan Am Southern holds those freight operating rights. The services on this right-of-way are shown in Figure 3.2.

The MBTA dispatches train operations on the Fitchburg Line from Boston to Ayer and performs maintenance of the right-of-way from Boston to Fitchburg. Pan Am Southern dispatches from Ayer to the state line with Vermont and beyond to New York state. Pan Am Southern maintains the right-of-way from Wachusett into Vermont and New York State. This dispatching control and maintenance, which does not strictly follow the ownership boundaries, can affect the reliability and on-time performance of both freight and passenger train service. Dispatching control and maintenance responsibility are shown in Figure 3.3.

Figure 3.2: Passenger and Freight Operations along the Northern Tier Corridor

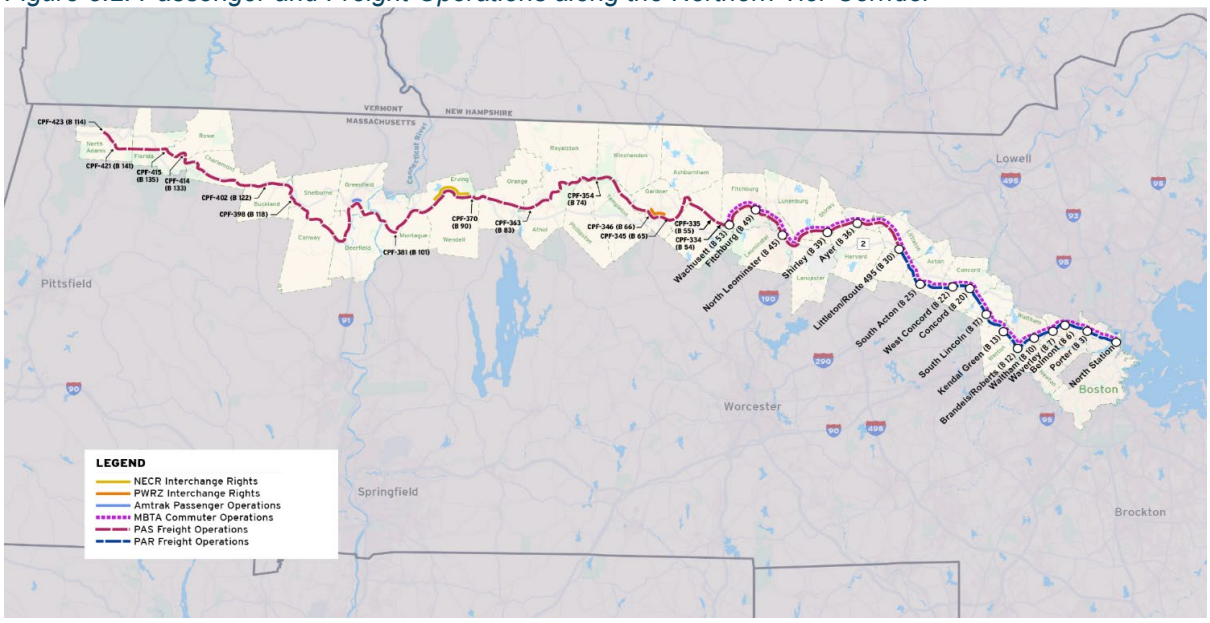
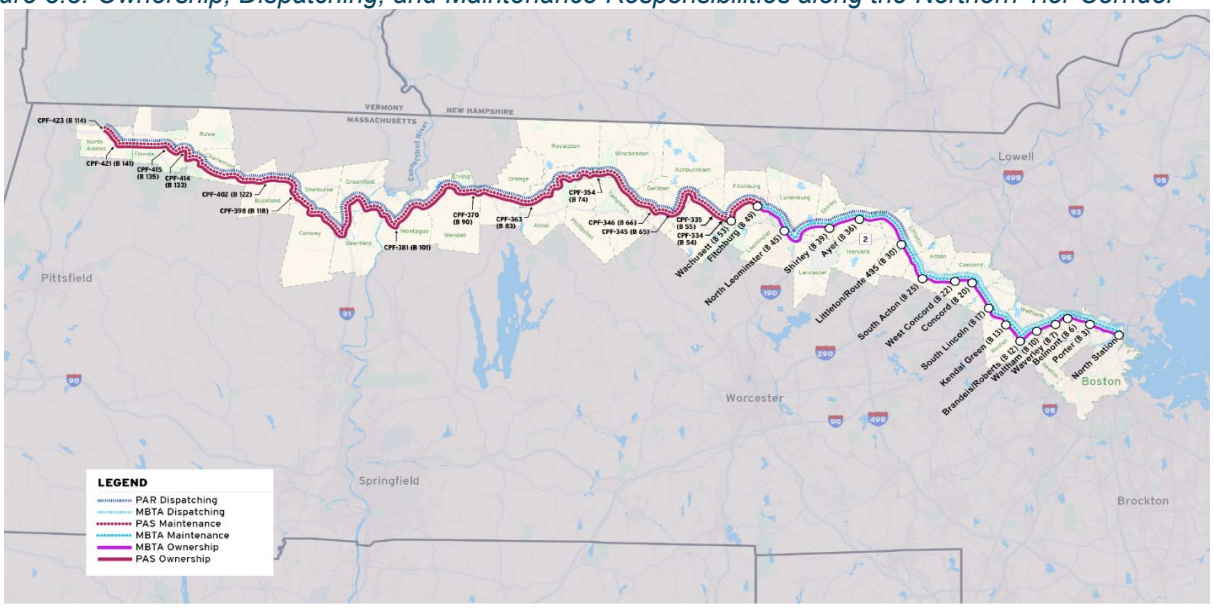


Figure 3.3: Ownership, Dispatching, and Maintenance Responsibilities along the Northern Tier Corridor



Existing Passenger Rail Service

The MBTA operates 34 weekday trains and 16 trains each weekend day on the Fitchburg Line with seven train sets and 17 stations. The weekday span of service is about 4:30 AM to 11:00 PM. Fitchburg Line trains are maintained and stored during the day at the MBTA Commuter Rail Maintenance Facility near North Station. Trains are stored overnight at Westminster Yard, west of Wachusett Station.

Amtrak operates six daily trains to or originating in Greenfield, with regional stops in Northampton, Holyoke, and Springfield. Two of these trains are the round trip of the Vermonter, which operates between St. Albans, VT and Washington, DC. The other trains are the two round trips of the MassDOT-sponsored Valley Flyer service. Valley Flyer trains operate between Greenfield, MA and New Haven, CT where connections are made to New York City and other locations on the Northeast Corridor. The Valley Flyer also offers connections to Bradley International Airport in Windsor Locks, CT from the Windsor Locks Station.

Other Public Transportation

The Northern Tier corridor west of Fitchburg is currently served by regional transit authority service to Charlemont from Wachusett Station – an approximately 4.5-hour trip that requires a transfer from Montachusett Regional Transit Authority service to Franklin Regional Transit Authority service. The schedules do not make a return trip possible on the same day.

West of Charlemont, there is no public transportation service until North Adams, which is served by the Berkshire Regional Transit Authority. Regional intercity bus service along Route 2 has been provided periodically, most recently by MAX service run by TrueNorth Transit Group. The service operated between 2015 and 2018.

There is no intercity bus service provided in the Connecticut River Valley north of the Five College area or in northern Berkshire County, and there is limited direct intercity bus service to New York City provided from Greenfield and Williamstown. Greyhound provides service from Greenfield to New York City via other destinations in the Connecticut River Valley of Massachusetts and

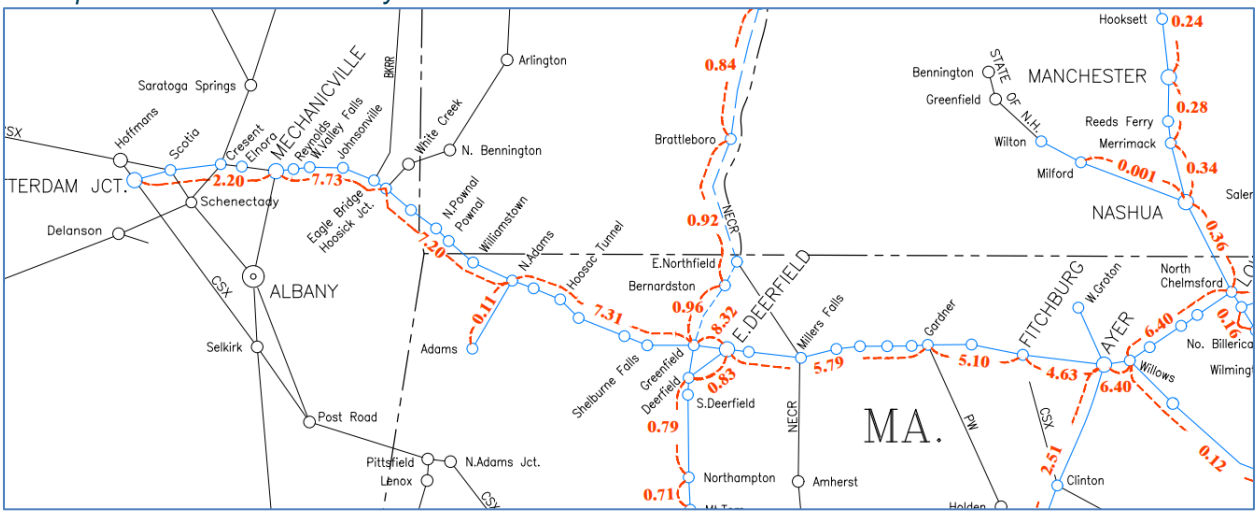
Connecticut. Peter Pan Bus Lines service to Williamstown is concentrated during the weekends on a route that connects other Berkshire County destinations with New York City.

Freight Operations

Freight operations occur primarily between Ayer and North Adams, with approximately ten trains operating daily between Ayer and East Deerfield. In 2019, Pan Am Southern moved more than 37,000 freight carloads under trackage rights arrangements with Norfolk Southern. Aside from traffic hauled on behalf of Norfolk Southern, overhead traffic represents more than one-third of Pan Am Southern traffic while 40-percent of Pan Am Southern traffic consists of deliveries to Pan Am Southern shippers.[3] Figure 3.4 presents annual million gross ton-miles (MGTM) carried over the Pan Am Southern Patriot Corridor. For example, between North Adams and Greenfield, 7.31 MGTM are carried annually (for 2019).

CSX's acquisition of Pan Am Railways produced a CSX commitment to move some Norfolk Southern trains from the Pan Am Southern/Northern Tier right-of-way to the CSX Main Line between Boston and Albany. These and other changes are ongoing.

Figure 3.4: Annual MGTM handled on the Pan Am Southern Patriot Corridor – CSX Application before STB for acquisition of Pan Am Railways



Regulatory Baseline

New passenger rail service along the Northern Tier corridor would be subject to a range of statutes and regulations, including federal requirements, and would require the establishment of a governance structure to provide oversight and funding. Northern Tier service would be classified as an intercity service under federal law. As such, it is subject to safety regulation by the Federal Railroad Administration (FRA) of the United States Department of Transportation (USDOT). Northern Tier infrastructure improvements would most likely be eligible for federal intercity rail funding.

[3] Overhead traffic is freight that the railroad moves over its right-of-way, which neither originates nor is delivered on that railroad.

As outlined in the Passenger Rail Investment and Improvement Act of 2008 (PRIIA), intercity trains are trains with routes less than 750 miles long with long distances between stations serving a variety of markets – e.g., tourism, business travel – but not specifically serving daily work trips. Intercity service is distinguished from commuter rail service in that the latter has a service pattern that historically has transported workers from suburban areas to downtown cores, with peak-oriented services and fare policies to serve and encourage high frequency riders. The Federal Railroad Administration generally restricts its capital funding to intercity services, while the Federal Transit Administration generally does not fund intercity capital projects.

The National Railroad Passenger Corporation, better known as Amtrak, provides most U.S. intercity service and possesses a statutory right to operate on any other railroad in the country. Amtrak's experience in intercity passenger operations and its access to operate on other railroads gives it advantages in working with state sponsors of new intercity services. Amtrak's access rights may allow the state sponsor to obtain operations access at a better price than if the state negotiated on its own. However, contracting with Amtrak for operations does not necessarily provide the state sponsor any reduction in infrastructure costs for a new service. Amtrak's intercity services often operate on rights of way owned by privately owned freight railroads. However, there is no comparable statutory right for freight railroads to operate on Amtrak or other railroad rights of way. Freight railroads obtain rights on other railroads through acquisitions, agreements, deeded rights, and other sources.

The Surface Transportation Board (STB) is an independent federal agency that is charged with the economic regulation of various modes of surface transportation, including freight railroads. One example is its recent adjudication of the acquisition of the Pan Am Railways by CSX. In its decision on the CSX-Pan Am Railways acquisition, the STB concluded that CSX should continue to work with passenger rail partners to address any future regional growth. As a result, there will be no near-term change in how passenger rail projects can gain access to the lines of the private railroads – either by agreement, or through Amtrak.

The Springfield Terminal Company (STC) is one of the Pan Am Railways railroads acquired by CSX. Springfield Terminal functioned as a contract operator for Pan Am Southern and as Pan Am Southern's agent. Norfolk Southern has trackage rights over the Pan Am Southern line between Mechanicville, New York, and Ayer, Massachusetts. These trackage rights generally allow Norfolk Southern to operate its own trains between those points. The CSX acquisition of Pan Am Railways included a plan to transfer the STC operations to the Berkshire & Eastern Railroad (B&E). The B&E (also known as Pittsburg and Shawmut Railroad (PSR)) is a subsidiary of the Genesee & Wyoming Railroad (G&W).

Pursuant to section 60 of chapter 176 of the acts of 2022, the Western Massachusetts Passenger Rail Commission (WMPRC) was established to assess passenger rail construction, operations, maintenance, and governance in the Commonwealth outside of the MBTA service area.[4] In November 2023, the WMPRC released its final report which concluded by stating that "the Legislature should look to MassDOT as the best entity to receive and manage additional resources should expansion of intercity rail services continue in future years".[5] Aside from the WMPRC recommendation, there are no unique factors in regulatory status or other governance and financing structures that would then prevent development of an intercity passenger rail service on the Northern Tier.

[4] Mass. Gen. Laws ch. 176, § 60 (2022)
[5] https://archive.org/details/wmpr-final-report/page/n31/mode/1up

Route Configuration

The MBTA-owned Fitchburg Line is double tracked except for a 0.4-mile stretch in Waltham. The Pan Am Southern-owned right-of-way west of Fitchburg is principally single-track with sidings. Interlocking spacing averages six miles along the line.[6] Doubletracking with frequent interlockings allows greater flexibility in operations, as more trains can be operated on a route segment in the same or opposite direction and can be moved from track to track as conditions require, such as station stops and freight drop-off and pick-up. These factors play a significant role in system capacity and the development of service alternatives. The right-of-way is equipped with Positive Train Control, a federally mandated safety technology.

Freight yards include locations in Ayer, Fitchburg (at the former MBTA layover location), and East Deerfield. Pan Am Southern connects with other freight railroads at Ayer, Greenfield, and other locations.

Allowable Speeds and Shared Corridor Challenges

Federal regulations establish several classes of track with associated Maximum Authorized (or Allowable) Speeds for passenger and freight trains. The classes of track that apply to the Northern Tier are shown in Figure 3.5. The class of track is dictated by the condition of the track and railroad-bed components, the grades, the curvature of the track, and the signaling system. Superelevation, where the outside rail of a curve is elevated, can be added to curves in the track to allow certain trains to operate at higher speeds.

Figure 3.5: Track Classes and Maximum Allowable Operating Speeds

Differences in allowable speeds for passenger and freight trains on a shared corridor have the potential to impact schedules for both. A related factor is the signal system, which is designed to maintain a distance between trains corresponding to a safe braking distance, with the heavier freight trains often requiring longer braking distances.

[6] Interlockings are locations where switches allow trains to be held by the dispatcher or to change tracks.

Other factors that limit train speeds are grades and curves. Grade is the change in elevation of the railroad as it ascends and descends hills, which are important features of the Northern Tier right-of-way. The dominant grades of the railroad in each segment affect the amount of locomotive power required for a train to safely ascend and descend those grades. These factors together also govern the maximum speed of a train on the grades it encounters on the right-of-way. The most extreme grade on a segment of the right-of-way will establish the maximum length and weight of the train and required locomotive power. These characteristics will affect the speed of the train on the rest of the segment of the right-of-way. The relationship of the train wheels to the rail on a curve involves a variety of forces, including pushing, pulling, and centrifugal forces. These forces in the wheel- rail relationship limit the speed at which the train can move safely through the curve, similar to the forces on an automobile operating through curves.

Additional Corridor Characteristics

Highway-Rail Grade Crossings

There are 69 active grade crossings along the corridor between Somerville and North Adams. Active highway-rail grade crossings along the corridor were inventoried, including the location of the crossing, the unique U.S. Department of Transportation (USDOT) crossing number, and the number of tracks currently in place at the crossing. The inventory is shown in the Appendix.

Grade crossings are classified as either public or private. Public grade crossings involve roadways or pathways that are under the jurisdiction of and maintained by a public authority. Private grade crossings involve privately owned roadways or pathways intended for use by the owner or by the owner's invitees. A private crossing is not intended for public use and is not maintained by a public authority. Private grade crossings are typically established through an agreement between the railroad and the users of the grade crossing.

The inventory also identifies crossings that are pedestrian only. These crossings may be either public or private but are only for passage by pedestrians. Most pedestrian crossings along the corridor are associated with rail stations or rail yards.

Warning devices are installed at most grade crossings to identify the presence of the crossing and the potential for train activity. Active warning devices (e.g., flashing lights and gates) indicate when a train is approaching the crossing. Passive warning devices (e.g., railroad cross-buck signs and stop signs) alert a driver or pedestrian that a grade crossing is present but do not provide a warning that a train is approaching. The configuration of grade crossing warning devices is guided by the Federal Highway Administration’s (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) and must conform with regulations established by the FRA. In Massachusetts, the Massachusetts Department of Public Utilities oversees the design and installation of new grade crossing warning devices.

The FRA requires that trains sound their horns when approaching and traveling over a public grade crossing and has specific requirements governing many of the aspects of train horns. Communities may establish a “quiet zone,” an FRA exemption where trains are not required to regularly sound their horns when approaching a public grade crossing, through a process led by the community, governed by FRA, and coordinated with the operating railroad which may include the installation and maintenance of certain supplemental safety measures to mitigate for the reduced safety

conditions resulting from the elimination of train horns. As of October 2022, Massachusetts has 29 quiet zone locations, including one in Ayer.[7]

Additional train operations may require evaluation of noise impacts. New rail services usually implement grade crossing safety programs such as Operation Lifesaver Inc. (OLI).

The Federal Railroad Administration Grade Crossing Inventory is available in the Appendix.

Bridges and Tunnels

Pan Am Southern and the MBTA Fitchburg Line include numerous structures, including undergrade bridges that carry the railroad over roadways and waterways and overhead bridges that carry roadways over the railroad. The Federal Railroad administration requires Pan Am Southern and the MBTA to maintain bridge management plans (BMP) for the inspection and maintenance of these structures. These plans include bridge inventories and condition information. A review of detailed track charts identified 97 bridges on the Pan Am Southern. Future planning and design phases would require access to these plans as well as details on existing and proposed freight and passenger train operations.

Pan Am Southern includes the engineering landmark known as the Hoosac Tunnel. The tunnel under the Hoosac Mountain was completed in 1875 at 4.75 miles in length and remains the longest tunnel east of the Rocky Mountains, connecting the municipalities of North Adams and Florida. In 2020, the Tunnel was closed for two months for repairs.[8]

Stations

Historical stations were inventoried and underwent preliminary screening for several factors, including location access and area characteristics, surrounding platform fit, nearby transit services, and potential parking. Locations in Baldwinville, Gardner, Athol, Orange, Erving, Millers Falls, Greenfield, Shelburne Falls, Charlemont, Zoar, North Adams, and Williamstown were reviewed.

While many of the historical station locations have the potential for parking and full length, accessible platforms, there are challenges in terms of highway access and track configuration (e.g., the proposed transfer between Valley Flyer and Northern Tier trains at Greenfield).

Profiles for potential stations provide a summary analysis of the historic station locations and an overview of their feasibility as new passenger rail stations. The following station assumptions are included as part of the analysis:

- Platform length of no longer than 800 feet
- Platform to be 12 feet wide at four feet above top of rail
- Platforms to be located on straight track, where feasible
- All platforms to be accessible, including platform height to allow level boarding, and an accessible path of travel to the nearest public way or parking area
- Space for parking should be available at the station or nearby, and a pick-up and drop-off area provided

[7] Federal Railroad Administration Quiet Zone Locations by City and State
[8] https://www.berkshireeagle.com/archives/hoosac-tunnel-open-again-after-partial-collapse-in-february/article_25edfdfb-2f40-5580-a5d4-5cd192dcfd30.html

- The number of parking spaces required for each station has not been determined at this level of planning

Existing regional transit bus routes within 0.5 miles of the potential station locations are noted. Any plans for reintroduction of service to these stations would have an impact on the local municipality and the neighborhood surrounding the potential station locations.

North Adams

Station Location Access and Area Characteristics

Located between American Legion Drive and the rail corridor, the site of the historic station is currently occupied by the American Legion and its adjacent parking lot. The site is about 0.5 miles from the downtown area and the Massachusetts Museum of Contemporary Art (MASS MoCA).

The site of the former station roughly parallels the Hoosic River. South of the American Legion is The Brien Center, focusing on mental health and addiction recovery. To the north is the Hotel Downstreet at the corner of Main Street. Adjacent to Hotel Downstreet is North Adams City Hall. Across American Legion Drive is a shopping center with the North Adams Police and Fire Departments just to the north.

On the southwest side of the rail corridor, the Hoosic River runs parallel with a narrow strip of land in between containing the former 1492 Nightclub and industrial uses to the south. This parcel and the American Legion parcel have been proposed as the location of a model train and building museum. On the west side of the river is the Noel Field Athletic Complex containing the skateboard park, splash park and ball fields. There is currently no connection across the rail corridor.

A new station could be located south of American Legion Highway at the junction of the Adams Branch track and the main line and could be accessed from Ashland Street.

Platform Fit

There is space for an 800-foot platform south of the junction of the Adams Branch track and the main line tracks. A platform at this location could also accommodate any service on the Adams Branch.

Nearby Transit Services

The Berkshire Regional Transit Authority (BRTA) operates the North Adams Loop (34 Line) on weekdays with stops at Main Street, the Massachusetts College of Liberal Arts, Ocean State Job Lot, and Walmart. Additional bus service is provided to Pittsfield via Route 1 and to Williamstown via Route 3.

There is no intercity bus service to North Adams. Peter Pan Bus Lines ended service to North Adams in October 2018.

The Berkshire Scenic Railway Museum provides seasonal, special occasion train service between Adams and North Adams along the Adams Branch. Trains leave Adams from Adams Station off Hoosac Street.

Potential Parking

There is space for parking between the main line tracks and the Adams Branch tracks, which can be accessed from Ashland Street.

Figure 3.6: North Adams, MA yard – Google Earth

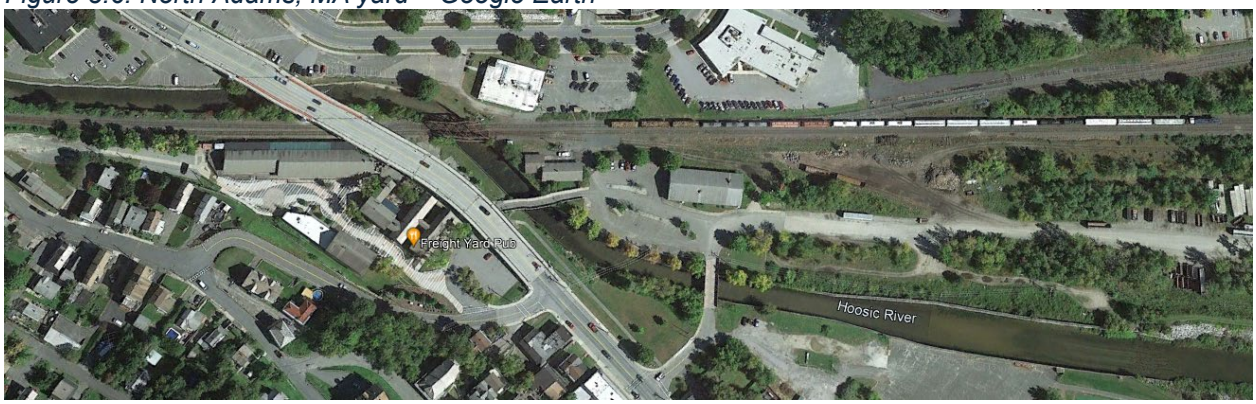
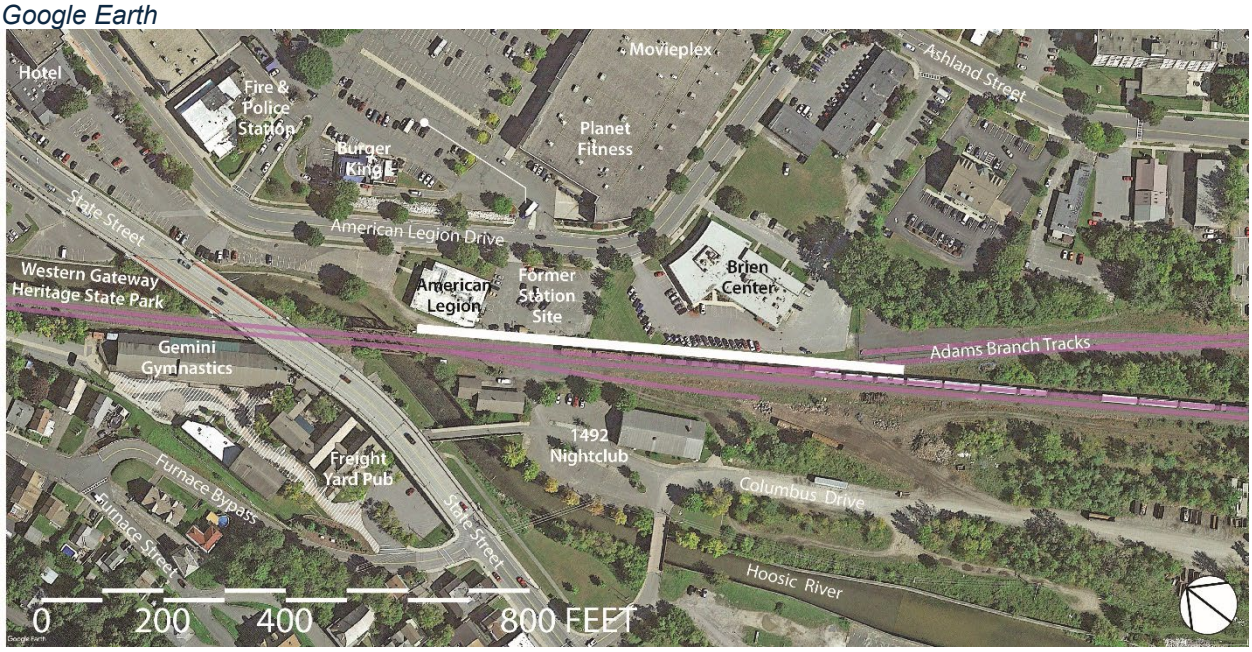


Figure 3.7: North Adams - Area surrounding the location of the former North Adams Station with rail corridors shown in purple – Google Earth

Figure 3.8: North Adams - Site of former station with hypothetical 800-foot platform shown in white for scale – Google Earth



Shelburne Falls

Station Location Access and Area Characteristics

Shelburne Falls is a historic village in the towns of Shelburne and Buckland. The village is split by the Deerfield River, which is crossed by two roadway bridges and a former trolley bridge that has been converted into the Bridge of Flowers — one of the major attractions of the village. Shelburne Falls is accessed via Routes 2/112 from the west and Route 2 from the east.

The former station is located on the south side of the river in a rail yard that has been converted into the Shelburne Falls Trolley Museum.

Platform Fit

Two tracks run through the corridor along a straight section that is adequate for an 800-foot platform on either side of the tracks.

Nearby Transit Services

There is currently no RTA or intercity bus service to Shelburne Falls.

Potential Parking

There are several locations that have potential for a parking area off Depot Street. Additionally, shared parking could be considered at the Trolley Museum or at the Blue Rock Restaurant.

Figure 3.9: Shelburne Falls - Area surrounding former station with rail corridor shown in purple – Google Earth

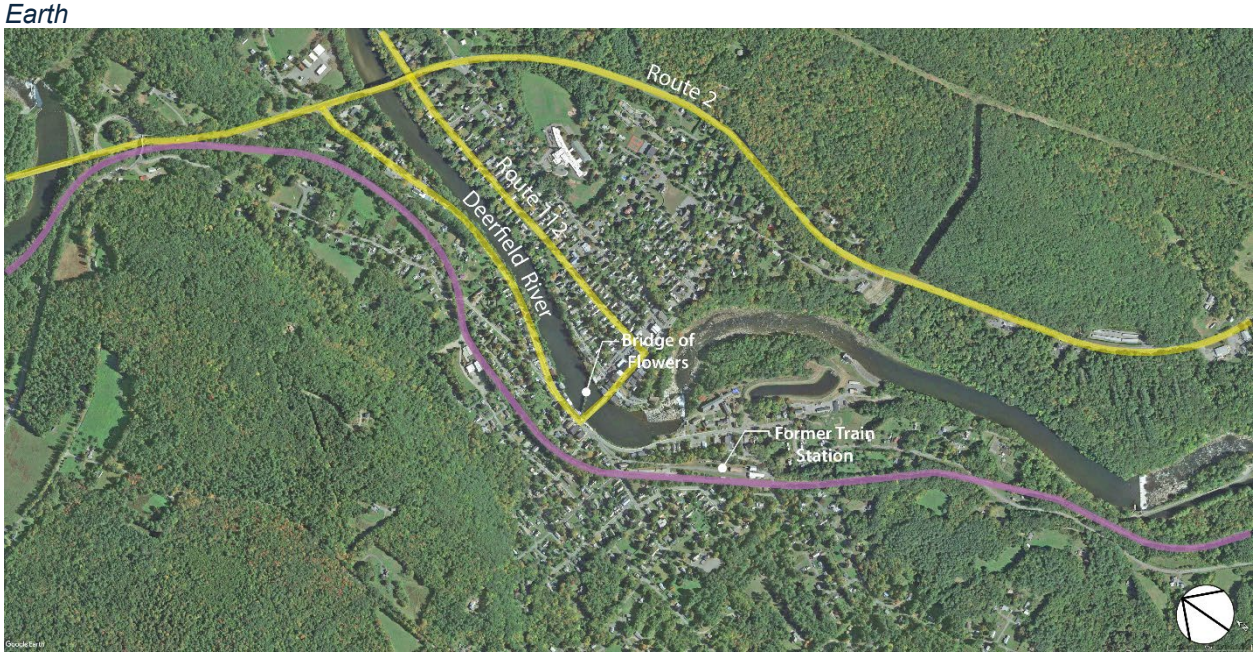
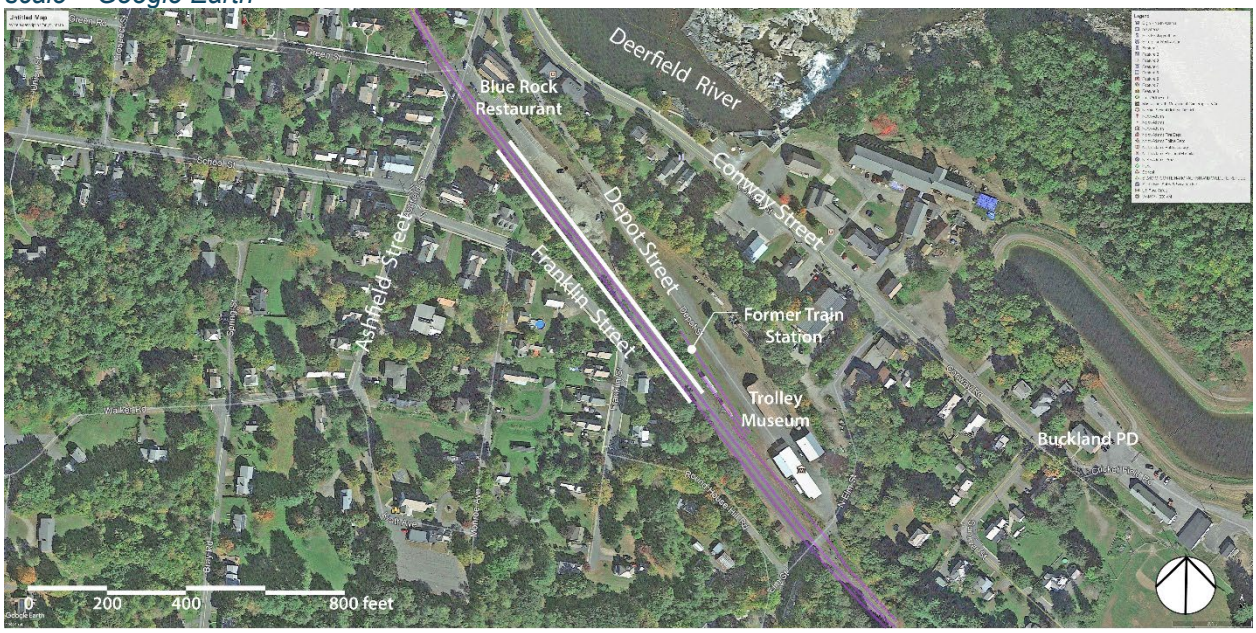


Figure 3.10: Shelburne Falls - Former station location with hypothetical 800-foot platform shown in white for scale – Google Earth



Greenfield

Station Location Access and Area Characteristics

Greenfield is located at the junction of Interstate 91, Route 2, Route 2A, Route 5, and Route 10. Interstate 91 travels north and south through the western stretch of the city and is concurrent with Route 2 for a three-mile stretch.

The former Greenfield train station (demolished in 1966) was located across the tracks from the current train platform, in the present-day Energy Park. The John W. Olver Transit Center is in the vicinity of the former station site and is a stop on the Amtrak Vermonter and Valley Flyer intercity

passenger rail service. The passenger rail platform is located along the Connecticut River Line slightly north of where it diverges from the shared right-of-way with the Pan Am Southern freight mainline.

The Olver Transit Center is also home to the administrative offices for both the Franklin Regional Transit Authority (FRTA) and the Franklin Regional Council of Governments.

Platform Fit
The tangent section of track opposite the Olver Transit Center, along Deerfield Street, may have adequate space for an 800-foot-long platform.

Nearby Transit Services
Intercity bus connections to New York City and Boston are offered by Greyhound bus lines. The Olver Transportation Center is also the hub of the FRTA, whose local service extends from Bernardston to Northampton and from Orange to Charlemont.

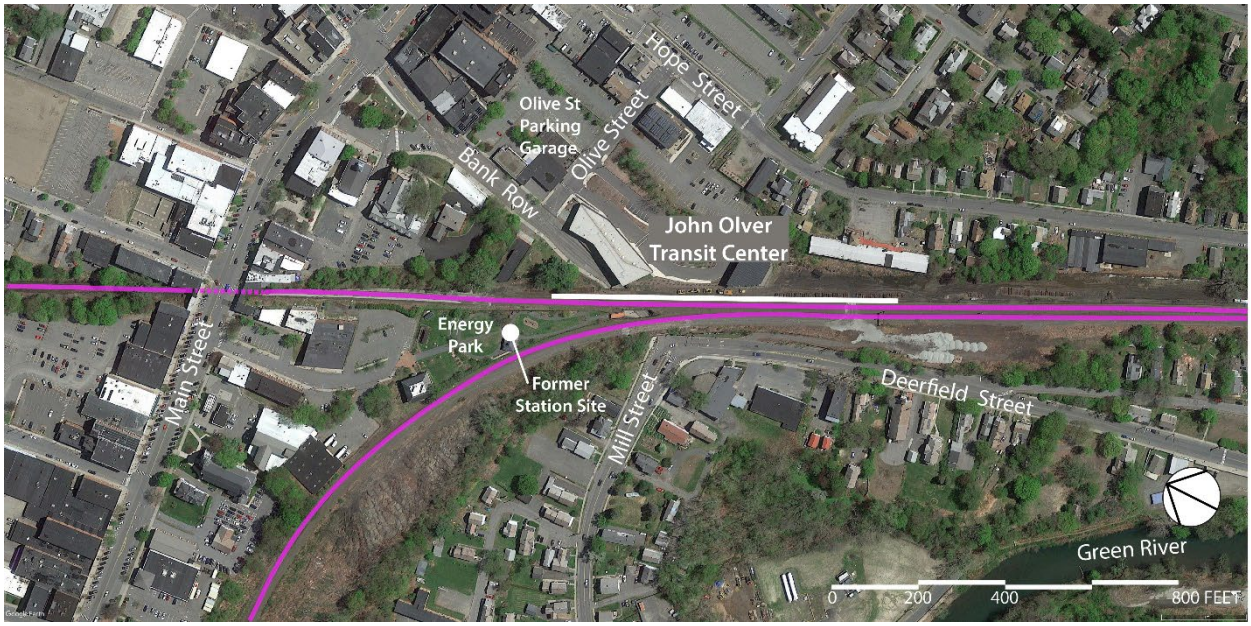
Passenger rail service resumed in Greenfield on December 29, 2014, with the rerouting of Amtrak's Vermonter, with all trains serving the Olver Transit Center. In June 2018, MassDOT announced that Greenfield would become the terminus for an extension of the New Haven–Springfield Shuttle, as a pilot program launched by CTDOT and MassDOT. The new intercity rail service, the Valley Flyer, made its first run on August 30, 2019. It runs twice in each direction on weekdays and once on weekends, to and from Connecticut, with connections to New York City.

Potential Parking
There is a parking lot (approximately 35 spaces) associated with the Greenfield ITC, the Olive Street Parking Garage just to the north, and a public parking lot on Hope Street. Parking access could be provided from Deerfield Street, but the steep topography could make access challenging.

Figure 3.11: Greenfield, MA passenger train station and intermodal

Figure 3.12: Area surrounding Greenfield ITC with rail corridors shown in purple – Google Earth

Figure 3.13: Site of Greenfield ITC with hypothetical 800-foot platform shown in white for scale – Google Earth



Athol

Station Location Access and Area Characteristics

Athol lies along Route 2, which is concurrent with U.S. Route 202 as a limited access highway through town, with its old route, now Route 2A, passing through downtown Athol. Route 2A (Main Street) is the principle east-west roadway access through Athol. Route 2 (also Route 202), the closest highway, is approximately two miles south of the downtown and connects with Daniel Shays Highway to the southwest and with Petersham Road (Route 32) to the southeast.

The former train station is owned by the MART and serves as the Athol Depot ITC for regional bus service through Athol and Orange.

Platform Fit

The rail corridor runs along the area of the historic station and there may be sufficient length along the track between the bridges at Carbon Street and School Street for a 510-foot-long platform.

Nearby Transit Services

The Montachusett Regional Transit Authority (MART) ITC is one block south of Main Street on South Street. The Gardner-Athol Link provides transit services for Athol and the neighboring communities of Phillipston and Templeton to Gardner. Five stops are located along Main Street in Athol. The Athol/Orange Shuttle service provides 12 trips per day each way between the two communities.

The Hannaford Shopping Plaza at the western end of Athol is served by both MART and FRTA and serves as the point of connection between both systems. The FRTA, based in Greenfield, has daily runs from the Plaza to points west while MART, based in Fitchburg, runs to points east. Community transit service buses provide dial-a-ride service for Athol and the nearby towns of Orange and Winchendon for trips to work, medical appointments, shopping, or other errands. There is no intercity bus service to or from Athol.

Potential Parking

There is an approximately 38-space, town-owned parking lot at the corner of Traverse Street and School Street. Additionally, there is a two-level parking facility across Traverse Street from the MART ITC. The upper level is accessed from Traverse Street and could serve as parking.

Figure 3.14: Athol - Area surrounding former station with rail corridor shown in purple– Google Earth

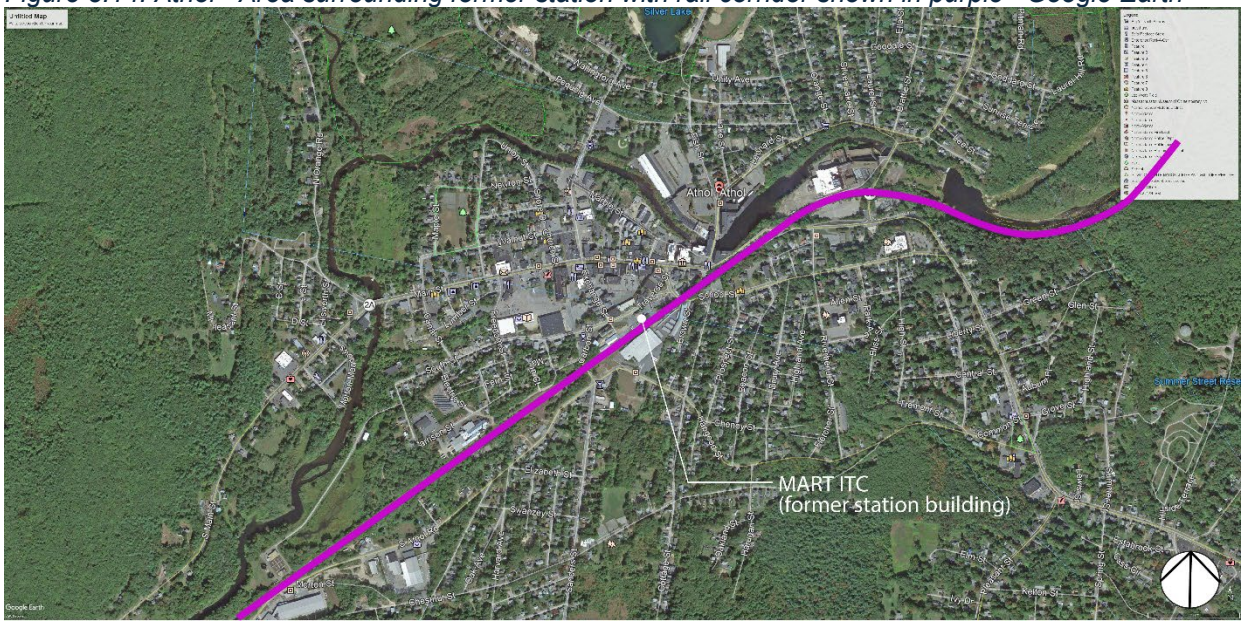
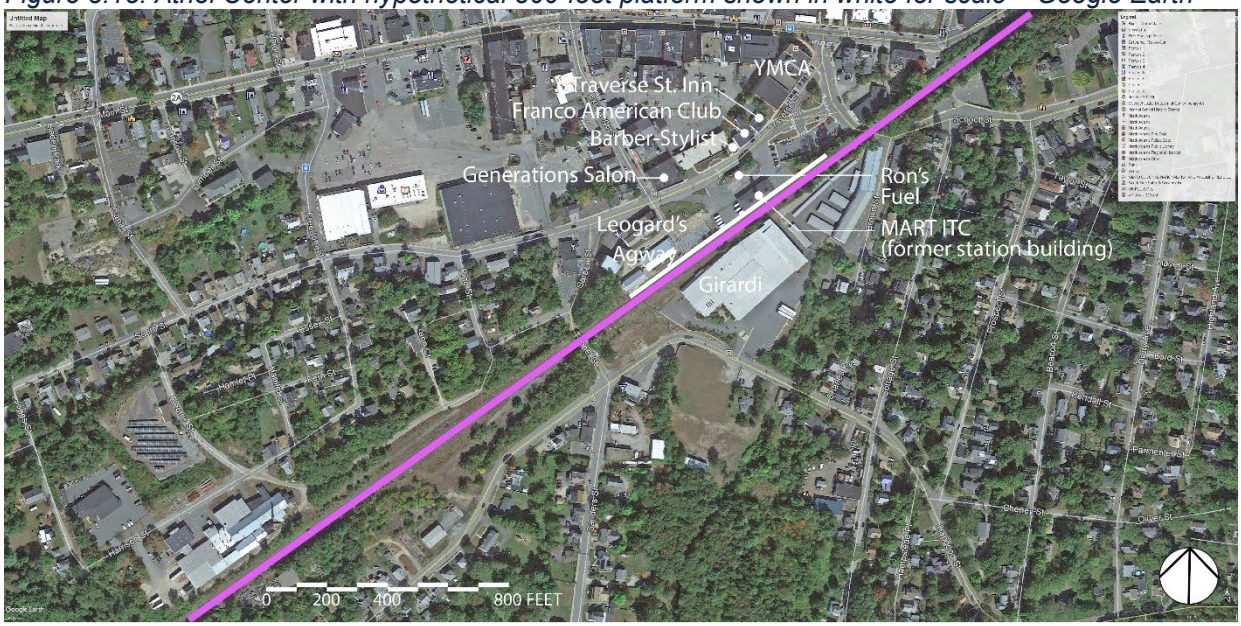


Figure 3.15: Athol Center with hypothetical 800-foot platform shown in white for scale – Google Earth



Gardner

Station Location Access and Area Characteristics

The rail corridor is closely paralleled by Route 2, which passes just south of Gardner's downtown. The downtown can be accessed from Route 2 by two exits on either side of the downtown that are roughly 0.75 miles apart. Approaching Gardner from the west, Exit 86 connects to Route 68, also called Timpany Boulevard and Main Street. From the east, Exit 87 connects to Pearson Boulevard, which links to Main Street via Chestnut Street.

Union Square, the street side of the tracks along Pearson Boulevard, is lined with commercial establishments and restaurants. Properties along the corridor are part of the Downtown Urban Renewal District.

The parking lot on the west side of the former Jade II restaurant is the location of the original Union Station.

Platform Fit

The track running between Pearson Boulevard-Chestnut Street and Route 2 provides an opportunity for a 510-foot platform. To the east, the tracks pass over Pearson Boulevard, and to the west, sidings turn off the main line toward the north. One of these sidings passes just south of the MART maintenance facility.

Nearby Transit Services

Gardner is served by MART operating local fixed-route bus services and shuttle services, as well as paratransit services. Both the MART Gardner Route 1 and Route 2 bus service currently stop at Gardner Plaza and the MART Intermodal Transportation Center. The parcel which contains the MART Intermodal Facility, is owned by MART and abuts the rail corridor. MART also runs the Wachusett Shuttle service from Gardner City Hall and the MART Maintenance Facility to the MBTA Wachusett Station and Fitchburg Intermodal Transportation Center, with commuter rail connections to Boston.

Potential Parking

There is no public parking immediately adjacent to the rail corridor, although there is a small lot between the former D'Angelo's Restaurant and the Tender Heart Animal Hospital which may have potential for parking.

Figure 3.16: Gardner, MA freight railroad yard – Google Earth

Figure 3.17: Gardner Center area with rail corridor highlighted in purple, parallel to Route 2. The Montachusett Regional Transit Authority (MART) facility is adjacent to the former station location - Google Earth

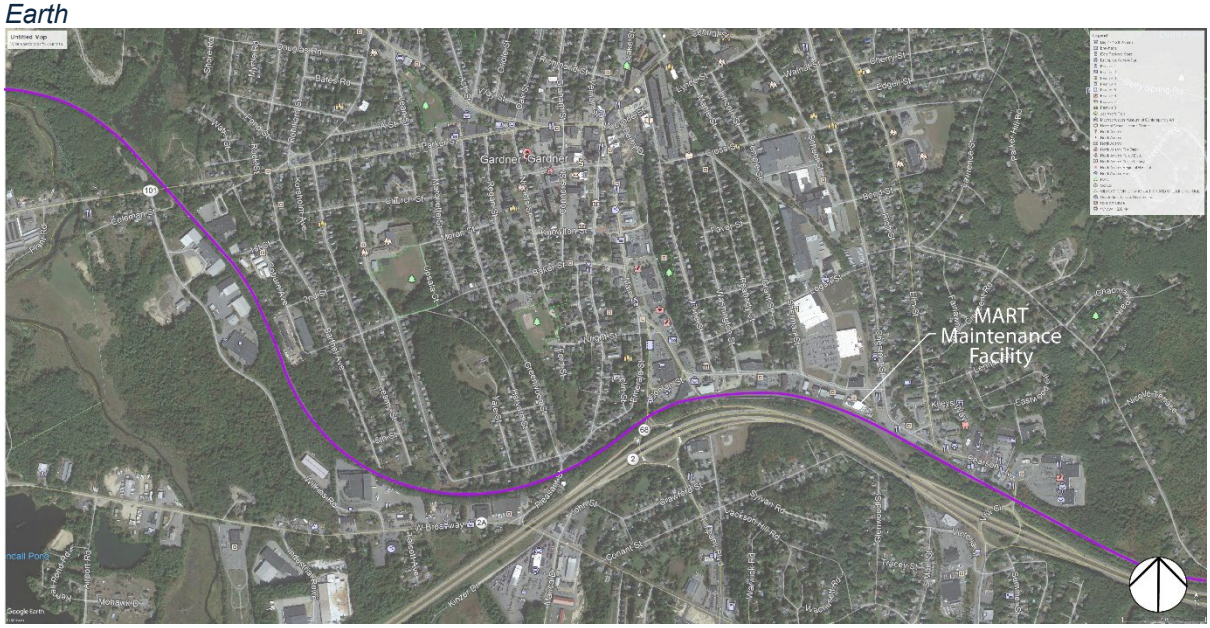
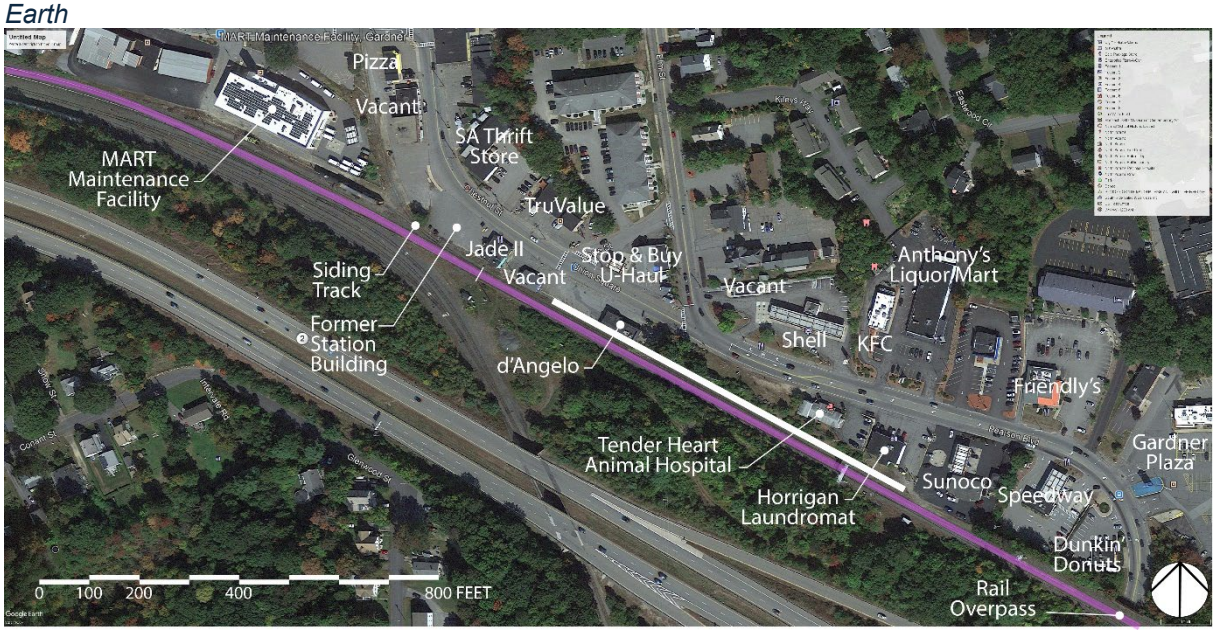


Figure 3.18: Gardner Station area with hypothetical 800-foot platform is shown in white for scale - Google Earth



Environmental Review

Existing environmental constraints within and adjacent to the Northern Tier route were identified using mapping tools such as the MassGIS MassMapper and the U.S. Environmental Protection Agency (U.S. EPA) Environmental Justice (EJ) Screen.

The corridor traverses several natural, built, and social resources including wetlands and waterways; FEMA designated floodplains; designated open space and recreational parklands; National Register listed historic districts and properties; state designated Areas of Critical Environmental Concern (ACEC); and 2020 EJ Census block groups. Detailed mapping of these resource areas and demographic groups is provided in the Appendix**.** A description of each figure is provided in Table 3.1 below, with the corresponding regulatory review and permitting requirement**.** Potential regulatory review and permitting requirements are based on anticipated funding sources, scope of work and proximity of sensitive environmental resources and demographic groups to the Northern Tier route. The complexity and duration of the agency review and approval process will be determined by the extent of unavoidable impacts associated with the proposed action.

Table 3.1: Potential Regulatory Review and Permitting Requirements for the Northern Tier Corridor

Regulation	Trigger	Jurisdictional Agency	Project Considerations	Mapping
Federal				
National Environmental Policy Act (NEPA)	Any federal agency action (including federal permitting or financial assistance).	Lead federal agency	The lead federal agency is responsible for determining the appropriate NEPA Class of Action (Categorical Exclusion, Environmental Assessment, or Environmental Impact Statement) based on the significance of environmental impacts.	N/A
Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800)	Any federal agency action with the potential to affect historic properties that are listed or are eligible for listing in the National Register of Historic Places.	State Historic Preservation Officer (SHPO)	The Advisory Council on Historic Preservation (ACHP) exempts certain undertakings from standard Section 106 review for any project that occurs entirely within the existing railroad ROW.	Appendix A Figure 6 depicts historic properties and districts available through MACRIS adjacent to the Northern Tier Corridor. Areas with a high concentration of historic properties occur near Williamstown and North Adams (Sheet A), Charlemont, Shelburne, and Greenfield (Sheet B), Montague and Orange (Sheet C), Athol and Fitchburg (Sheet D), Shirley (Sheet E), Weston and Waltham (Sheet F), and Belmont, Somerville, Cambridge and Boston (Sheet G).
Section 4(f) of the Department of Transportation Act of 1966 (23 CFR 774)	Any temporary occupancy or "use" [1] of significant publicly owned park, recreational area, wildlife, or waterfowl refuge or any publicly or privately-owned historic sites that are listed or eligible for	Lead federal agency and officials with jurisdiction over the subject parcel(s)	The lead federal agency and officials with jurisdiction cannot approve the "use" of land from any jurisdictional property unless there is no feasible avoidance alternative to the use of land, and the action includes all possible planning to minimize harm to the property resulting from such use.	The location of publicly owned and accessible recreational parcels that may be subject to 4(f) jurisdiction are identified in Appendix A Figure 5. Historic properties (available through MACRIS) adjacent to the Northern Tier Route are depicted in Appendix A Figure 6.

	listing on the National Register of Historic Places.			
Section 7 of the U.S. Endangered Species Act	Any federal agency action with the potential to affect federally protected threatened and endangered species (as defined by 50 CFR § 17.3).	U.S. Fish and Wildlife Service and National Marine Fisheries Service (NMFS)	The level of consultation required with USFWS and/or the NMFS will be determined based on the potential for the project to cause adverse effects to any federally listed species.	The presence of federally protected species and their habitats will be identified through a survey of the proposed Northern Tier Route using the USFWS IPAC tool.
Section 404 of the Clean Water Act (33 USC 1344)	Required for any discharge of dredged or fill materials to Waters of the United States[2]	U.S. Army Corps of Engineers	The need for Section 404 authorization will be determined once the preferred alternative has been established. All impacts to waters of the U.S.should be avoided and/or minimized to the maximum extent practicable.	Wetland resource areas adjacent to the Northern Tier Route are depicted in Appendix A Figure 2.

Section 9 of the U.S. Rivers and Harbors Act of 1899	Required for any proposed construction or modification of a bridge or causeway over a navigable water of the U.S. (as defined by 33 CFR 32.9)	U.S. Coast Guard (USCG)	The presence of "navigable waterways" intercepting the Northern Tier Route requiring authorization from the USCG will be determined through review of their consistency with the navigability criteria.	Waterways intercepting the Northern Tier Route are depicted in Appendix A Figure 4.
State				
Massachusetts Environmental Policy Act (MEPA) (301 CMR 11.00)	Any state agency action (including state permitting, financial assistance or land disposition) that triggers a MEPA review threshold pursuant to 301 CMR 11.03.	Massachusetts Environmental Policy Act Office	Effective January 1, 2022, any project within a Designated Geographic Area (as defined by 301 CMR 11.02) that triggers any of the MEPA review thresholds (301 CMR 11.03) is required to file an EIR with the MEPA Office.	Environmental justice populations[3] adjacent to the Northern Tier route are depicted in Appendix A Figure 1.
			The Northern Tier Route traverses state designated ACECs. Any work within an ACEC that does not meet the exemption criteria (301 CMR 11.03(2)b.3.) will trigger the MEPA review threshold at 301 CMR 11.03(11)b.	State designated ACECs adjacent to the corridor are depicted in Appendix A Figure 4. The Northern Tier Route passes through the Squannassit and Petapawags ACECs in Shirley, and Groton, respectively (Sheet E).
Massachusetts Wetlands Protection Act (WPA) (310 CMR 10.00)	Impacts to wetland resource areas specified	Municipal Conservation Commissions	The need for WPA authorization will be determined once the preferred alternative has been established.	Wetland resource areas adjacent to the Northern Tier Route are depicted in Appendix A Figure 2.

	under 310 CMR 10.02.		All impacts to jurisdictional wetland resource areas should be avoided and/or minimized to the maximum extent practicable.	Federal Emergency Management Agency (FEMA) delineated floodplains are depicted in Appendix A Figure 3. The Northern Tier Route does not pass through any mapped floodplain between North Adams and Leominster (Sheets A through E).
M.G.L. Chapter 91 – The Massachusetts Public Waterfront Act (310 CMR 9.00)	Work activity within, under or over flowed tidelands, filled tidelands, great ponds and certain non-tidal rivers and streams within the Commonwealth.	Massachusetts Department of Environmental Protection (MassDEP)	The applicable MassDEP authorization (minor modification concurrence, waterways license or waterways permit) will be determined by the proposed nature of work within Chapter 91 jurisdictional areas.	The jurisdictional limits of historically filled tidelands near the Northern Tier Route are depicted in Appendix A Figure 4, Sheet G.
Section 401 Water Quality Certification Program (314 CMR 9.00)	Required for any proposed discharges of dredged or fill material to Waters of the U.S. within the Commonwealth as defined in 314 CMR 9.02.	MassDEP	The need for Section 401 Water Quality Certification will be determined based on the extent and location of unavoidable impacts to jurisdictional wetland resource areas.	Wetland resource areas adjacent to the Northern Tier Corridor are depicted in Appendix A Figure 2. Outstanding resource waters adjacent to the Route are depicted in Appendix A Figure 4.
Massachusetts Endangered Species Act (321 CMR 10.00)	Required for any state agency action that may have the potential to affect protected rare species and their habitats as defined by 321 CMR 10.02.	Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program (NHESP)	The level of consultation with NHESP or need for a Conservation Management Permit (CMP) will be determined based on the nature of proposed work within NHESP Priority and estimated habitat (as defined in 321 CMR 10.02) and potential for a "take" [4] of a state-listed species.	Mapped NHESP estimated and priority habitats adjacent to the Northern Tier Route are depicted in Appendix A Figure 4.

Article 97 of the Amendments to the Constitution of the Commonwealth	Any transfer or conveyance of ownership or other interests, any change in legal control, or change in use to Article 97 land[5] or interests in Article 97 land.	Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA)	EOEEA and its agencies shall not support an Article 97 Land Disposition unless all other options to avoid the disposition have been explored and no feasible and substantially equivalent alternatives exist. An Article 97 Land Disposition requires the support of a two-thirds vote of the state legislature.	The location of Article 97 protected parcels, as identified by the MassGIS "open space" data layer, are depicted in Appendix A Figure 5.

Regional Demographics and Trends

This section provides an overview of regional trends impacting travel demand, such as population dynamics, economic development activity, and transportation levels of service across modes.

Population

According to the 2020 U.S. Census, the Northern Tier corridor communities are home to 1,751,000 people, which represents approximately 25% of the total population in Massachusetts. The East segment communities are home to 1,408,000 people, 80% of the corridor population. The Central and West segment communities have total populations of 237,000 and 106,000, respectively. The East segment has experienced high population growth in recent years, while the Central and West segments have experienced lower growth or decline, as shown in Figure 3.19. Figure 3.19 shows that the West segment is projected to experience population decline and the Central segment is estimated to see modest growth (1 percent) through 2040.

The East segment saw nine percent growth in population between 2010 and 2020, as compared to five percent growth in the Central segment and a decline of two percent in the West. This disparity in growth rates further exacerbated the differences in population size, with the East segment making up roughly 80% of the population of the corridor, the Central segment 14%, and the West segment six percent.

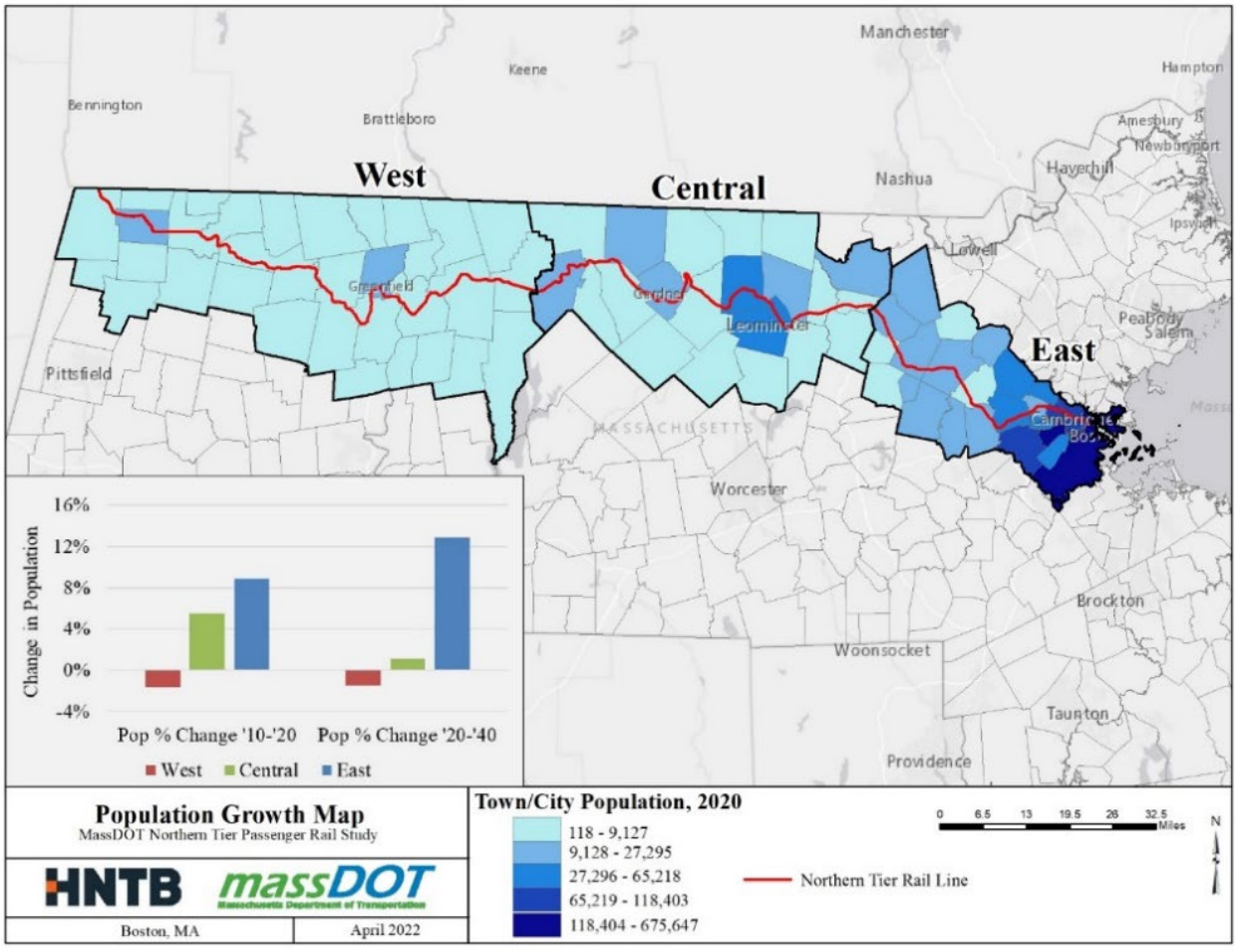
The variations in population growth are reflective of complementary trends, where total jobs and real estate values in the East segment are large and growing while these indicators are steady or in decline further west. If these trends continue, more households may be pushed further out into the west by increasing housing costs, but anchored to the Boston region through the employment and services it offers.

Based on current trends, eastern Massachusetts is poised to continue driving overall statewide growth while the rest of the state lags. Figure 3.19 shows how population density is higher closer to Boston, with lower population density in the Central and West segments. Figure 2 also shows that the West segment is projected to experience population decline and modest growth is projected in the Central segment (one percent) through 2040.

This regional disparity in growth is largely driven by the aging populations outside of the I-495 area. Eastern Massachusetts, with its institutions of higher education, large employment base, and numerous amenities has a much higher proportion of working-age residents (34%) compared to the West (22%) and Central (25%) portions of the corridor. Conversely, the West and Central segments both have higher proportions of older workers, approximately 30% of their populations in the 45 – 64-year age group compared to 23% in the East segment.

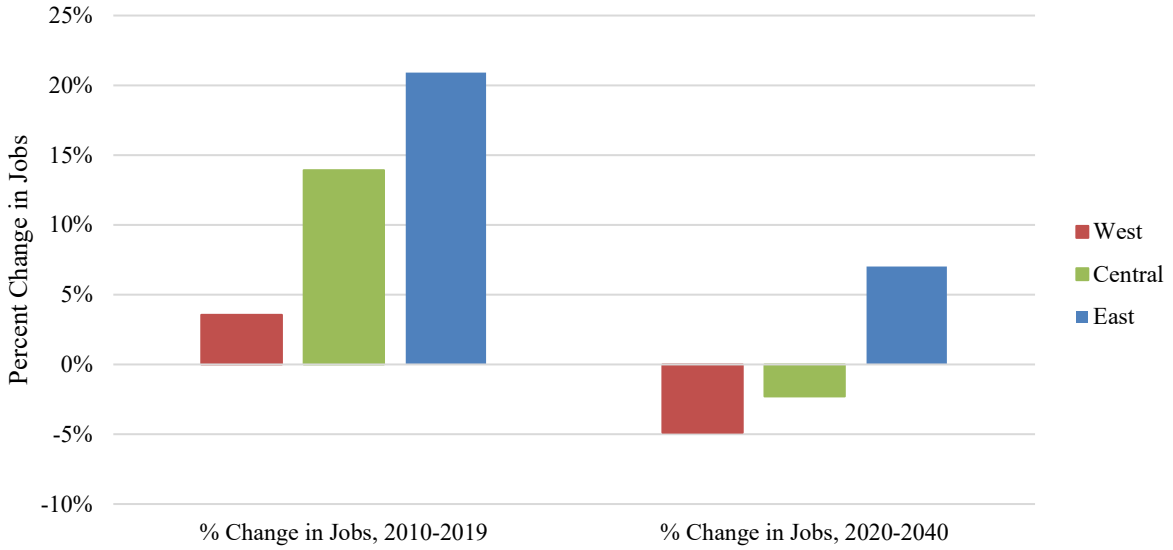
This regional dynamic – with more working-age and young people in the East segment and more older workers and seniors in the Central and West segments – is a primary factor driving overall population and employment trends in the respective regions. The aging population leaving the workforce in the Central and West segments is projected to contribute to a two percent decline in overall jobs in the Central segment and a five percent decline in the West segment, while jobs are projected to increase by seven percent in the East segment (Figure 3.20).

Figure 3.19: Population Growth Map within the Northern Tier Corridor



Source: American Community Survey and UMass Donahue Institute Projections

Figure 3.20: Projected Change in Jobs by Segment



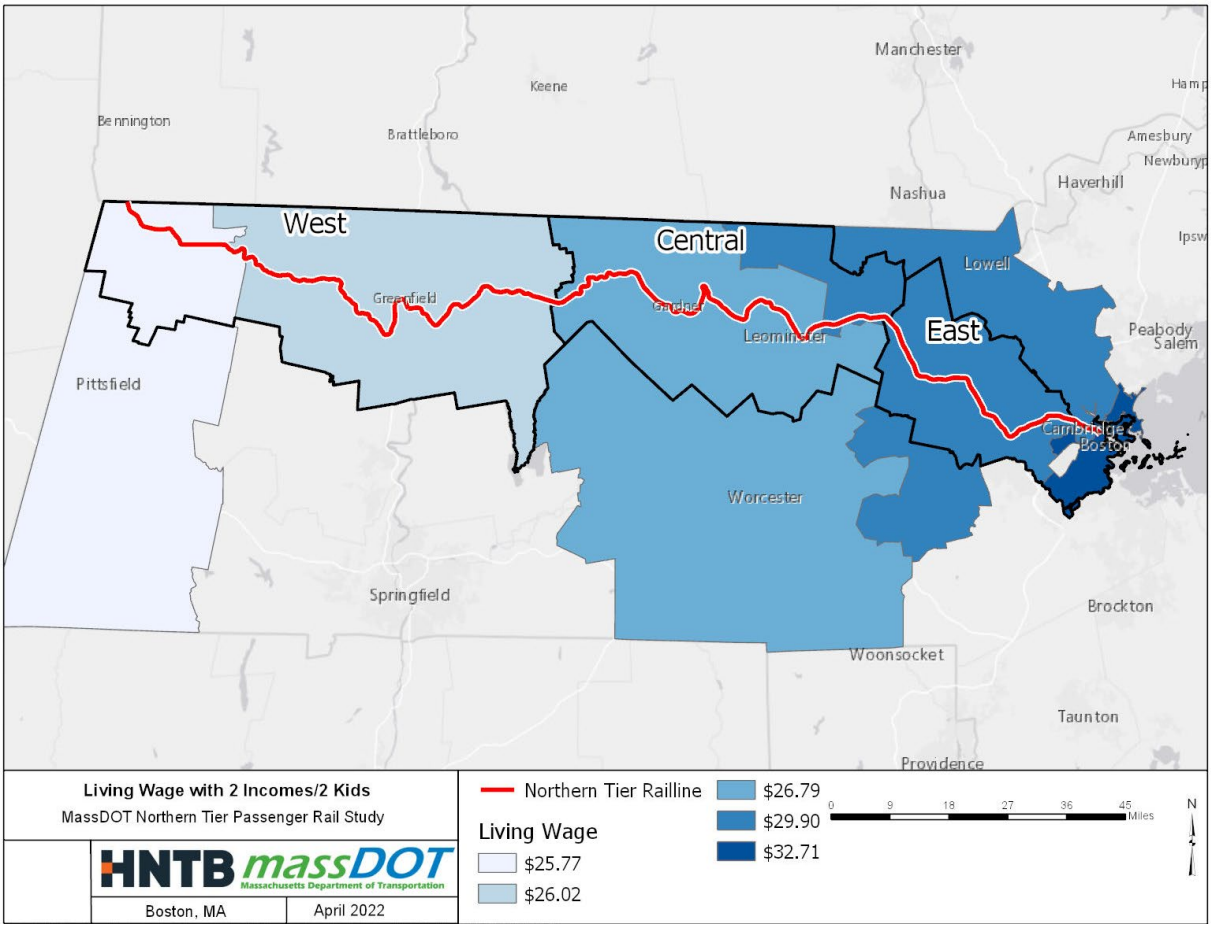
Source: UMass Donahue Institute Projections

However, there is some evidence that the high cost of housing may have begun to dampen growth in large cities shortly before the pandemic, slowing the population boom after the 2008 – 2009 recession. The Brookings Institution noted that in 2018, New York, Los Angeles, and Chicago all lost population, while at the same time rural areas grew – albeit modestly – after several years of losses.[9] This could be driven by the cost of living in these major urban areas, which can act as a drag on the relatively higher wages offered there. Indeed, the cost of living in Suffolk County is 27% higher than Berkshire County, 26% higher than Franklin County, and 22% higher than Worcester County. Though it should be noted that the 2010 – 2020 population change in large cities was robust despite the more recent slowing.

Without major intervention or a disruption in current trends, pressure will continue to rise on the Boston region to provide housing for these projected new jobs. Suburban communities, such as Framingham, Plymouth, Chelsea, Lowell, and Burlington, will continue housing growing numbers of Boston-based workers commuting into the city – in addition to Boston itself.

[9] Pew Research Center, The Future of World Religions: Population Growth Projections, 2010 – 2050, 2015.

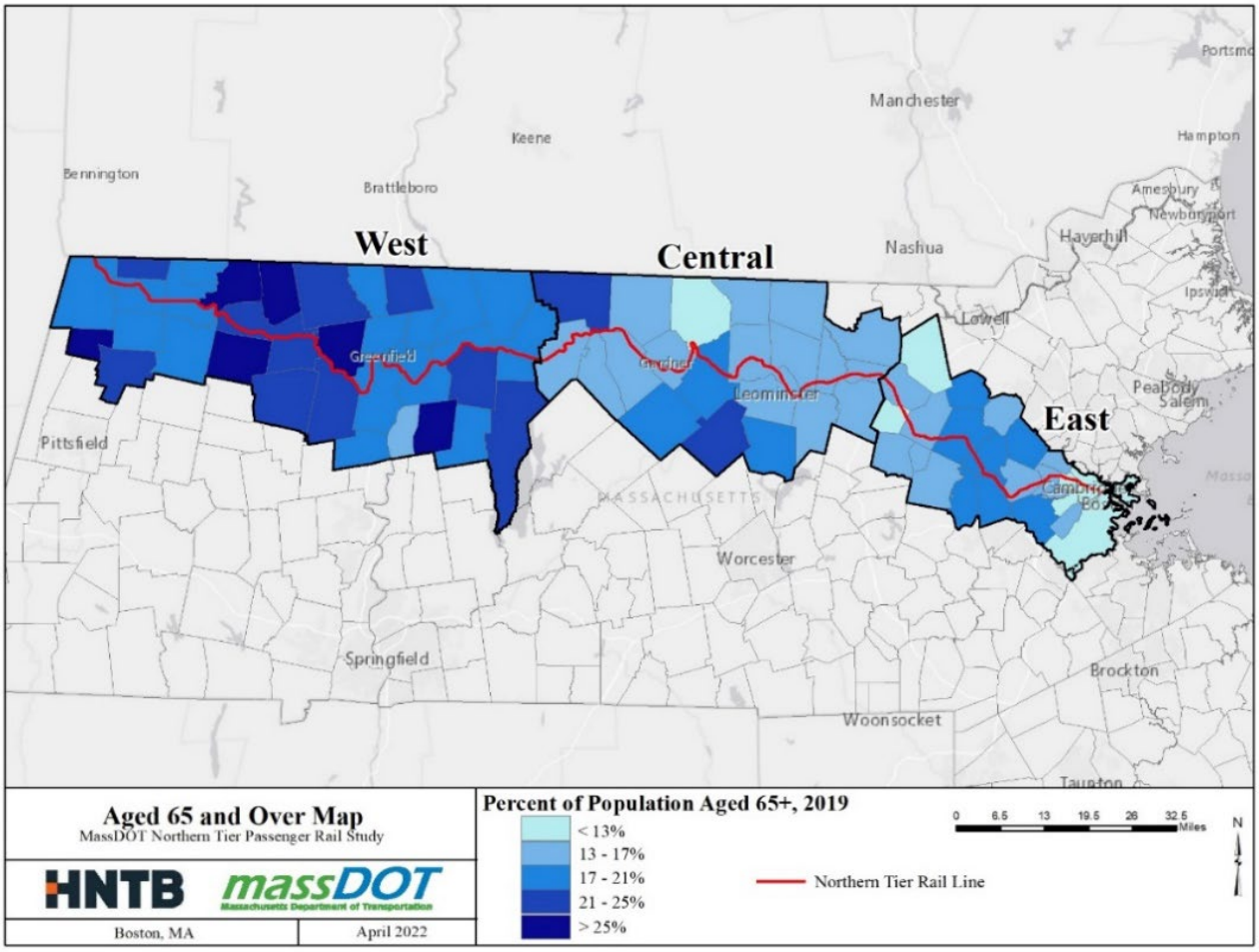
Figure 3.21: Living Wage by County



Source: Living Wage Calculator

Eastern Massachusetts has a higher proportion of working-age residents (34%) compared to the West (22%) and Central (25%) portions of the corridor due in part to the number of higher education institutions in the area and its large employment base. Conversely, the West and Central segments have higher proportions of older workers, approximately 30 percent of their populations in the 45 – 64-year group compared to 23% in the East segment.

Figure 3.22: Percentage of Population Aged 65 and Over within the Northern Tier Corridor



Source: American Community Survey

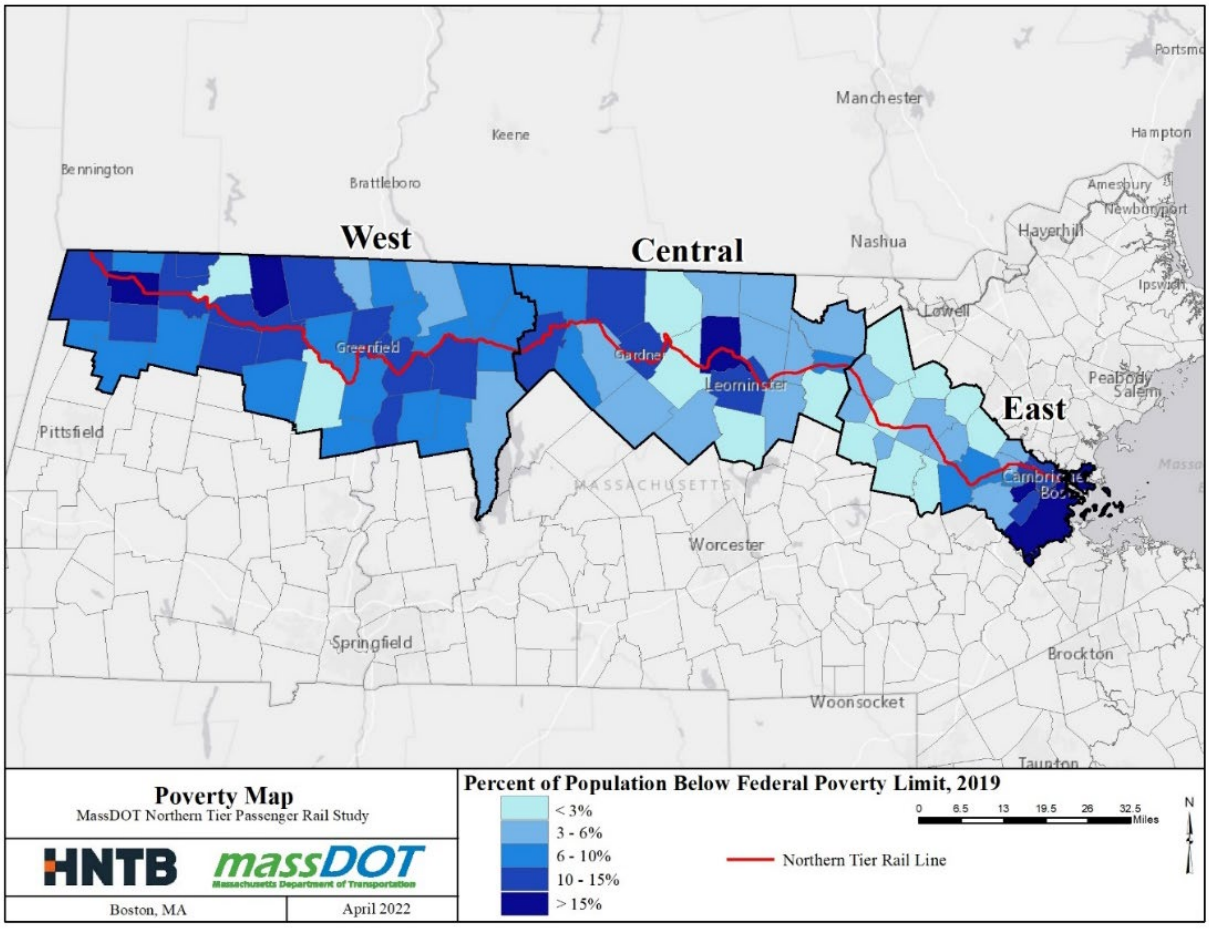
Environmental Justice

At 20%, the East segment has the highest proportion of households earning above $200,000 per year. The West segment, at nearly 25%, has the highest proportion of households earning within the $10,000 to $35,000 bracket.[10] All three segments have three to seven percent of households earning less than $10,000 per year.

The share of households making over $200,000 in the East segment is more than twice as high as the Central segment and four times as much as the West segment. Further, almost half of all households in the East segment earn more than $100,000 annually which could be attributed to the Boston suburbs of Lexington, Lincoln, Concord, and Acton. Figure 3.23 shows the percentage of population below the poverty level across the corridor in 2019.

[10] Depending on household size, many of those households would fall below the poverty line.

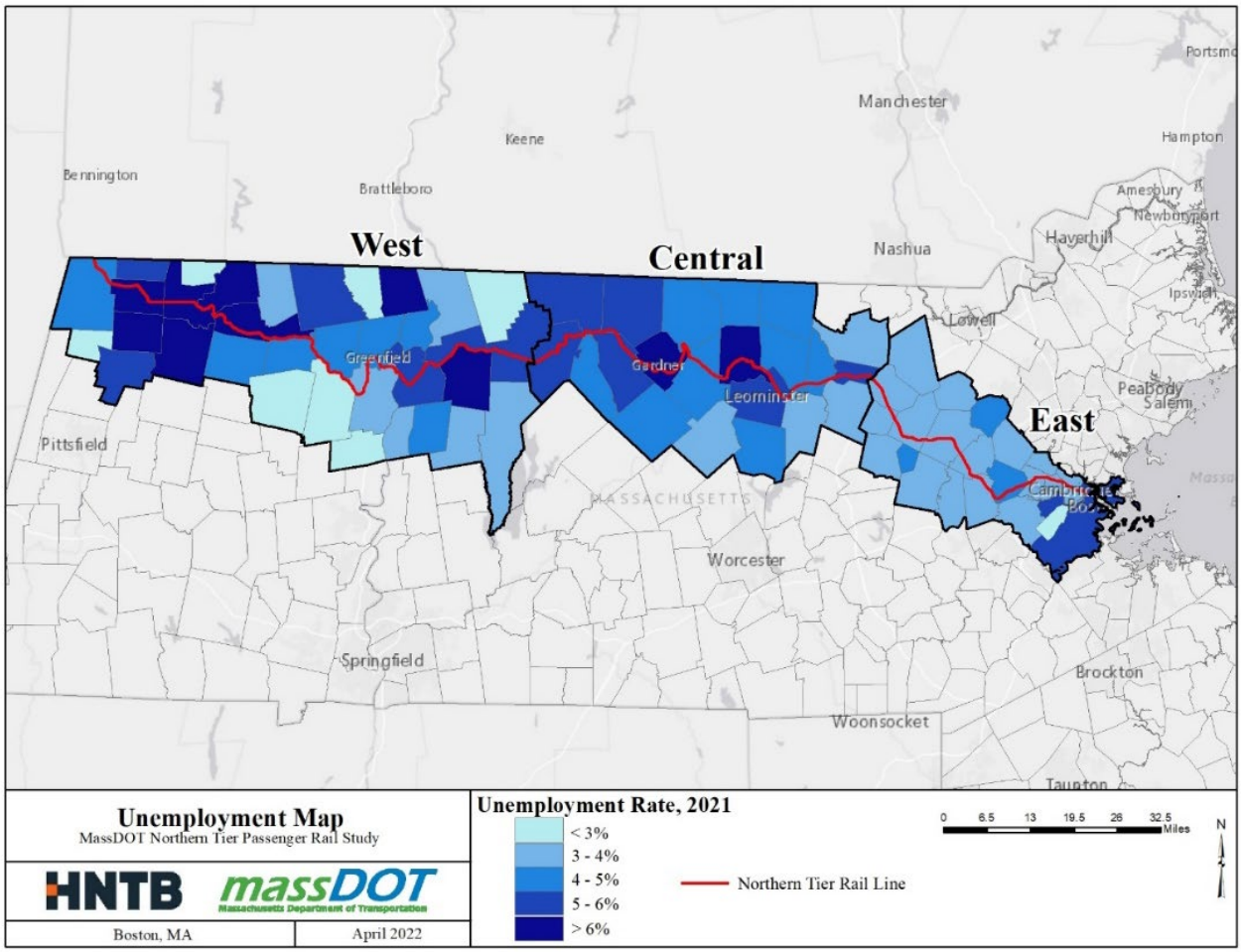
Figure 3.23: Percentage of Population Below Federal Poverty Limit within the Northern Tier Corridor



Source: American Community Survey

In 2021, the statewide average unemployment was 5.7%, similar to the unemployment rate in the West segment. During this timeframe, the unemployment rate in the East segment was 4.9% and was 6.1% in the Central segment (Figure 3.24).

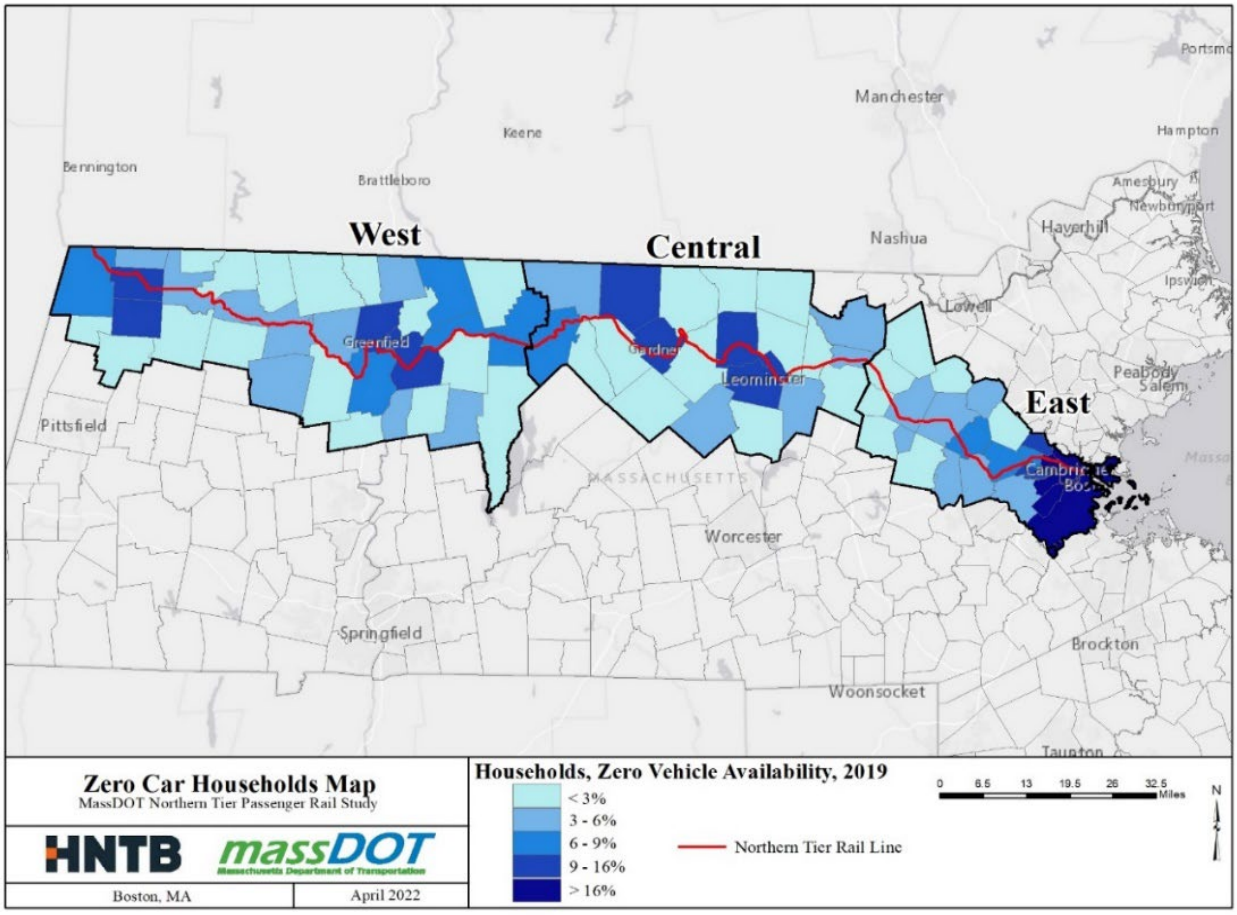
Figure 3.24: Unemployment Rates within the Northern Tier Corridor



Source: American Community Survey

The East segment of the Northern Tier corridor has higher rates of zero-car households than either the Central or West segments, shown in Figure 3.25. This difference is largely driven by the town of Brookline and the cities of Boston, Cambridge, and Somerville, and could be attributed to the large numbers of students, high population density, significant parking constraints, and comprehensive public transit services in these and other nearby areas. While overall low levels of zero-car households in both the Central and West segments may reflect low-density land use and a lack of reliable and frequent public transportation service, a lack of vehicle ownership was identified in communities along the corridor, including Fitchburg, Gardner, and North Adams.

Figure 3.25: Zero-Car Households within the Northern Tier Corridor



Source: American Community Survey

Economic Development and Related Factors

Between 2010 and 2019, the East segment experienced employment growth of 20% while Central and West saw growth rates of 14% and four percent, respectively. About two-thirds of the jobs in Massachusetts are not in the Northern Tier corridor. Together, the Central and West segments comprise between three and four percent of all Massachusetts jobs.

The cost of living in Suffolk County is 27% higher than Berkshire County, 26% higher than Franklin County, and 22% higher than Worcester County. An analysis of Massachusetts Association of Realtors data on 2021 single family and condominium home sales shows higher home values along the stretch of the Northern Tier corridor between Boston and I-495 as compared to further west.

Tourism Trends and Major Attractions

Tourist attractions are located across the corridor, including educational, healthcare, and other significant activity centers. Major activity centers in the Central segment include: Wachusett Mountain & Reservation, Great Wolf Lodge, Devens, Fitchburg State University, and the University of Massachusetts Memorial Health Alliance Clinton Hospital. Activity centers in the West segment include Franklin County Fairgrounds, Baystate Franklin Medical Center, Massachusetts Museum of Contemporary Art, Clark Art Institute, and the Berkshire East Mountain Resort.

Major activity centers in the East segment include:

- Boston-area medical facilities (e.g., Massachusetts General Hospital)
- Sports facilities (e.g., TD Garden, Fenway Park)
- Higher educational institutions (e.g., UMass-Boston)
- Large employers (e.g., state government)
- Tourism destinations (e.g., the Freedom Trail, Faneuil Hall)
- Recreational facilities (e.g., the Minuteman Trail)

Travel Patterns

Community-level travel patterns for Northern Tier communities throughout the Commonwealth were assessed using StreetLight Location-Based Services (LBS) data. Aggregations of this travel data are reported for the three segments along with the remainder of the Commonwealth in Table 3.2 and Table 3.3. Compared to 2019, travel volumes were lower in 2021, likely due to the COVID-19 pandemic and the resulting increase in work from home, remote learning, telemedicine, etc.

Table 3.2: StreetLight 2019 Average Daily Trips - All Modes by Segment

		Destination				
	Segment	**West**	**Central**	**East**	**Other**	**Total**
Origin	**West**	198,804	6,844	359	30,217	236,224
	Central	7,322	484,122	23,765	66,194	581,403
	East	360	24,448	3,004,703	830,564	3,860,075
	Other	31,156	66,893	815,621	13,771,833	14,685,503
	Total	237,642	582,307	3,844,448	14,698,808	19,363,205

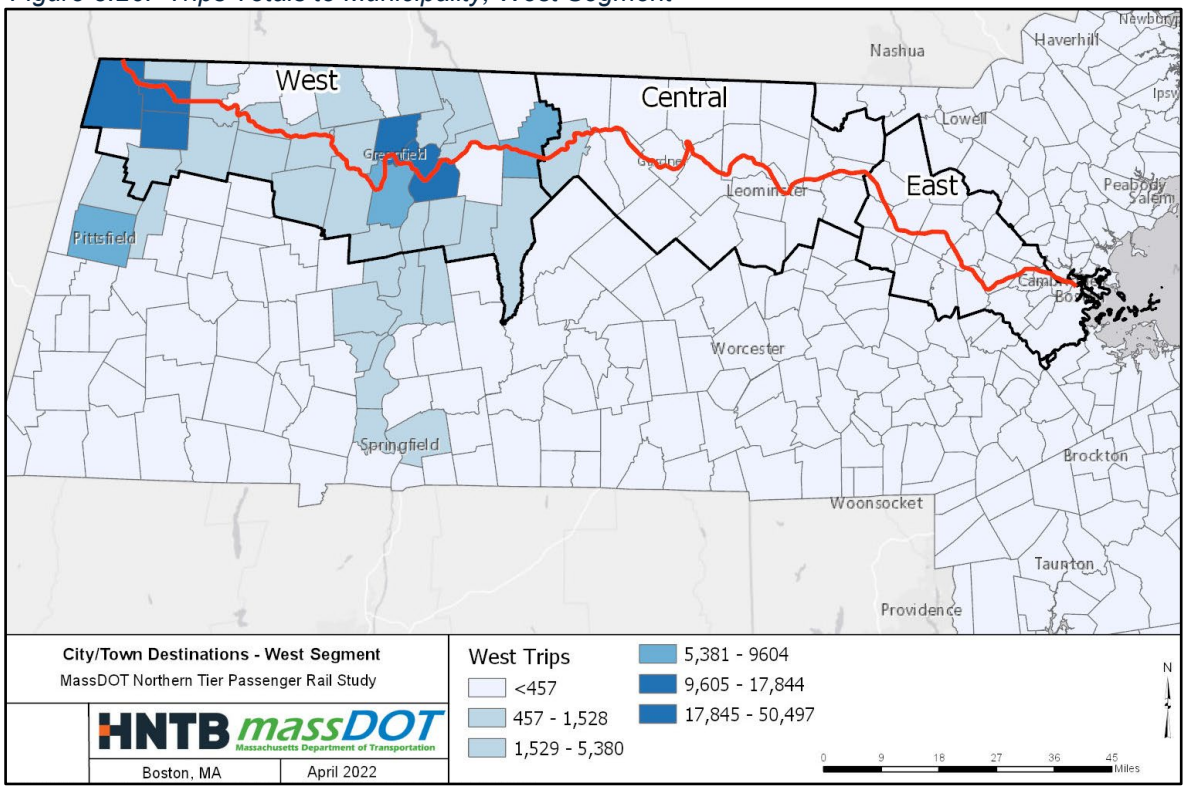
Table 3.3: StreetLight 2021 Average Daily Trips and Percent Change – All Modes by Segment

		Destination					
		West	**Central**	**East**	**Other**	**Total**	**2019 to 2021 Change**
Origin	**West**	156,553	5,113	326	28,425	190,417	-19%
	Central	5,476	383,284	20,658	58,085	467,503	-20%
	East	343	21,394	2,079,638	598,124	2,699,499	-30%
	Other	29,674	59,849	579,870	10,998,734	11,668,127	-21%
	Total	192,046	469,640	2,680,492	11,683,368	15,025,546	-22%

The majority of daily trips stay within the segment of the Northern Tier corridor from which they originate: 82% for West and Central segments and 77% for East. Trip levels decrease as they travel farther away from their origin. The East segment shows a strong orientation toward communities in and around Boston. The Central segment shows Fitchburg, Leominster, and Gardner as the top three destinations for trips originating in the segment. The West segment has a strong north-south orientation for trips, suggesting that many people living in the region travel to

Pittsfield and Springfield for work, medical care, or other trip purposes. Figure 3.26 shows trip destinations originating from the West segment.

Figure 3.26: Trips Totals to Municipality, West Segment



Source: StreetLight

Work Trips in the Corridor

The majority of total trips stay within the individual segment for the Central and West segments. The data demonstrates that the East segment has more daily work trips than the Central or West segments and, while the East captures considerable numbers of work trips from the Central segment and some from the West, there is very little commuting traffic from the East into the other two segments. Table 3.4 shows that while the majority of total trips stay within the individual segment for the Central and West segments, trips that move between segments are more likely to be for work.

Table 3.4: Work Trip Proportion by Segment (2019)

		Destination				
		West	**Central**	**East**	**Other**	**Total**
Origin	**West**	16%	22%	95%	53%	21%
	Central	17%	12%	63%	47%	19%
	East	15%	13%	18%	16%	17%
	Other	21%	27%	57%	14%	17%
	Total	17%	14%	26%	14%	17%

Source: American Community Survey and StreetLight

Trip Mode Share in the Corridor

Mode share is the relative percentage of users of each mode of transportation, i.e., automobile, walk, bus, rail. Mode share data is developed from the American Community Survey and is based on work trips.

West of I-495, travel in the corridor is predominantly by motor vehicle use. In the West segment of the corridor (Franklin and north Berkshire Counties), 85% of work trips are taken by car. In the Central segment (I-495 to Athol/Orange), 92% of work trips are taken by car. In contrast, the East segment (inside I-495) has 64% of its work trips taken by car; the remainder of trips are split between active transportation, transit, and working from home. The West and Central segments both have higher levels of automobile use than the state average (at 85% and 92%, respectively versus the state average of 84%). The proportion of auto use in the West segment is only slightly higher than statewide averages. The Central segment has the highest level of auto use at 92%.

There is variation in communities' mode shares in the western part of the corridor. North Adams has the lowest auto mode usage at 82%, while Athol has the highest at 92%. Both are higher than the Greater Boston Area, which has an auto share of just under 70%. These variations, similar to overall segment trends, are likely a result of the number of transportation options, the size of the working age population, and household income distributions. Local regional transit authority service provides a small share of overall trips (less than two percent).

Auto Travel Patterns

Current travel conditions for the corridor were assessed using INRIX (location-based data and analytics) travel data. The average daily travel times to urban centers along the corridor were estimated, including average and morning peak travel times. These travel times are benchmarks for comparison with potential rail service along the Northern Tier corridor.

Preferred travel routes (defined as 80% or higher) by car between different origin-destination pairs were also analyzed. The top route for each of the origins (North Adams, Greenfield, Orange/Athol, Fitchburg/Leominster) to Boston/Cambridge is the Route 2 corridor, with a much smaller proportion of travel going along the I-90 (the Massachusetts Turnpike, or Mass Pike). The average travel time by automobile between Boston and North Adams is 2.5 hours using Route 2. The Fitchburg Commuter Rail Line scheduled travel time between the two stations is 1 hour, 37 minutes.

Figure 3.27: Daily North Adams to Boston Travel Patterns

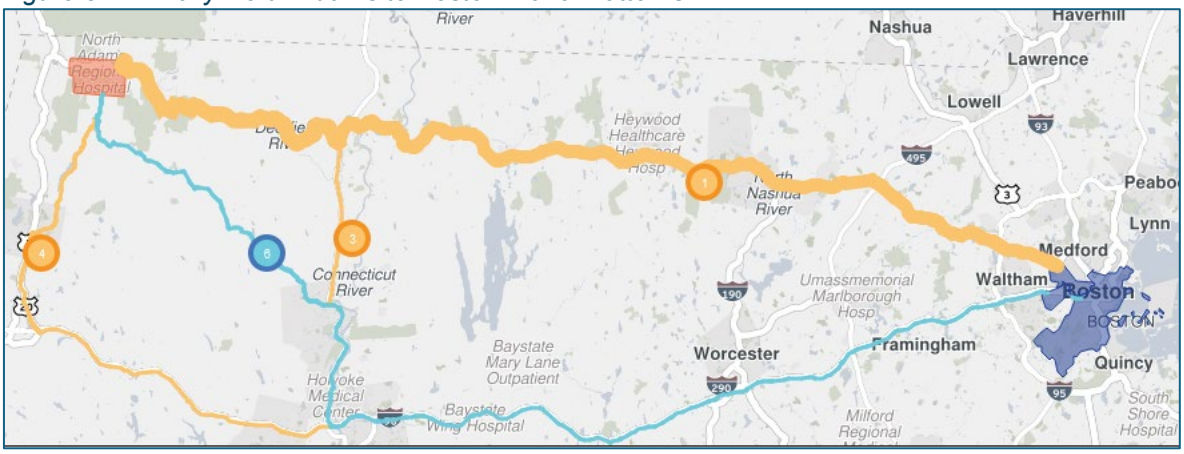


Table 3.5: North Adams to Boston Route Choice

Route	Percent Trips	Length (mi)	Travel Time	Avg TT	Min TT	Max TT	Reliability*
1	80%	120	2:31:10	2:34:37	1:58:20	3:30:42	1.12
3	8%	149.26	2:42:25	2:45:23	2:12:50	3:33:42	1.08
4	7%	147.81	2:46:10	2:46:45	2:29:49	3:13:16	1.02
6	5%	138.62	2:39:39	2:48:12	2:26:44	3:15:43	1.22

*Reliability is calculated as the ratio of the 80th percentile travel time to the 50th percentile travel time
Source: INRIX Data

Approximately 80% of trips along the full corridor use Route 2 and is consistently the fastest route, which attributes to its reliability.[11]
Closer to Boston, trips along the corridor also divert from Route 2. The diversion is due to congestion or the location of the driver's final destination.

Figure 3.28: Daily and AM Peak Fitchburg/Leominster to Boston Travel Patterns

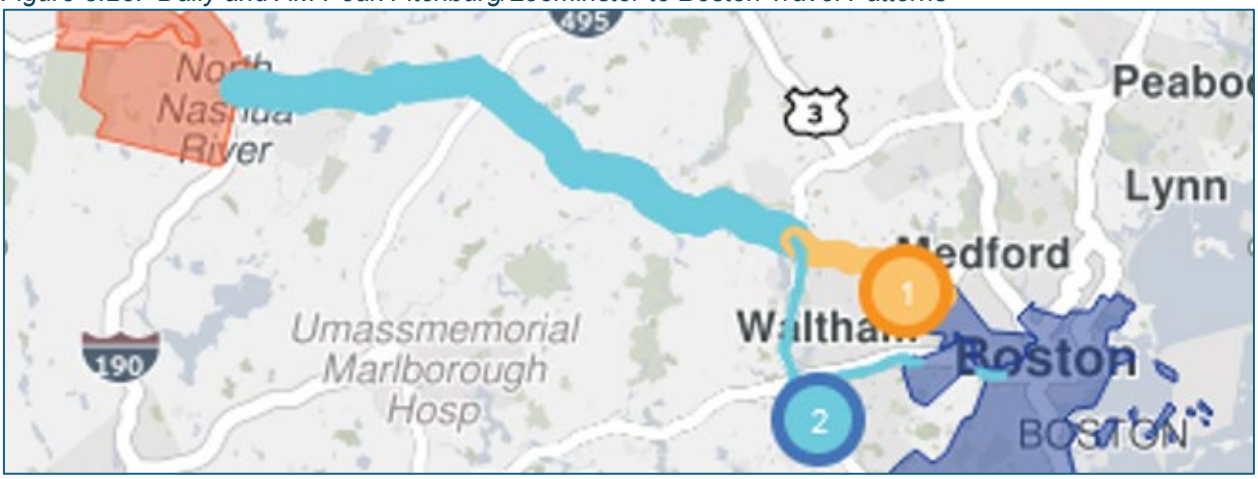


Table 3.6: Daily Travel Data and AM Peak Travel Data

Daily Travel Data							
Route	Percent Trips	Length	Travel Time	Avg TT	Min TT	Max TT	Reliability
1	65%	32.68	0:32:17	0:33:07	0:23:16	1:14:05	1.16
2	35%	32.69	0:28:03	0:28:32	0:23:35	0:40:21	1.07
AM Peak Travel Data							
Route	Percent Trips	Length	Travel Time	Avg TT	Min TT	Max TT	Reliability
1	72%	32.68	0:37:41	0:43:58	0:18:51	2:16:05	1.43
2	28%	39.4	0:56:27	1:00:11	0:31:28	2:01:45	1.29

[11] Reliability is measured as the ratio of the 80th percentile travel time to the 50th percentile travel time. The closer the value is to 1, the more reliable the route. Reliability is not an indication of the fastest route; it is an indication of the consistency of the route.

The AM peak is more congested and less reliable than the average daily travel time patterns due to the high concentration of work trips traveling to Boston in the morning from within the corridor and also along I-90. The INRIX data shows that the average travel time from Fitchburg/Leominster to Boston using I-90 doubles in the AM peak compared to the daily peak. This congestion on I-90 may also contribute to trips in the Route 2 corridor remaining in the Route 2 corridor as it is relatively uncongested compared to other travel paths.

Other Travel Modes

West of Charlemont, there is no public transportation service until North Adams, which is served by Berkshire Regional Transit Authority. Furthermore, there has not been any intercity bus service available along the corridor since it was discontinued in 2018.
Fitchburg, Leominster, and other stations in the eastern segment of the corridor are served by the MBTA Fitchburg Commuter Rail Line with approximately 14 weekday roundtrips and eight weekend roundtrips to North Station in Boston. The line provides hourly weekday service and every two hours on weekends between Wachusett Station in Fitchburg and North Station.

Projected Travel Trends

Building upon the analysis of the current travel market characteristics, projected travel trends were developed. This projection process assumes that the overall pattern of existing trips will continue, that is, people will continue to travel between the same origins and destinations. The projection process also assumes that changes to the origins and destination of trips within these travel patterns will depend on projected future changes in population and employment. That is, increases or decreases of persons travelling in these patterns are based on projected increases or decreases in population and employment. Estimating future travel trends does not include estimating changes in the travel patterns and travel markets that result of changes to the transportation system, in this case, a Northern Tier passenger rail service. Projected travel trends are used to help develop ridership estimates for the potential service alternatives. These ridership estimates are developed by analyzing travel market trends in light of the characteristics of the new transportation service to estimate how many people may move from their existing travel mode (e.g., automobile) to the Northern Tier service. The ridership estimates are developed by using the projected total travel market trends. The new transportation service is introduced to this total travel market to estimate how persons from these markets may choose to use the new mode.

Trip tables for 2019 have been projected to 2040 based on the population and employment growth, respectively, of each community.

Table 3.7: Segment-Level Projected Streetlight 2040 Average Daily Vehicle Trips

		Destination				
		West	**Central**	**East**	**Other**	**Total**
Origin	**West**	189,200	7,000	330	29,100	225,600
	Central	6,700	467,300	22,700	62,700	559,400
	East	400	25,500	3,197,400	937,200	4,160,400
	Other	30,100	69,100	815,100	13,798,900	14,713,300
	Total	226,400	568,900	4,035,500	14,827,900	19,658,800

Most overall travel is projected to remain within each segment area, with little interplay between the West and East segments. Projections for work trips show a similar pattern. Most work travel is

projected to occur within the East segment, with the Central segment having a stronger orientation eastward.

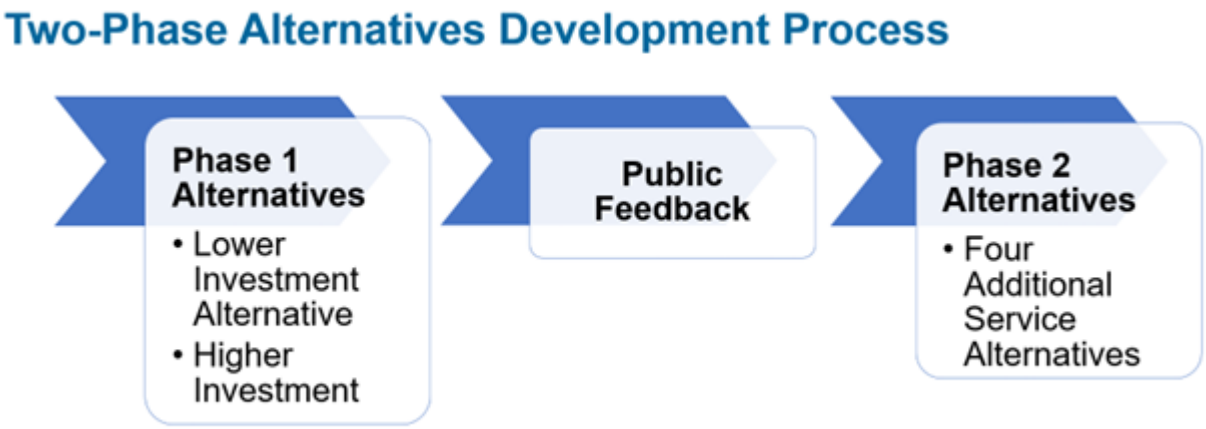
When examining projected job growth/decline by region, the East segment again leads both for the 2010-2020 period and the forecasts for the 2020-2040 period. The Central segment is currently projected to see a slight decline in jobs between now and 2040. The West segment may see its economy, at least in terms of the number of jobs, diminish at an accelerating pace over the next 20 years.

Overall, population and employment are estimated to decline in the West segment of the corridor. In the Central segment, population is expected to grow modestly with declining employment. Although work-from-home flexibility has recently introduced considerable uncertainty about this trend, it is estimated that the demographic dynamics will continue without some major intervention or disruption.

CHAPTER 4: ALTERNATIVES DEVELOPMENT AND EVALUATION

To illustrate a range of possible options for new intercity passenger rail service along the corridor, alternatives were developed and evaluated based on the established goals, objectives, and evaluation criteria, as well as identified challenges and opportunities. Using a two-phase alternatives development approach, the process began with the development and evaluation of two potential initial service alternatives representing lower investment and higher investment scenarios. With feedback from the Working Group and the public, the two initial service alternatives were refined, and four additional alternatives were developed and assessed as part of Phase 2.

Figure 4.1: Alternatives Development Process



Each service alternative incorporates differing characteristics (e.g., stations served, travel times, etc.) and associated metrics (e.g., ridership, costs, etc.) to measure how these elements interact with one another and how well the alternatives meet the goals and objectives of the study.

Alternatives Development

Phase 1 of the alternatives development process began with an assessment of existing track conditions and travel patterns in order to develop the initial two service alternatives. Each alternative consists of a combination of infrastructure and service characteristics including stations, coverage area, service structure, frequency of service, span of service, travel time between stations, and physical improvements (outlined in Figure 4.2).

Figure 4.2: Service Characteristics

Ingredient	Range of Options
Stations	• Increase or decrease number of stations • Locations could change
Coverage Area	• Limited to Massachusetts vs. extended into Vermont and New York
Service Structure	• Direct service to Boston vs. transfer to other services (e.g., MBTA Commuter Rail, Valley Flyer)
Frequency of Service	• Increase or decrease number of daily trains
Span of Service	• Full day service vs. commuter peak • Daily vs. seasonal
Travel Time Between Stations	• Existing freight train speeds to full high-speed rail (slow to very fast)
Physical Improvements	• Incremental State of Good Repair, full reconstruction in existing alignments, new alignments

Stations and Coverage Area

The number of stations and their locations can affect markets served based on the coverage area. Market and ridership analysis determines the coverage area. The coverage area is the area around a station from which riders would be attracted to the proposed passenger rail service. The number of stations can affect travel time. For each station stop, a train must reduce its speed over a given distance in order to stop safely. Each station stop has a prescribed dwell time to allow passengers to alight with their luggage and for other passengers to board the train. Additional time is added to the train schedule because the train gradually accelerates to the allowed track speed.

Service Structure

One-seat ride point-to-point (e.g., boarding in North Adams and taking the train to the final destination, for example, Boston North Station), or a two-seat ride (e.g., leaving North Adams, changing trains in Fitchburg to take the MBTA Commuter Rail service to Boston).

Frequency of Service

The frequency of service is the number of trains per day operated plus the days and times they operate. This service element can directly affect ridership. Travel purpose, the days that service is offered, and the frequency can all affect travel mode decisions. Short-term leisure travel such as sporting events may become easier with more frequent service. Weekend or longer vacation travel may not need higher frequency train service.

Span of Service

The span of service is the number of hours in a day that service is offered. A long span of service, 6 am to 11:30 pm for example, may provide the opportunity for round trip travel on one day and attract riders whose trip purposes match that availability.

Travel Time Between Stations

Travel times between the end stations and between other stations can be important for end-to-end riders and for intra-corridor customers. Trip times that are competitive with other modes for various trip purposes can produce higher ridership.

Physical Improvements

Physical improvements are the capital construction of track and other system improvements (e.g., signal) to increase train speeds or improve operations and reliability, examples of this include replacement of railroad ties and ballast, realigning track curves and adding superelevation, and/or constructing new track alignments. All of the alternatives assume that Northern Tier passenger rail service would share the right of way with the MBTA Commuter Rail service on the Fitchburg Line and the PAS right of way with freight service. Specific double tracking and other improvements are identified based on the modeling results for each alternative. The modeling results showed that all three types of rail service could be operated compatibly on the existing rights of way, so that an additional corridor or right of way would not be required.

Another element to consider is vehicle type. The type of train equipment used affects top train speeds, passenger capacity and acceleration. The most common types of equipment for intercity passenger service are coaches hauled by locomotives. Sometimes these trains have a control unit on the non-locomotive end that allows the train to be driven from both ends. There are several types of locomotives in passenger service today: diesel electric, high speed or Genset, electric locomotives, and dual mode. All of these locomotives can achieve higher horsepower and therefore speed than the traditional diesel locomotive, with the electric engine being the best performer. All of these units can comply with environmental regulations. The emission status of the electric locomotive would depend on the fuel used at the power source. Intercity passenger coaches tend to have fewer seats and more amenities than commuter coaches in order to allow for more comfort during a longer ride.

Phase 1 Alternatives

As part of Phase 1, two initial alternatives were designed to demonstrate the types of service that could result from different levels of investment in the corridor infrastructure outside of the MBTA service area. Alternative 1 (the lower investment alternative) minimizes the level of infrastructure investment, while Alternative 2 (the higher investment alternative) identifies infrastructure investments that could enable rail travel times that are equivalent to vehicle travel times from North Adams to Boston.

Rail travel times comparable to auto travel were achieved without the need for constructing new track alignments outside of the existing right-of-way. The main elements of the initial service alternatives are similar with some key exceptions.

Alternative 1: Lower Investment

Improvements included in Alternative 1 are the minimum steps necessary to operate passenger trains, eliminate the low-speed segments that would have significant impacts on travel times, and create additional track capacity to accommodate planned operations, as shown in Figure 1. The

characteristics for Alternative 1 were developed to serve a variety of trip purposes and to serve the population centers of North Adams and Greenfield, as included in the founding legislation.

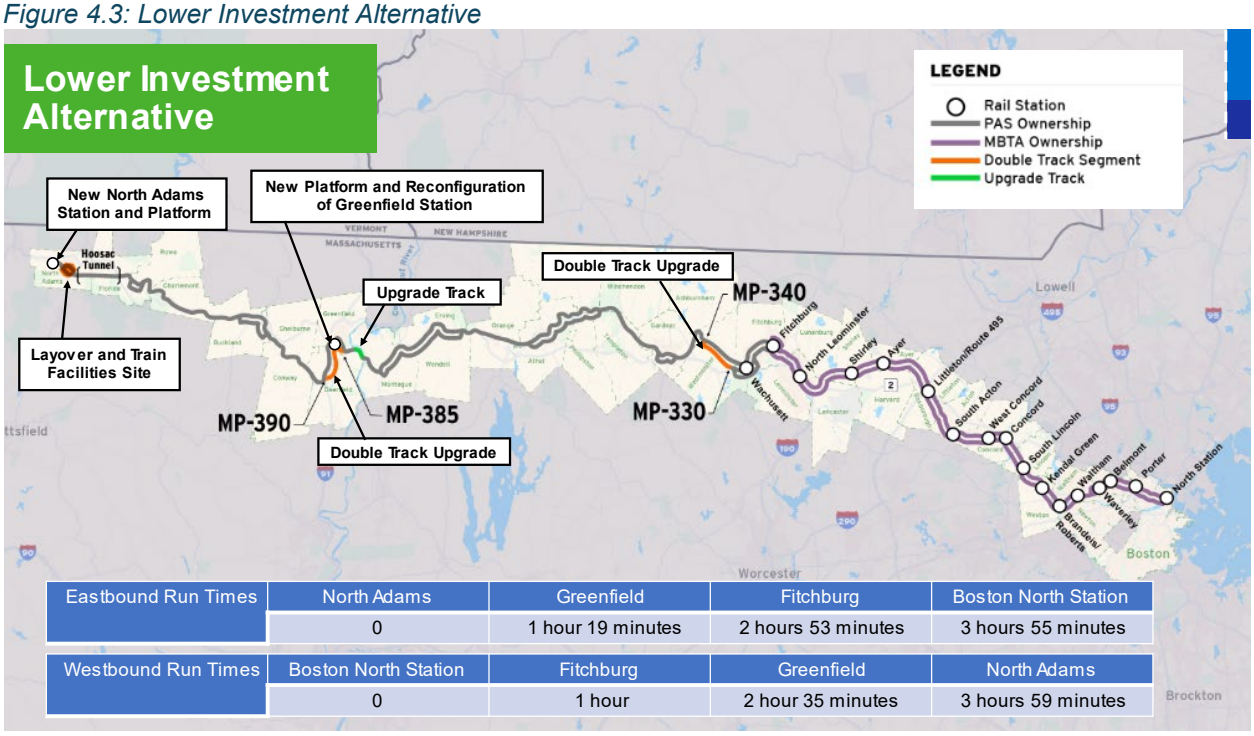
Alternative 1 would reintroduce service between North Adams and Boston and include four station stops: North Adams, Greenfield, Fitchburg, and Boston North Station. Passengers would use the MBTA Fitchburg Commuter Rail Line in Fitchburg to connect to intermediate stations between Fitchburg and Boston North Station. With five round trips per day, Alternative 1 would feature the following service patterns to serve differing trip purposes:

- From North Adams - one morning peak train, two midday trains, one evening peak train, one evening train
- From Boston North Station – two off-peak trains, one evening peak train, one evening train, one late evening train

Alternative 1 would take 3 hours and 55 minutes from North Adams to Boston North Station, utilizing diesel locomotive and coaches comparable to those operated on the Valley Flyer service. The assumed vehicles are consistent with those of typical Amtrak intercity passenger operation, which are capable of higher speeds on certain track curves. All infrastructure improvements are assumed for the PAS trackage between Fitchburg and North Adams; no improvements were assumed for the MBTA-owned Fitchburg Line.

Alternative 1 would improve signals (including Positive Train Control), upgrade Class 1 track at East Deerfield Yard, add trackage to support capacity improvements, and feature a new station and platform in North Adams, a new layover and train facilities site in North Adams, as well as a new platform and reconfiguration of the station in Greenfield. Additional double track would be built in Greenfield and Westminster. While Alternative 1 would not change superelevation on PAS corridor, the improvements included in Alternative 1 would enhance track capacity and allow higher speeds along the corridor from Fitchburg to North Adams.

Figure 4.3: Lower Investment Alternative



Eastbound Run Times	North Adams	Greenfield	Fitchburg	Boston North Station
	0	1 hour 19 minutes	2 hours 53 minutes	3 hours 55 minutes

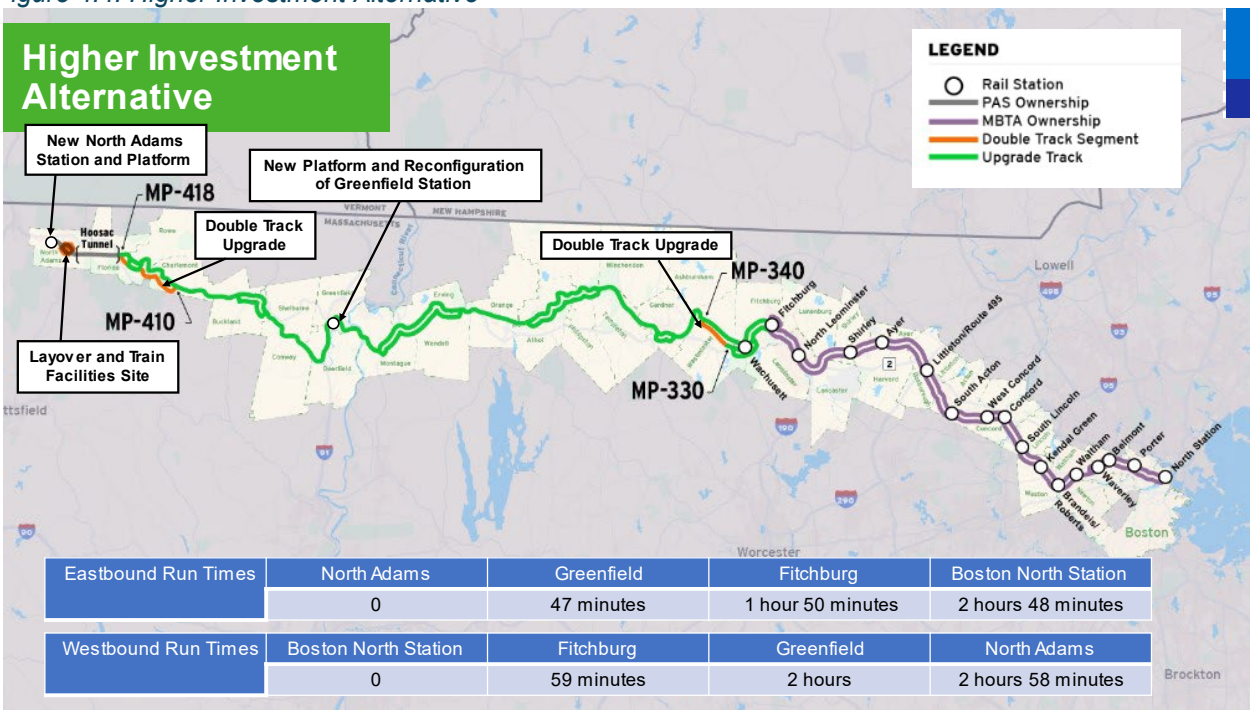
Westbound Run Times	Boston North Station	Fitchburg	Greenfield	North Adams
	0	1 hour	2 hour 35 minutes	3 hours 59 minutes

Alternative 2: Higher Investment

Alternative 2 would serve the same set of trip purposes as Alternative 1 and feature the same stations and vehicle type. The infrastructure in Alternative 2 would include further track rehabilitation and improvements to support superelevation and increase the track class to support enhanced capacity from Fitchburg to North Adams. Additional double tracking would be built in Westminster, Rowe, and Charlemont. These higher speeds and capacity further improve trip time and efficiency. Similar to Alternative 1, all infrastructure improvements are assumed for the PAS trackage between Fitchburg and North Adams, and not on the MBTA-owned Fitchburg Line.

As a result of these additional improvements, Alternative 2 would take 2 hours and 48 minutes from North Adams to Boston North Station, as shown in Figure 4.4.

Figure 4.4: Higher Investment Alternative



Eastbound Run Times	North Adams	Greenfield	Fitchburg	Boston North Station
	0	47 minutes	1 hour 50 minutes	2 hours 48 minutes

Westbound Run Times	Boston North Station	Fitchburg	Greenfield	North Adams
	0	59 minutes	2 hours	2 hours 58 minutes

Table 4.1: Comparison of the Lower and Higher Investment Alternatives

Assumptions	Lower Investment	Higher Investment
Track Infrastructure Improvements	Limited to signal improvements (including PTC) and upgrade of Class 1 track at East Deerfield Yard; some trackage additions to support meet-pass locations; no change in superelevation on PAS corridor	More track rehabilitation and improvements to support superelevation and increase in track class to fully use capability of the train to match superelevation; some trackage additions to support meet- pass locations
Service Type	One-seat ride from North Adams to Boston North Station	
Number of Stations	4 (North Adams, Greenfield, Fitchburg, Boston North Station)	
Frequency	5 trains daily (1 morning peak, 2 midday, 1 evening peak, 1 evening)	
Schedule Times	Schedule times selected for trip purposes; secondary bias toward connection with North-South Service at Greenfield	
Other uses of ROW	Assumes MBTA Commuter Rail schedules and freight trains	
Dwell Time at Stations	2 minutes	
Equipment Type	Diesel trains with Amfleet passenger cars and same consist as Valley Flyer	
MBTA Infrastructure	No modification to MBTA infrastructure	

Evaluation of Phase 1 Alternatives

To assess how well the initial service alternatives would meet the needs outlined in the goals and objectives for the study, the Phase 1 alternatives for passenger rail service were measured against these goals and objectives using the following criteria:

- Mobility and access
- Economic impact
- Social equity and fairness
- Impacts on rail capacity
- Environmental and cultural resources
- Cost effectiveness
- Safety and air quality

Ridership and cost estimates (both capital and operations and maintenance), as well as additional metrics, became the basis for estimating the array of benefits and costs for each alternative and the following alternatives evaluation.

Operations Modeling

Developing each alternative requires the use of a Rail Traffic Controller (RTC), an industry-standard software model. The RTC model produces characteristics of the resulting train service, including the schedules and station to station travel times. The model requires several inputs (or types of information) about the current railroad infrastructure, including track condition, track geometry, track configuration, train schedules, signal control systems, and grade crossings. Other model inputs include the proposed service alternative elements such as desired travel times, schedules of other trains (MBTA Commuter Rail trains and PAS freight trains) in the model area, stations, and station dwell times.

The model processes the information and produces graphical representations and data about how the trains could operate. The model outputs include the schedule adjustments or infrastructure improvements needed to meet the required elements of each alternative. For example, when the model identifies locations where two trains are operating in opposite directions on the same segment of single track, the issue may be resolved by an adjustment to the schedule to avoid the conflicting use on the single track. The model is then rerun with the new schedule to attempt to resolve the conflict. If the conflict cannot be resolved via a schedule change, then a "meet-pass location" is noted.[12] Higher train speeds also could increase right-of-way capacity by allowing more operations on the same track. In this way, the model is a primary tool for identifying necessary infrastructure investments for each service alternative.

In addition to track occupancy charts and detailed train status information, the RTC provides animations of train movements, operating statistics, time-distance diagrams, and train performance calculator profiles displaying information on elevations, speeds, throttle, brake settings, and cumulative distance. Among the most important outputs of the RTC model is the travel time for each alternative. Travel time information is critical for estimating potential ridership. Ridership can then be used to determine other measures of effectiveness or potential benefits, such as environmental benefits. Travel time also is a function of train speeds and is a measurement of train efficiency.

Estimation of Ridership

Forecasting ridership for a new rail service requires the review of various data sources that provide analogies, or examples, of the magnitude of ridership that could develop. Varying data sources may provide different insights into potential ridership patterns.
Three primary data sources were used to develop the initial forecast models:

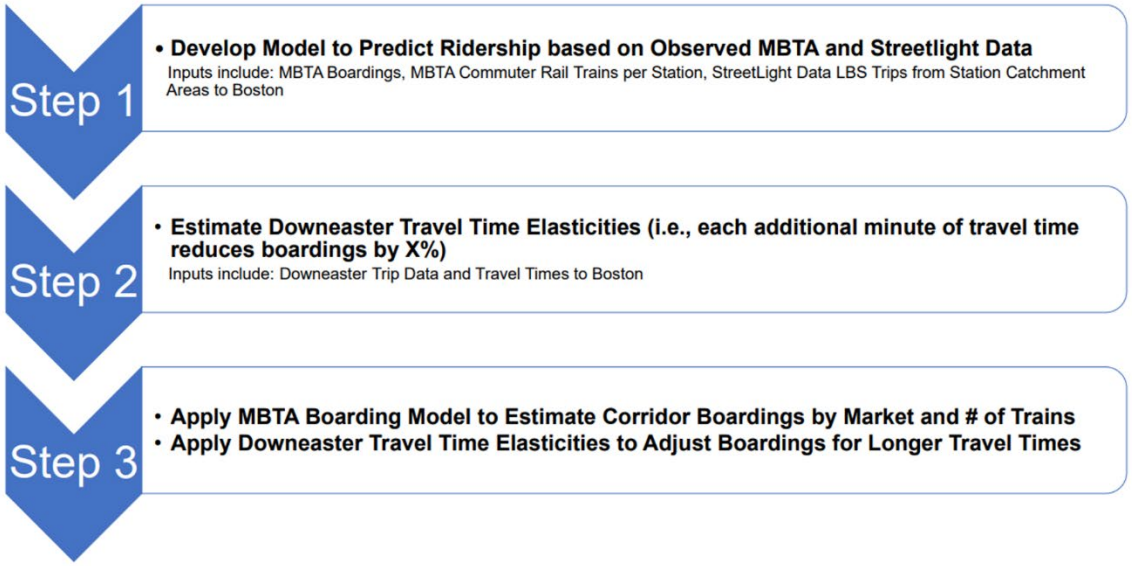
- MBTA Commuter Rail Service Data: MBTA Commuter Rail station-level data for the number of daily boardings, frequency of service, travel time, and travel distance to Boston by station.
- StreetLight Location-Based Services Data (LBS): Anonymized geographic data processed to determine travel patterns throughout the Commonwealth, including daily trips in the spring and fall recorded between the catchment areas[13] of stations along the Northern Tier corridor.
- Amtrak *Downeaster* data: station to station origin-destination data, trip data, and travel times for estimation on intra-corridor trips.

[12] This is a location where double tracking would be constructed so two trains could operate in the same route segment at the same time.
[13] The area from which ridership to each station is drawn.

Ridership Methodology

A three-phase approach was originally developed to estimate passenger volumes for the first phase alternatives, which is shown in Figure 3. A passenger rail boarding model was developed which first estimates the number of boardings at each station along the proposed route using linear regression, which employs a statistical process to predict the value of a variable based on the value of other variables, in this case predicting passenger station boardings based on population and the relationship between travel time by auto and proposed train service. The number of daily boardings at each station are estimated based on the average daily LBS trips, starting with an estimated ridership based on MBTA Commuter Rail ridership behavior. As the Northern Tier service alternatives run fewer daily trains than the MBTA Commuter Rail, the effect of service frequency on the number of boardings was accounted for by adjusting the modeled boardings based on headway elasticity calculated from the ridership levels on the Amtrak Downeaster.

Figure 4.5: Initial Ridership Estimation Process



The model was then applied to the average daily LBS trips to Boston from the communities in the station catchment areas outside of the MBTA service area. In the final step, the volume of intra-corridor trips was estimated by comparing each Northern Tier service alternative with the volume of intrazonal travel between comparable stations on the Amtrak Downeaster.[14] Forecasted ridership ranges were developed for each alternative, displayed as low and high ends of the range. The resulting estimates for each service alternative are presented in Table 4.2.

[14] The volume of intra-corridor trips refers to those not having an origin or destination in Boston.

Table 4.2: Phase 1 Alternatives Average Annual Daily Boardings

Alternative	Station	Average Annual Boardings	
		Low End	High-End
1 – Lower Investment	NORTH ADAMS	220	440
	GREENFIELD	2,420	6,600
	FITCHBURG	18,480	48,730
	BOSTON	19,200	50,700
Totals		**40,320**	**106,470**
2 – Higher Investment	NORTH ADAMS	1,430	4,180
	GREENFIELD	7,370	20,350
	FITCHBURG	21,120	55,330
	BOSTON	27,200	72,600
Totals		**57,120**	**152,460**

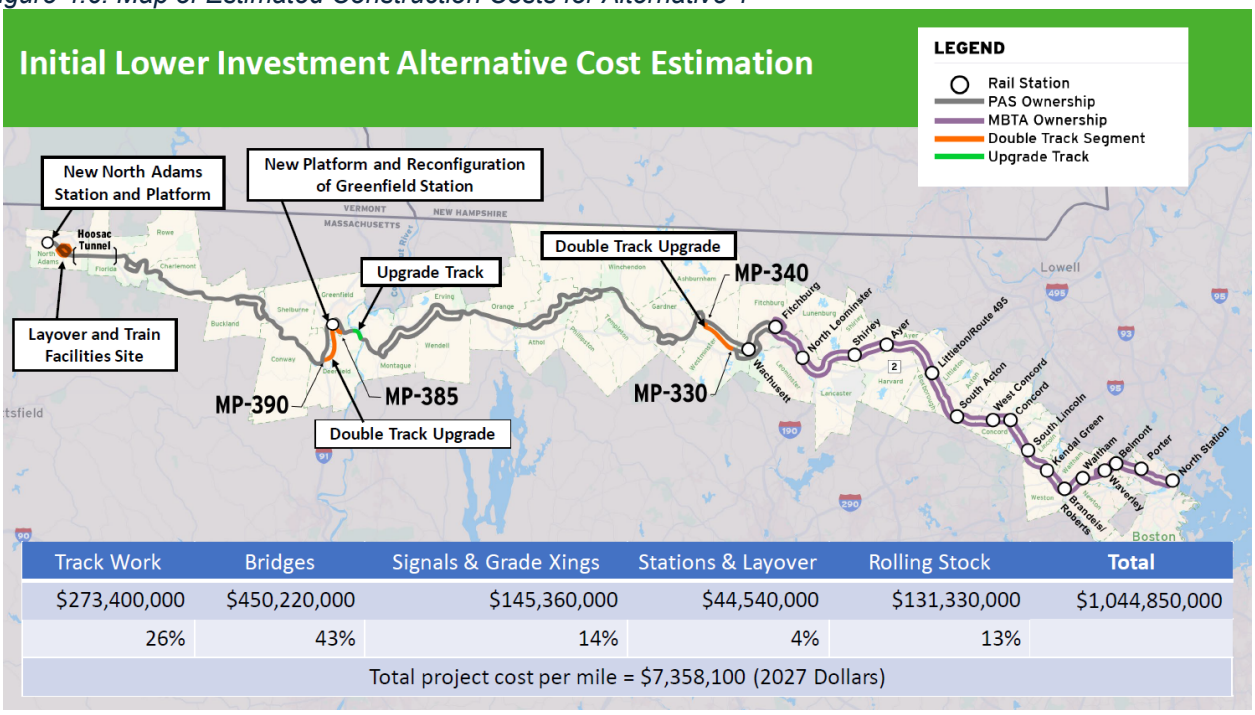
Estimation of Construction and Operating Costs

Two types of costs are estimated for each alternative: capital, and operations and maintenance. The capital cost estimate includes the design, construction, and property acquisition for the new and modified infrastructure required to provide the service under each alternative. The operations and maintenance cost estimate is the annual cost of providing the service.

Capital (or construction) cost estimates consider the materials, location, equipment, and labor needed for the proposed service. The level of certainty and accuracy of a construction cost estimate is impacted by the level of design. An Order of Magnitude Estimate was used at this stage of conceptual planning to evaluate the feasibility of each service alternative. The estimation process builds in contingency costs to account for the unknown elements of the project to reduce the level of uncertainty at this feasibility stage. As more about the existing site conditions and proposed design is known, the amount of contingency in the estimate is decreased.

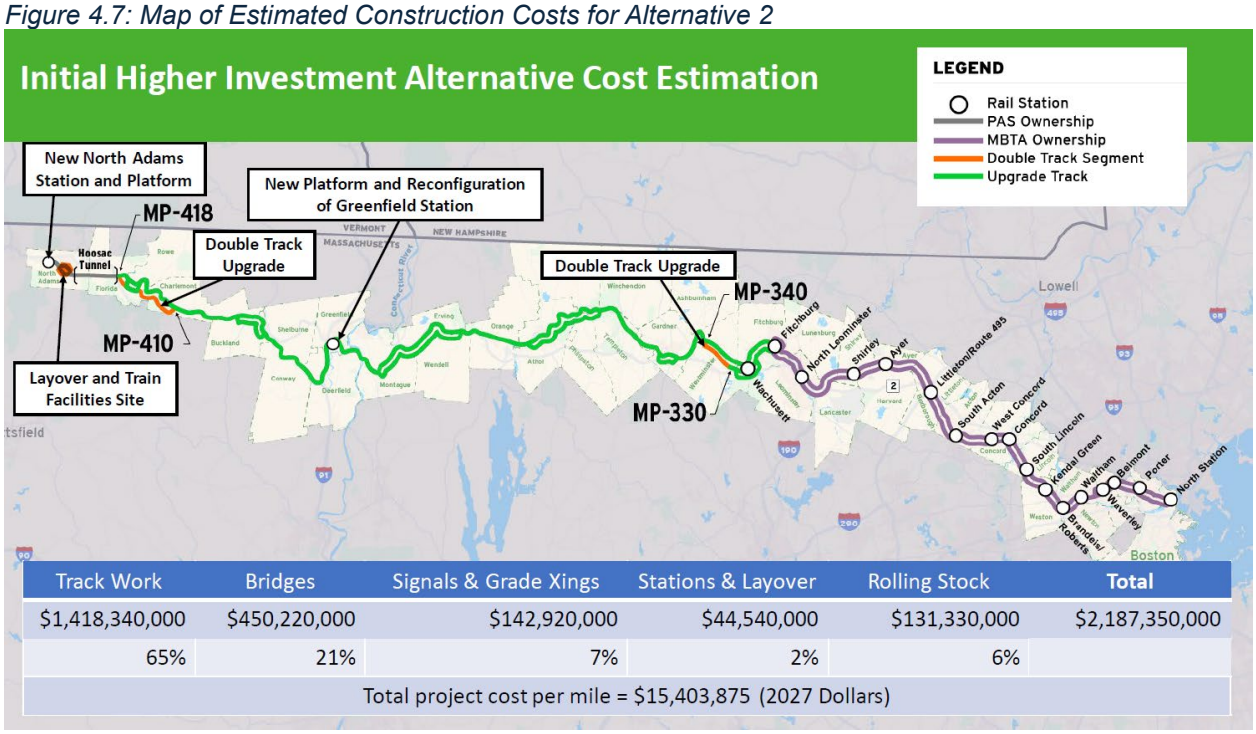
Construction cost estimates are based on material, equipment, and labor costs from recent railroad construction projects in Massachusetts and surrounding states. Level 1 construction cost estimates were relied upon, which represent the overall order of magnitude costs and incorporate significant contingency costs to account for unknown but expected costs for construction. Construction costs for Alternatives 1 and 2 are shown below in Figure 4.6 and Figure 4.7. 2027 costs were used as that was the earliest possible mid-point of construction for the project. mid-point of construction is a typical point for estimating total project costs.

Figure 4.6: Map of Estimated Construction Costs for Alternative 1



Track Work	Bridges	Signals & Grade Xings	Stations & Layover	Rolling Stock	Total
$273,400,000	$450,220,000	$145,360,000	$44,540,000	$131,330,000	$1,044,850,000
26%	43%	14%	4%	13%	
Total project cost per mile = $7,358,100 (2027 Dollars)					

Figure 4.7: Map of Estimated Construction Costs for Alternative 2



Track Work	Bridges	Signals & Grade Xings	Stations & Layover	Rolling Stock	Total
$1,418,340,000	$450,220,000	$142,920,000	$44,540,000	$131,330,000	$2,187,350,000
65%	21%	7%	2%	6%	
Total project cost per mile = $15,403,875 (2027 Dollars)					

These construction cost estimates illustrate the magnitude of investment required to improve a serviceable freight right-of-way for passenger rail service, along with the necessary facilities.

Estimates of the cost to operate the service and to maintain the fixed infrastructure and the rolling stock are developed using cost data from other comparable intercity services. These costs include operations staff, vehicle maintenance, facility maintenance, fuels, track maintenance, and administration and support.

Mobility and Access

Each of the Phase 1 alternatives provided similar access benefits by having the same stations and daily train frequency. For residents west of the MBTA Commuter Rail service area, the two initial alternatives provide a new mode of travel that increases mobility options and improves connectivity and access to destinations. With five trains per day, there is sufficient frequency for travelers to plan both work-based and non-work-based trips, such as healthcare-related travel and leisure travel.

The primary difference between the two initial service alternatives is the overall travel time between stations. The lower investment alternative would provide a 3-hour, 55-minute travel time from North Adams to Boston, whereas the higher investment alternative would provide a 2-hour, 48-minute travel time from North Adams to Boston, a travel time that is competitive with driving by personal vehicle during peak travel times. The benefits of the shorter travel time are illustrated in the higher annual ridership numbers from each station on the higher investment scenario.

Economic Impact

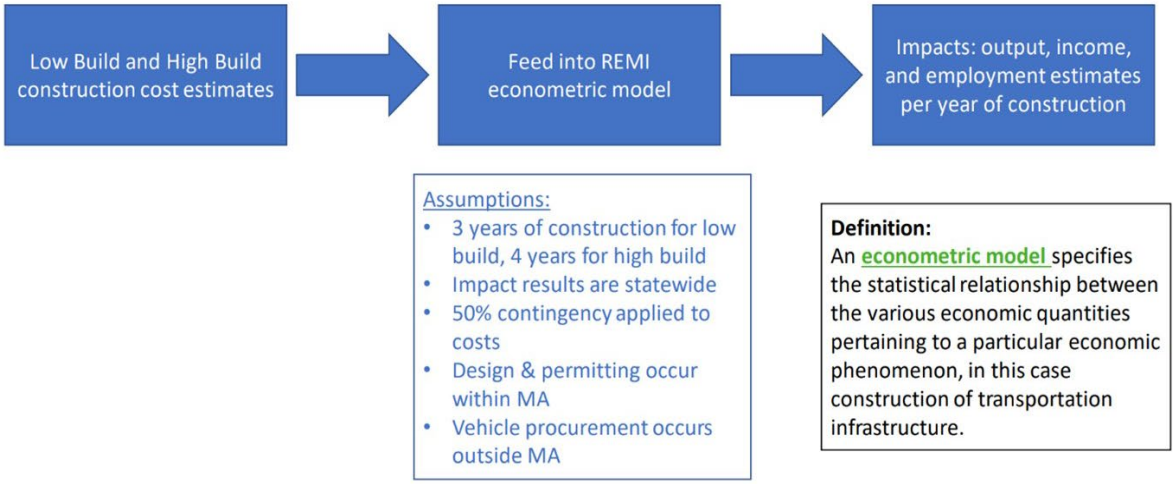
Construction and operating costs are used to develop metrics for several evaluation criteria, including economic impact. Construction cost impacts were analyzed using the econometric REMI Model.[15] The costs for each service alternative were input into the model, and the model then produced output, income, and employment estimates per year of construction:

- Output represents the total value of goods, services, and income that could result from the construction work;
- Income is derived from the anticipated resultant sales and employment; and
- Employment calculates the total of the three types of jobs created by the construction: direct, indirect, and induced.

While direct employment consists of the construction itself, indirect employment is the result of jobs that support the construction, such as supply related positions. Induced jobs are those that may result from the presence of those working on or supplying the project work who are spending in the local economy. For example, an increase in workers visiting a particular coffee shop in the construction area could result in the hiring of a new employee at the coffee shop.

[15] An econometric model specifies the statistical relationship between the various economic quantities pertaining to a particular economic phenomenon, in this case, the construction costs of transportation infrastructure.

Figure 4.8: Calculation Process for Primary Construction Impacts



For the calculations, a three-year construction duration for Alternative 1 and a four-year duration for Alternative 2 was assumed.[16] Additionally, it was assumed the economic impacts occur statewide; the design and permitting occur within Massachusetts; and the procurement of vehicles occurs outside of Massachusetts.

The Output represents the total value of goods/services/income that result from the construction work. Income is derived from resultant sales and employment. Employment represents the total of the three types of jobs created by the construction – direct (performing construction), indirect (supporting construction), and induced (developed as a result of the construction).

[16] Alternative 1's three-year construction duration is due to the smaller scale of infrastructure modifications.

Table 4.3: Estimated Primary Construction Impacts

Estimated Primary Construction Impacts – Lower Build

	Year 1	Year 2	Year 3
Output (in $ Millions)	424	440	447
Income (in $ Millions)	291	323	343
Employment	2,964	2,970	2,961
Direct	1,580	1,559	1,540
Indirect	431	437	435
Induced	953	974	986

Estimated Primary Construction Impacts – Higher Build

	Year 1	Year 2	Year 3	Year 4
Output (in $ Millions)	714	742	754	746
Income (in $ Millions)	492	544	579	595
Employment	4,911	4,924	4,910	4,799
Direct	2,578	2,544	2,512	2,482
Indirect	725	735	731	711
Induced	1,608	1,645	1,667	1,606

Social Equity and Fairness

Social equity and fairness were evaluated by assessing zero-car households and Environmental Justice (EJ) communities across the corridor. The rail service may be a new travel option for zero-car households around Greenfield, North Adams, and other communities with access to stations. The maps below show access for zero-car households and EJ communities.

Figure 4.9: Map of Zero-Car Households in the Northern Tier Corridor

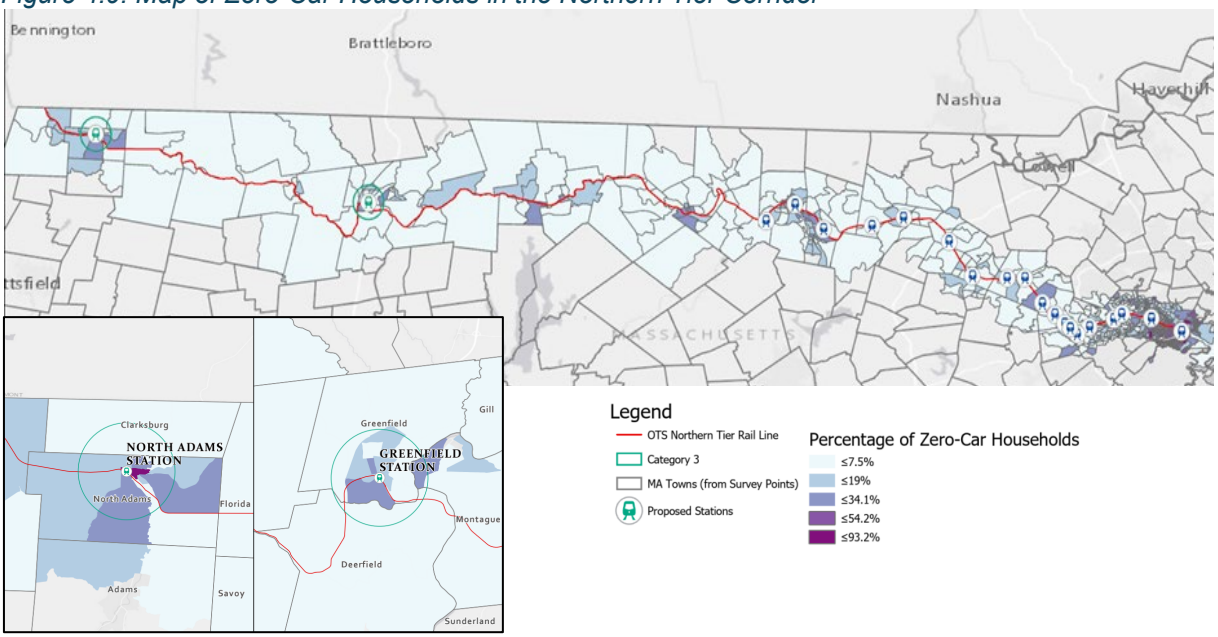
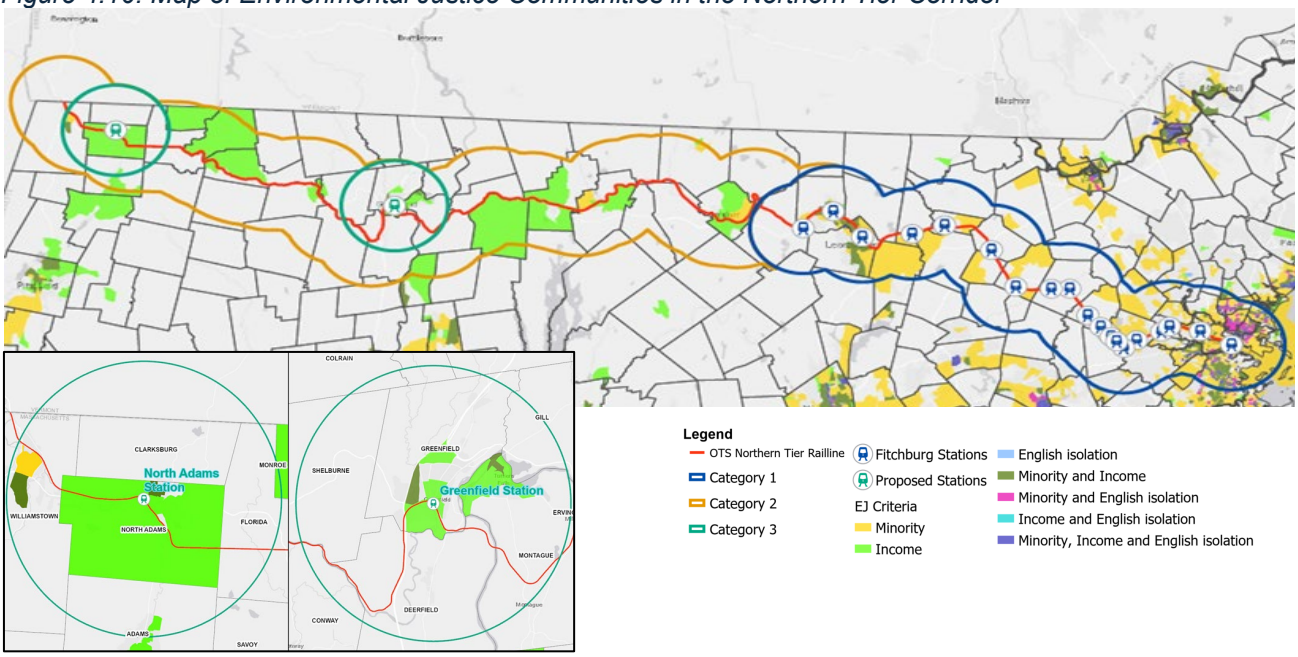


Figure 4.10: Map of Environmental Justice Communities in the Northern Tier Corridor



Impacts on Rail Capacity

A key factor in evaluation of the service alternatives is the potential for impacts on the Commonwealth's rail capacity. These impacts were accounted for in the RTC modeling process. Train schedules were developed to work with the current MBTA Commuter Rail service schedule. Current passenger and freight trains were incorporated into the model and produced minimal impacts on each.

Cost Effectiveness

Passenger rail service can also be evaluated for cost effectiveness. Such metrics include the construction cost per mile and per rider. The construction cost per mile is calculated by dividing the total project cost by the length of the project. Similarly, the cost per rider is total project cost divided by the total number of riders.

Figure 4.11: Capital Cost Effectiveness Metrics for the Initial Service Alternatives

Scenario	Lower Investment	Higher Investment
Cost per mile	$7,358,100	$15,403,875
Cost per rider	$18,735-$49,472	$27,390-$73,107

Similar measures can be used to evaluate the cost effectiveness of the proposed service. The annual cost of operations and maintenance (O&M) per rider are shown in the table below for each alternative.

Figure 4.12: Operations and Maintenance Cost Effectiveness Metrics for the Initial Service Alternatives

Scenario	Lower Investment	Higher Investment	Sample Cost/Range
Cost per rider	$215 to $568	$150 to $401	$15 to $50

Estimated ridership is a key factor in the cost difference between the lower and higher investment alternatives. For comparison, a sample range of costs is included for comparable services such as the Pere Marquette (IL-WI), the Downeaster (ME-MA), and the Vermonter (D.C.-VT).

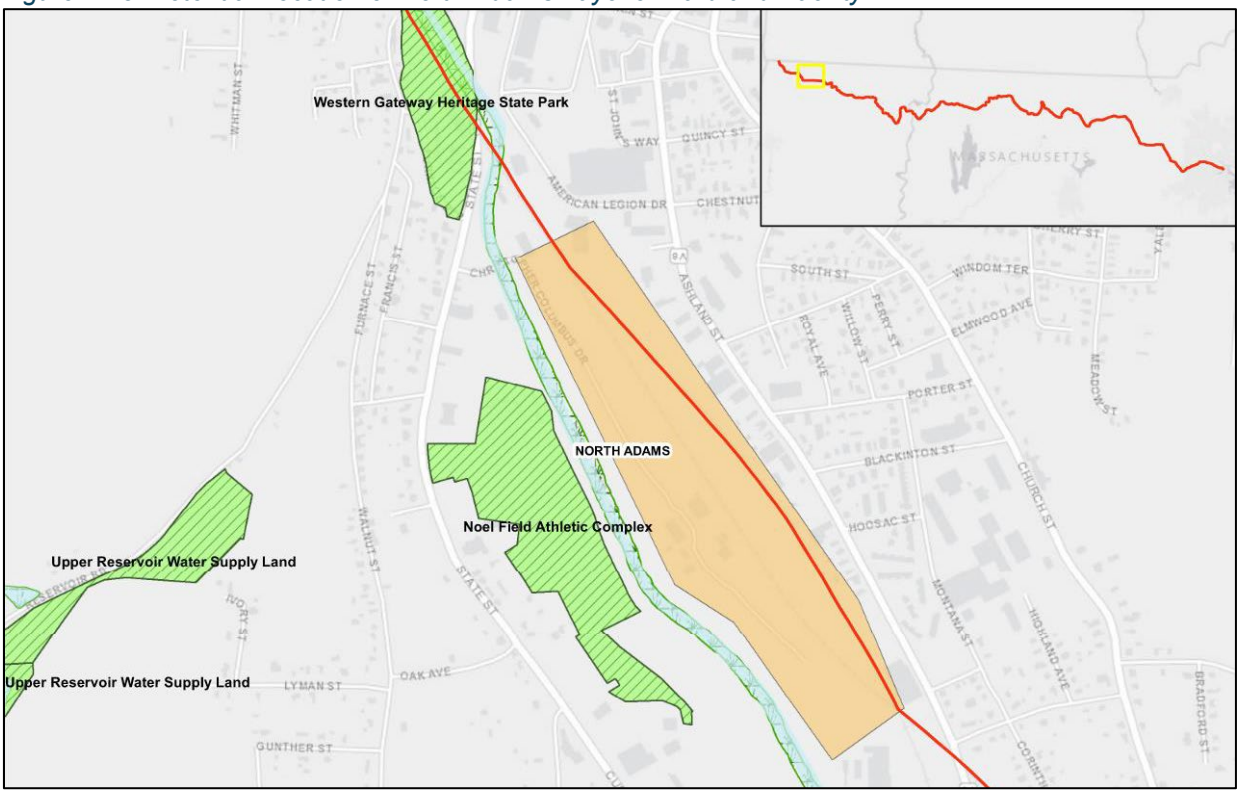
Environmental and Cultural Resources

A wide array of environmental and cultural resources were inventoried and mapped, including wetlands and waterways; FEMA designated floodplains; designated open space and recreational parklands; National Register listed historic districts and properties; state designated Areas of Critical Environmental Concern (ACEC); and 2020 EJ Census block groups.

Existing environmental constraints within and adjacent to the corridor were identified using MassMapper, FEMA Flood Insurance Rate Maps (FIRMs), the Massachusetts Cultural Resource Information System (MACRIS), and the U.S. Environmental Protection Agency (U.S. EPA) Environmental Justice (EJ) Screen. An extensive list of permits that may be required, funding sources, the proximity of the work to protected resources, and other factors was compiled. The service alternatives use existing right-of-way, which may limit environmental impacts.

The potential impact of a possible layover yard and facility in North Adams on a site outside of the existing right-of-way and adjacent to the Hoosic River would require future assessment.

Figure 4.13: Potential Location of North Adams Layover Yard and Facility



Safety and Air Quality

Measures to evaluate safety and air quality were developed based on estimated ridership, as new passengers could result in fewer cars on the road, lower emissions of pollution and greenhouse gases, and increased safety with fewer cars and less congestion on roadways. A decrease in vehicular travel could lead to a net reduction in traffic congestion and less idling could mean fewer emissions.

Figure 4.14: Estimated Environmental Benefits for the Initial Service Alternatives

Scenario	Lower Investment	Higher Investment
Annual VMT Reduction	-2,313,821 to -6,105,127	-3,754,257 to -10,128,225
% of Route 2 VMT	0.10% to 0.27%	0.17% to 0.46%

Phase 2 Alternatives

The Phase 1 service alternatives and the evaluation results were presented at a public workshop in January of 2023. Following an overview of the study process, the public workshop featured three modules:

- Module 1: Alternatives Development Approach and Methods
- Module 2: Evaluation of Phase 1 Alternatives
- Module 3: Looking Ahead of Phase 2

Each module included a presentation followed by discussion and questions and answers. Poll

questions were used to engage workshop attendees about potential trip purposes, service benefits, and service characteristics. Tradeoffs related to the potential characteristics of the four additional service alternatives to be developed as part of Phase 2 were also discussed, including stations, coverage area, service structure, frequency of service, span of service, travel time between stations, and physical improvements.

During and following the public workshop, Working Group members and other stakeholders provided feedback on the Phase 1 alternatives and input on the desired characteristics for potential inclusion in the development of the Phase 2 service alternatives. This feedback advocated for considering additional station stops in communities across the corridor (e.g., Shelburne Falls, Athol, Orange, Gardner, and Porter Square); evaluating a connection to Albany, NY; considering potential upgrades to support higher speeds, including the electrification of the passenger rail service and considering seasonal stops.[17]

The characteristics of the Phase 2 alternatives were developed based on the comments and questions received.

Overview of Phase 2 Alternatives

With Alternative 2 used as a base for the four additional service alternatives, the Phase 2 service alternatives each provide five round-trips, seven days per week. Each alternative provides service using coaches comparable to those used on the Valley Flyer service. The schedule times for the trains in each alternative are also similar, with one morning peak train, two midday trains, one evening peak train, and one evening train: from Boston North Station – two off-peak trains, one evening peak train, one evening train, one late evening train. All alternatives use diesel locomotives except for Alternative 3, which uses electrified locomotives.

Alternative 3: Electrified Service

Alternative 3 would provide a one-seat ride using electrified locomotives with the same type of coaches used in Alternatives 1 and 2 and includes electrification of the right-of-way between Fitchburg and North Adams with overhead catenary system and associated power substations. The service alternative assumes that electrification from Fitchburg east would be completed by the MBTA as part of a broader plan to electrify Commuter Rail service in Eastern Massachusetts. Alternative 3 would include North Adams, Greenfield, Athol, Fitchburg, Ayer, Porter, and North Station as station stops.

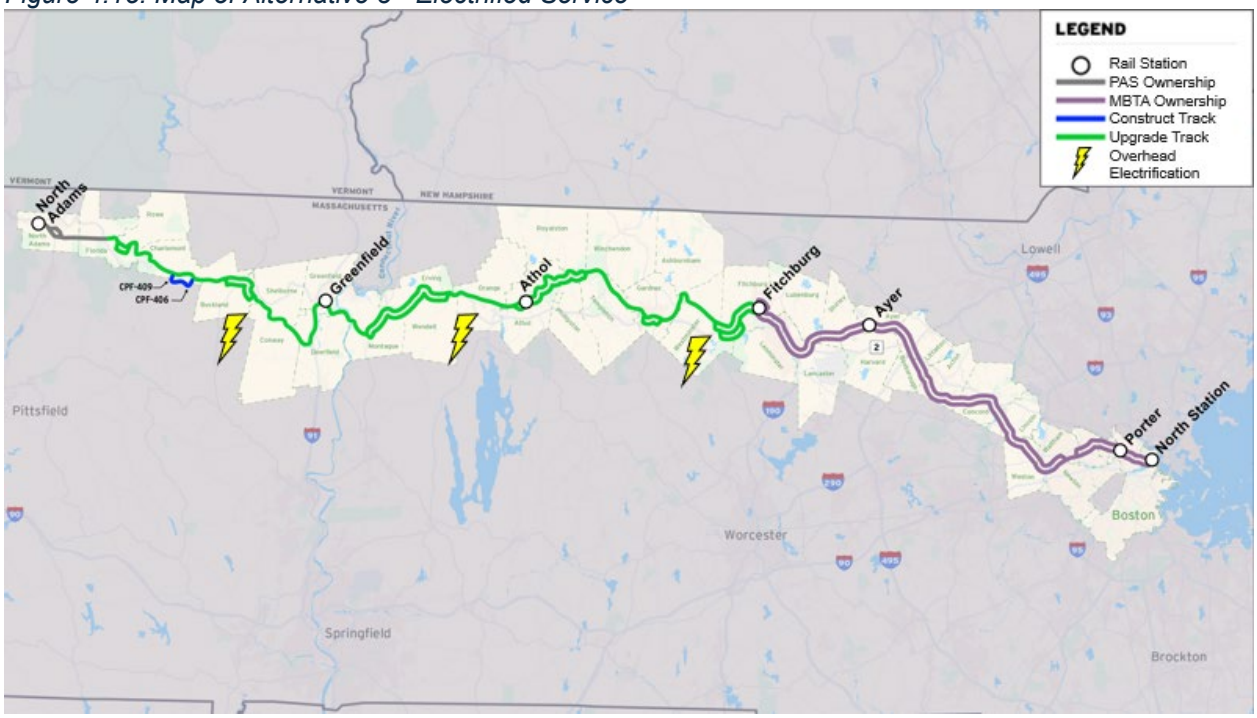
Other infrastructure improvements would include new double track in Charlemont, upgrades of the track from Class 3 to Class 4, crossing renewals, bridge rehabilitation, signal replacement and Positive Train Control, new stations and platforms in North Adams and Athol, a new platform and reconfiguration of Greenfield Station, and a layover and train facilities site in North Adams. Specific sites for power substations have not been identified.

These improvements would support an increase in track class to fully use capability of the train to optimize speed through curves, along with some trackage additions to support capacity improvements. Travel time from North Adams to Boston would be 2 hours and 50 minutes. The added station stops would allow for more travel within the corridor and serve major job centers such as Devens (via Ayer Station) and Kendall Square in Cambridge (via MBTA Red Line service

[17] Seasonal stops are added to the schedule to support seasonal attractors (e.g., weekend stops at Wachusett during the ski season.

from Porter Station). The maximum operating speeds in this alternative would be 60 mph in the PAS territory and 80 mph in the MBTA territory, similar to the Higher Investment Scenario developed in Phase 1. The electrification of the system allows for more efficient acceleration from and deceleration to stations, which produces a travel time similar to Alternative 2 even with three more station stops. These benefits are achieved with a significant cost above Alternative 2, with a difference of $1,355,397,655.

Figure 4.15: Map of Alternative 3 - Electrified Service



Alternative 4: Full Local Service

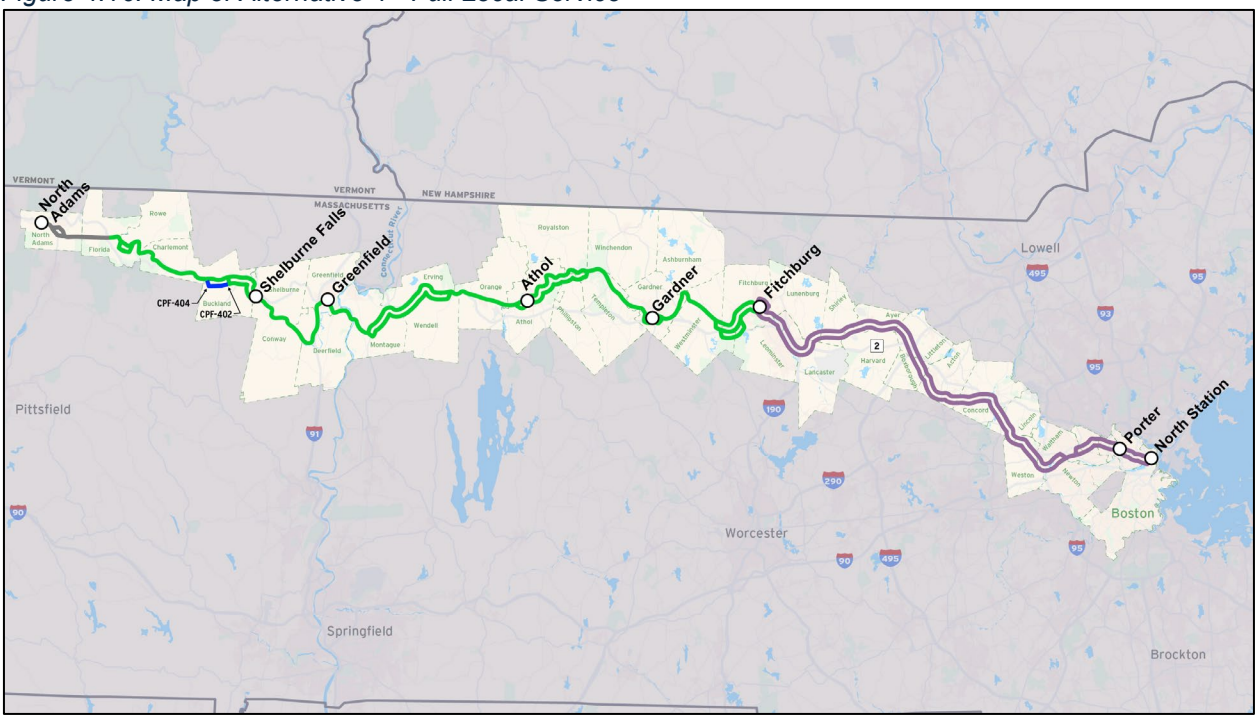
Alternative 4 would provide a one-seat ride. Infrastructure improvements would be comparable to those in Alternative 2, track rehabilitation and improvements to support an increase in track class to fully use capability of the train to optimize speed through curves, along with some trackage additions to support capacity improvements, including double track at Buckland. This alternative would add stops at Shelburne Falls, Athol, Gardner, and Porter Square. Travel time from North Adams to Boston would be 2 hours and 59 minutes.

The added station stops were selected to allow more travel within the corridor and serve the major job center at Kendall Square in Cambridge (via MBTA Red Line service from Porter Station). The maximum operating speeds in this alternative would be the same as the Higher Investment alternative developed in Phase 1.

Other infrastructure improvements would include new double track in Charlemont, upgrades of the track from Class 3 to Class 4, crossing renewals, bridge rehabilitation, signal replacement and Positive Train Control, new stations and platforms in North Adams and Athol, a new platform and reconfiguration of Greenfield Station, and a layover and train facilities site in North Adams.

These improvements would support an increase in track class to fully use capability of the train to optimize speed through curves, along with some trackage additions to support capacity improvements. Travel time from North Adams to Boston would be 2 hours and 50 minutes.

Figure 4.16: Map of Alternative 4 - Full Local Service

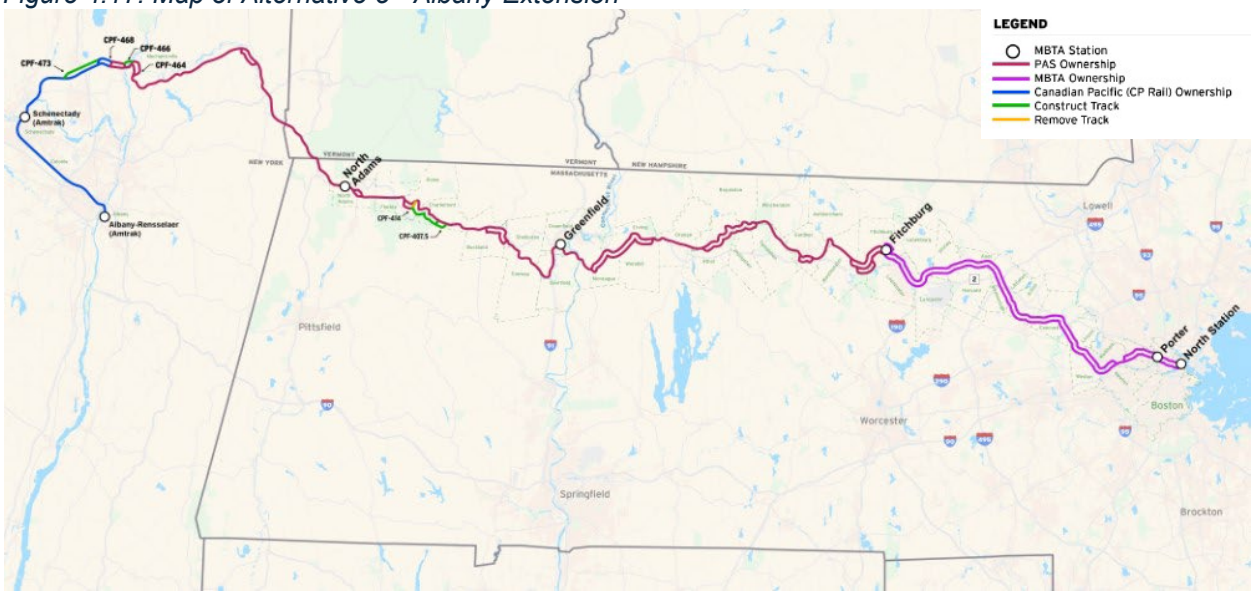


Alternative 5: Albany Extension

Alternative 5 would provide a one-seat ride. Infrastructure improvements would be comparable to those in Alternative 2: track rehabilitation and improvements to support an increase in track class to fully use capability of the train to optimize speed through curves, along with some trackage additions to support capacity improvements. Limited track additions are assumed for New York State, including Stillwater, Mechanicville, and Clifton Park. Instead of starting at North Adams, this alternative would run from Albany, New York, to Boston North Station. It would also include stops at North Adams, Greenfield, Fitchburg, and Porter. The schedule would be optimized to allow transfers to other passenger rail services at the Albany/Rensselaer and Greenfield Stations. Travel time from North Adams to Boston would be 2 hours and 49 minutes. Travel time from Albany, New York, to Boston North Station would be 4 hours and 34 minutes.

The schedule is optimized to allow transfers to other passenger rail services at the Albany/Rensselaer and Greenfield stations. The maximum operating speeds in this alternative would be the same as the Higher Investment Scenario developed in Phase A from North Adams to Boston North Station. No improvement in operating speeds will be included between North Adams and Albany, NY. Equipment for this service would layover at the existing Amtrak facility in Rensselaer, NY. Unlike the other alternatives, no facility would need to be constructed in North Adams.

Figure 4.17: Map of Alternative 5 - Albany Extension

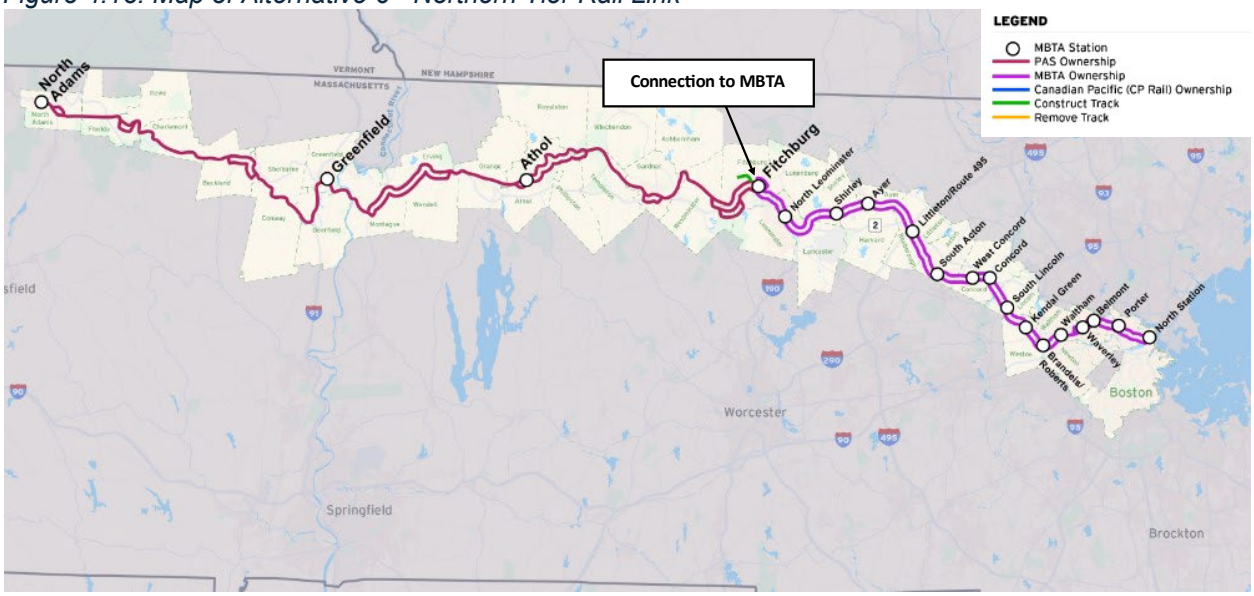


Alternative 6: Northern Tier Rail Link

Alternative 6 is a two-seat ride with a connection between Northern Tier trains and MBTA Commuter Rail Trains at Fitchburg. Infrastructure improvements would be comparable to those in Alternative 2 track rehabilitation and improvements to support an increase in track class to fully use capability of the train to optimize speed through curves, along with some trackage additions to support capacity improvements. This alternative would add stops at Athol and Fitchburg and make all scheduled MBTA stops between Fitchburg and Boston. This service alternative would provide daily service between North Adams and Fitchburg Station where passengers could transfer to the MBTA Commuter Rail service for destinations further east. Travel time from North Adams to Boston would be 3 hours and 22 minutes.

This service alternative provides service daily between North Adams and Fitchburg Station, where passengers could transfer to the MBTA Fitchburg Commuter Rail service for destinations farther east. The operating speeds in this alternative would be the same as the Higher Investment Scenario developed in Phase 1.

Figure 4.18: Map of Alternative 6 - Northern Tier Rail Link



A comparison of the Phase 2 service alternatives is included in Table 4.4.

Table 4.4: Features of Phase 2 Alternatives

Assumptions	Electrified Service	Full Local Service	Albany Extension or Albany Connector	Northern Tier Rail Link
Service Type	One-seat ride from North Adams to Porter Square, Boston North Station	One-seat ride from North Adams to Porter Square, Boston North Station	One-seat ride from Albany to North Adams to Porter Square, Boston North Station	Two-seat ride from North Adams, Greenfield, Fitchburg to Porter Square, Boston North Station
Number of Stations	7 -North Adams, Greenfield, Athol, Fitchburg, Ayer, Porter Square, North Station	8 - North Adams, Shelburne Falls, Greenfield, Athol, Gardner, Fitchburg, Porter Square, North Station	6 - Albany (NY), North Adams, Greenfield, Fitchburg, Porter Square, North Station	4 - North Adams, Greenfield, Athol, Fitchburg, (Connection to MBTA making scheduled station stops)
Dwell Time at Stations	2 minutes	2 minutes	2 minutes	2 minutes Northern Tier 30 seconds at MBTA stations

Layover Yard - Facility	North Adams	North Adams	Albany	North Adams
Track Infrastructure Improvements	Higher investment baseline with new trackage additions to support meet- pass locations. Electrification infrastructure additions.	Higher investment baseline with new trackage additions to support meet-pass locations.		
Equipment Type	Electric locomotive with Amfleet passenger cars and same consists as Valley Flyer	Diesel locomotive with Amfleet passenger cars and same consist as Valley Flyer		
MBTA Infrastructure	No modification to MBTA infrastructure			
Frequency	5 trains daily (1 AM peak, 2 midday, 1 PM peak, 1 evening)			
Schedule Times	Schedule times selected for trip purposes; secondary bias toward connection with North-South Service at Greenfield			
Other uses of ROW	Assumes commuter schedules and freight trains			

Evaluation of Phase 2 Alternatives and Refinements of Analysis

Refinement is a critical component of the study process. Based on comments and questions from the Working Group and the public, clarifications, and updates to the assumptions for ridership forecasting, cost estimation, and other elements were made.

The refinements to the Phase 1 alternatives and the Phase 2 alternatives development and evaluation were presented at Working Group and public meetings held in October of 2023.

Refined Ridership Methodology and Results

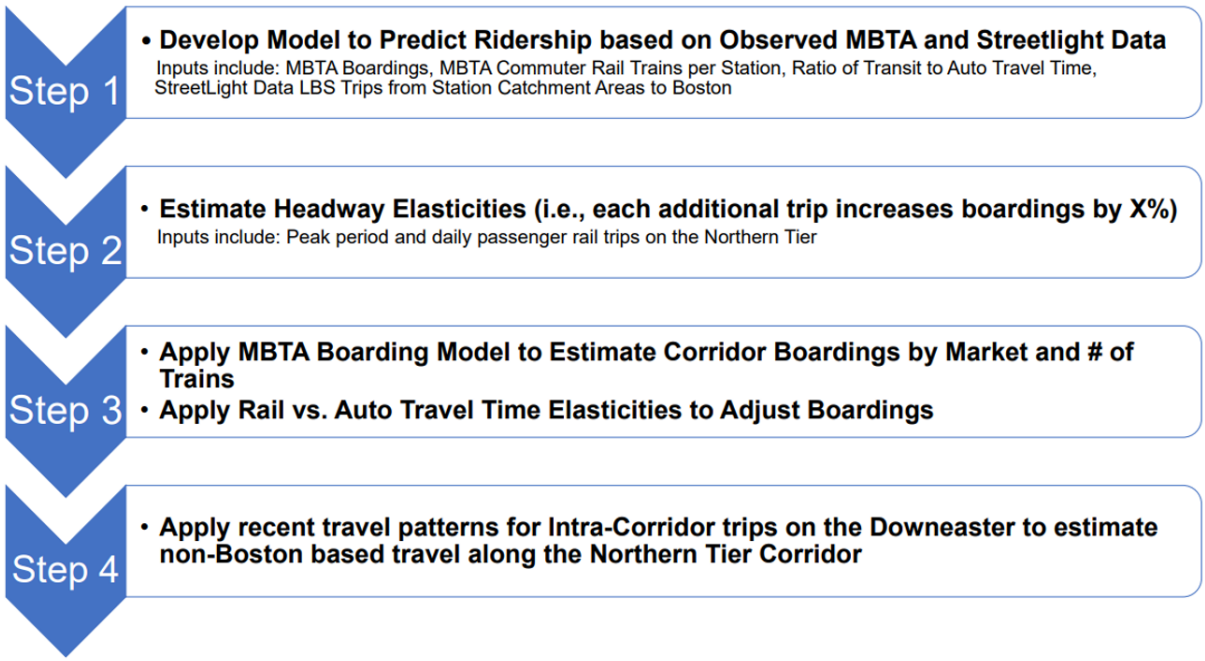
Ridership is one measurement of the effectiveness of the service alternatives. A revised passenger rail boarding model was developed which, like the previous model, first estimates the number of boardings at each station along the proposed route using linear regression. The number of daily boardings at each station are estimated based on the average daily LBS trips and the ratio of transit-to-auto travel time to Boston. For this revised approach, each station's rail and auto travel-time ratio was used in the estimation process. As the Northern Tier service alternatives run fewer daily trains than the MBTA Commuter Rail, the effect of service

frequency on the number of boardings was accounted for by adjusting the modeled boardings based on headway elasticity.

The model was then applied to the average daily LBS trips to Boston from the communities in the station catchment areas outside of the MBTA service area. For the revised approach, the ratio of rail travel times for the Amtrak Lake Shore Limited service to auto travel times was used in place of the MBTA-related values used in the first part of the modeling process. This resulted in a set of high and low values for ridership between the station catchment areas and Boston. In the final step, the volume of intra-corridor trips was estimated by comparing each Northern Tier service alternative to the volume of intrazonal travel between comparable station on the Amtrak Downeaster.[18] Forecasted ridership ranges were developed for each alternative, displayed as low and high ends of the range. The resulting estimates for each service alternative are presented in Table 4.5.

Each of the six alternatives has high- and low-end forecasts. The low and high ends of the ranges for Electrified Alternative (Alternative 3) and Full Local Alternative (Alternative 4) represent the highest ridership numbers while the estimates for Alternative 6 have the lowest volume projections, indicating that combinations of competitive trip times and expanded station access produce the best ridership results for this corridor.

Figure 4.19: Updated Ridership Estimation Process



[18] The volume of intra-corridor trips refers to those not having an origin or destination in Boston.

Figure 4.20: Station Catchment Area for LBS Trips

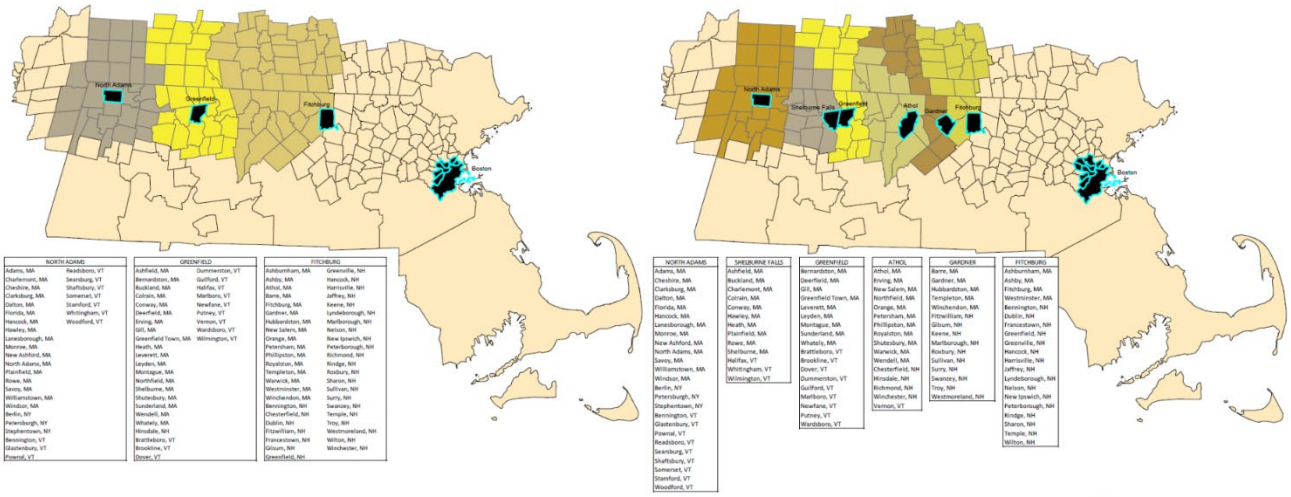


Table 4.5: Updated Phase 2 Alternatives Average Annual Daily Boardings

		Lower Bound	Average	Upper Bound	Range
1 – Lower Investment	**NORTH ADAMS**	590	860	1,130	590 - 1,130
	GREENFIELD	4,370	6,540	8,720	4,370 - 8,720
	FITCHBURG	29,710	39,260	48,810	29,710 - 48,810
	BOSTON	31,210	42,000	52,800	31,210 - 52,800
	TOTAL RIDERSHIP	65,880	88,660	111,460	**65,880 - 111,460**
2 – Higher Investment	**NORTH ADAMS**	9,730	10,690	11,660	9,730 - 11,660
	GREENFIELD	11,890	13,870	15,850	11,890 - 15,850
	FITCHBURG	31,430	40,960	50,500	31,430 - 50,500
	BOSTON	47,730	58,960	70,190	47,730 - 70,190
	TOTAL RIDERSHIP	100,780	124,480	148,200	**100,780 - 148,200**
3 – Electrified Service	**NORTH ADAMS**	9,390	10,420	11,440	9,390 - 11,440
	GREENFIELD	11,300	13,300	15,290	11,300 - 15,290
	ATHOL / ORANGE	14,310	17,130	19,940	14,310 - 19,940
	FITCHBURG	32,260	42,260	52,270	32,260 - 52,270
	AYER	36,170	48,680	61,180	36,170 - 61,180
	BOSTON	93,090	118,590	144,080	93,090 - 144,080
	TOTAL RIDERSHIP	196,520	250,380	304,200	**196,520 - 304,200**

4 – Full Local Service	**NORTH ADAMS**	6,640	7,270	7,920	6,640 - 7,920
	SHELBURNE FALLS	6,410	6,700	6,950	6,410 - 6,950
	GREENFIELD	10,440	12,530	14,620	10,440 - 14,620
	ATHOL / ORANGE	13,520	16,460	19,370	13,520 - 19,370
	GARDNER	19,840	27,260	34,660	19,840 - 34,660
	FITCHBURG	31,600	41,270	50,950	31,600 - 50,950
	BOSTON	79,590	100,290	120,990	79,590 - 120,990
	TOTAL RIDERSHIP	168,040	211,780	255,460	**168,040 - 255,460**
5 – Albany Extension	**ALBANY**	1,570	1,970	2,350	1,570 - 2,350
	NORTH ADAMS	8,550	9,270	9,980	8,550 - 9,980
	GREENFIELD	11,780	13,990	16,200	11,780 - 16,200
	FITCHBURG	30,920	40,460	49,980	30,920 - 49,980
	BOSTON	47,520	59,090	70,650	47,520 - 70,650
	TOTAL RIDERSHIP	100,340	124,780	149,160	**100,340 - 149,160**
6 – North Adams to Fitchburg With Transfer Between MBTA Commuter Rail and NT at Fitchburg	**NORTH ADAMS**	70	480	1,140	70 - 1,140
	GREENFIELD	310	2,190	4,090	310 - 4,090
	ATHOL / ORANGE	1,620	4,320	7,030	1,620 - 7,030
	FITCHBURG, Outbound	90	350	620	90 - 620
	Transfer from MBTA Commuter to NTPR at FITCHBURG	1,810	6,300	11,020	1,810 - 11,020
	TOTAL RIDERSHIP	3,900	13,640	23,900	**3,900 - 23,900**

Comparison with other Intercity Corridors

With annual ridership in the range of 65,000 to 304,000 (excluding Alternative 6), projected volumes are at the low end of currently operational regional intercity rail services in the United States. Table 4.6 below offers a comparison with select regional services in New England and the

Midwest across key metrics – route length, population, frequency, and ridership. Federal fiscal year 2023 ridership is included, which though not fully recovered from the COVID-19 on most routes, is approaching fiscal year 2019 levels. All of the routes listed are experiencing upward trends in ridership and most will likely close any remaining gap with fiscal year 2019 ridership in fiscal year 2024.

Table 4.6: Characteristics of Select Regional Intercity Services

Service	Route Length *(miles)*	Population within 25 miles of Service Area *(millions)*[i]	Frequency (Daily round trips)	Fiscal Year 2023 Ridership[ii]
Amtrak *Downeaster* Boston-Portland-Brunswick	145	5.6	5	542,639
Amtrak *Ethan Allen* New York – Albany – Burlington, VT	309	18.3	1	86,638
Amtrak Chicago-Quincy, IL	258	8.0	2	114,521[iii]
Amtrak Chicago-Carbondale, IL	310	7.4	2	270,017

Notes:
[ii]2020 population estimates, as reported in https://www.railpassengers.org/resources/ridership-statistics/
[ii]Amtrak Federal FY 2023 ridership statistics.https://media.amtrak.com/wp-content/uploads/2023/11/Copy-of-FY23-Year-End-Ridership.pdf. Ridership figures exclude trips exclusively on the Northeast Corridor.
[iii]Chicago-Quincy service experienced multiple interruptions in FY 2023, including partial substitution with buses November 2022 - January 2023. Prior to the COVID-19 pandemic, this service handled in excess of 200,000 passengers annually.

Refined Estimation of Construction and Operating Costs and Results

Total project costs including environmental permitting, design/engineering, construction and right of way costs were developed in the same way as for the initial alternatives, using costs from recent, comparable projects. The final analysis was updated to reflect changes in unit prices, where the largest change was lower costs for the purchase of vehicles. Similar to the first set of estimates, these estimates include escalation for engineering and construction in future years and contingency estimates to account for foreseeable costs that will emerge as design progresses. Operations and maintenance costs were estimated using the costs of similar services. Construction costs for Alternatives 1 - 6 are shown below in the following maps.

Figure 4.21: Capital Cost Categories

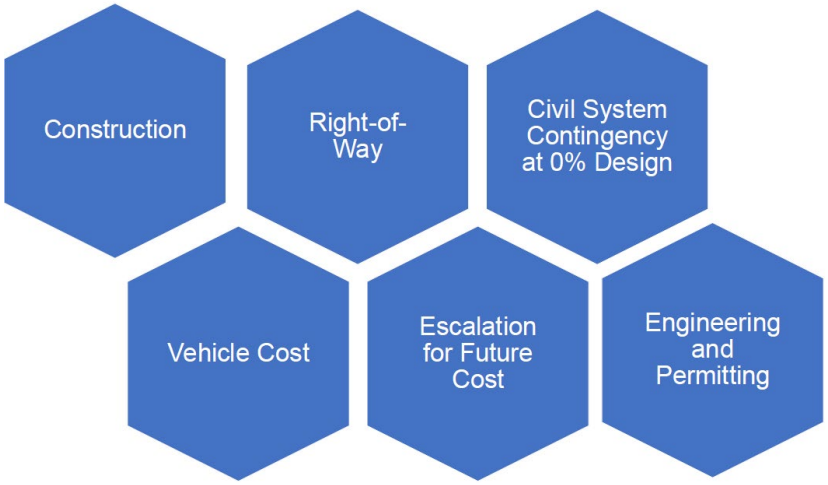
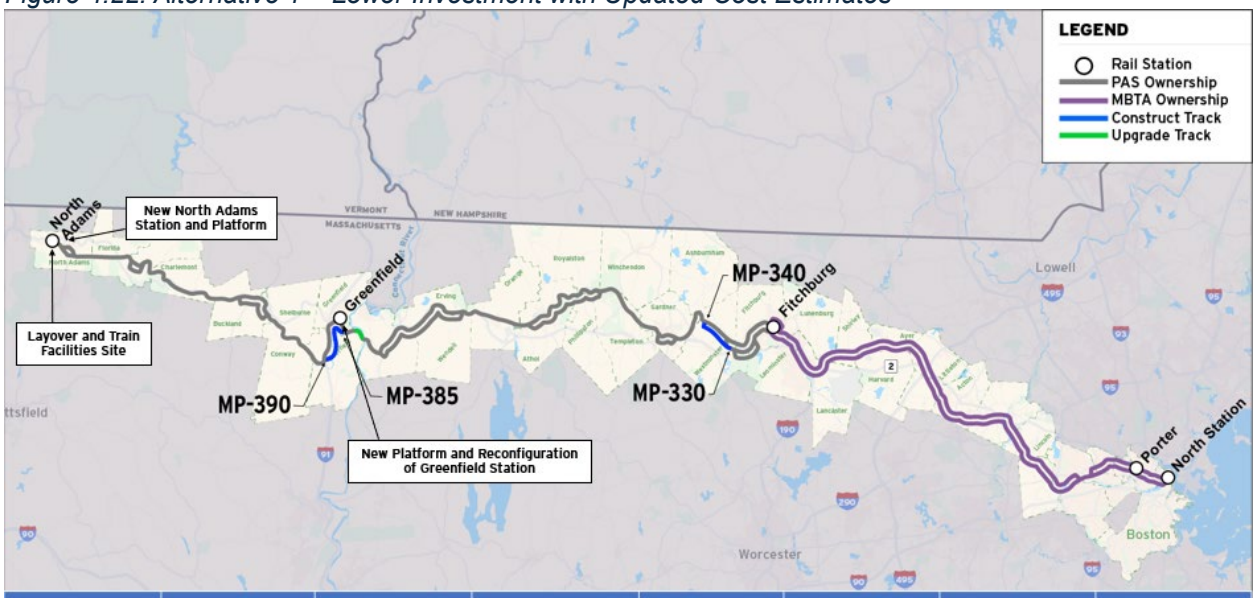
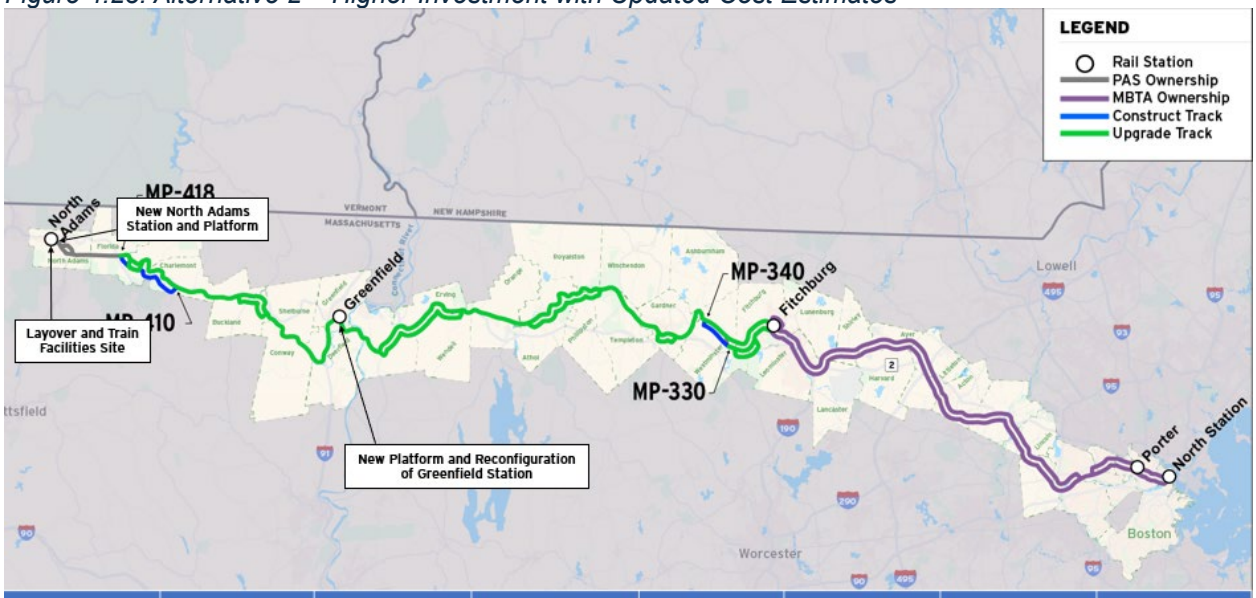


Figure 4.22: Alternative 1 – Lower Investment with Updated Cost Estimates



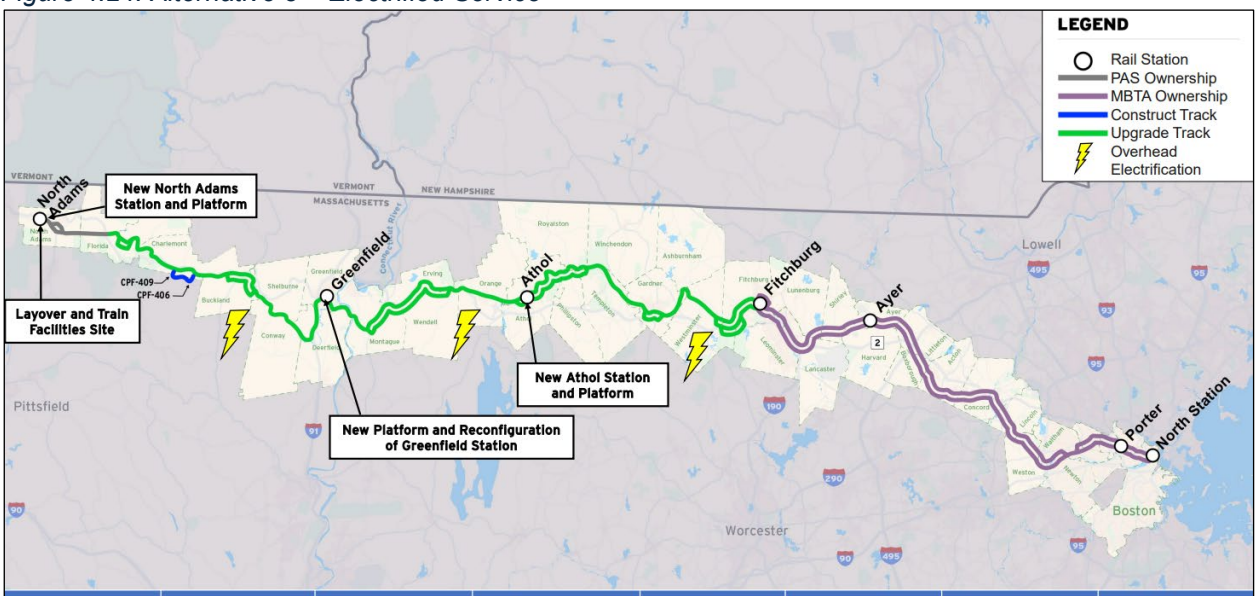
Track Work	Bridges	Signals & Grade Xings	Electrification	Stations	Layover	Rolling Stock	Total
$188,974,450	$429,711,003	$138,189,055	$0	$23,113,097	$15,660,145	$82,945,944	**$878,593,696**

Figure 4.23: Alternative 2 – Higher Investment with Updated Cost Estimates



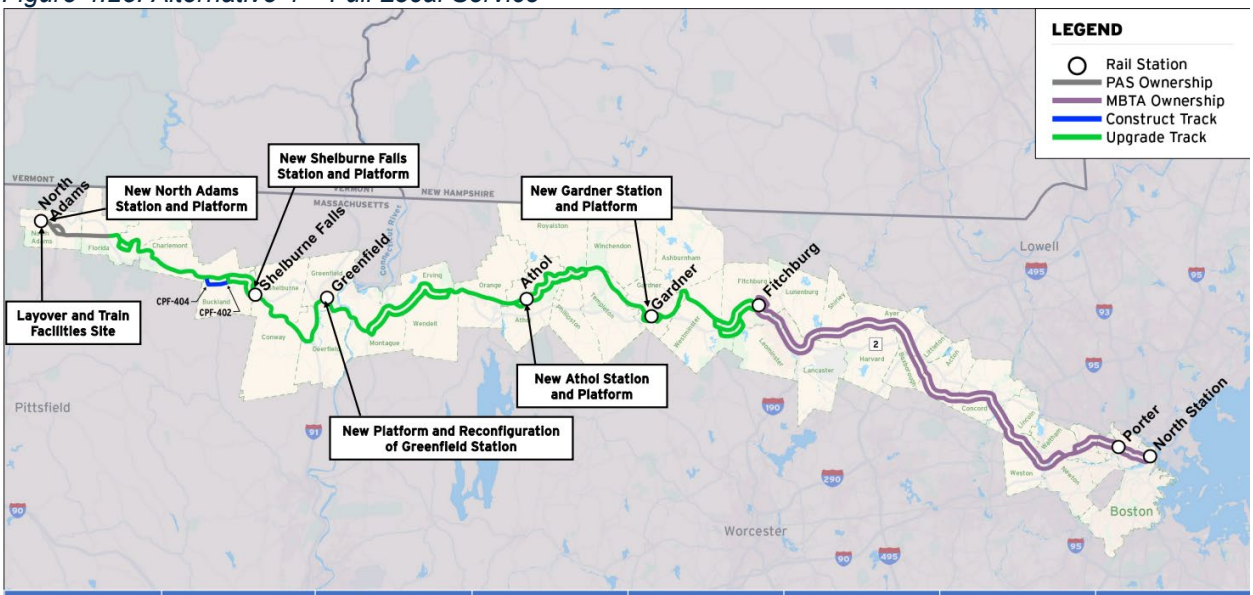
Track Work	Bridges	Signals & Grade Xings	Electrification	Stations	Layover	Rolling Stock	Total
$877,993,288	$429,711,003	$141,368,789	$0	$23,113,097	$15,969,632	$82,945,944	**$1,571,101,755**

Figure 4.24: Alternative 3 – Electrified Service



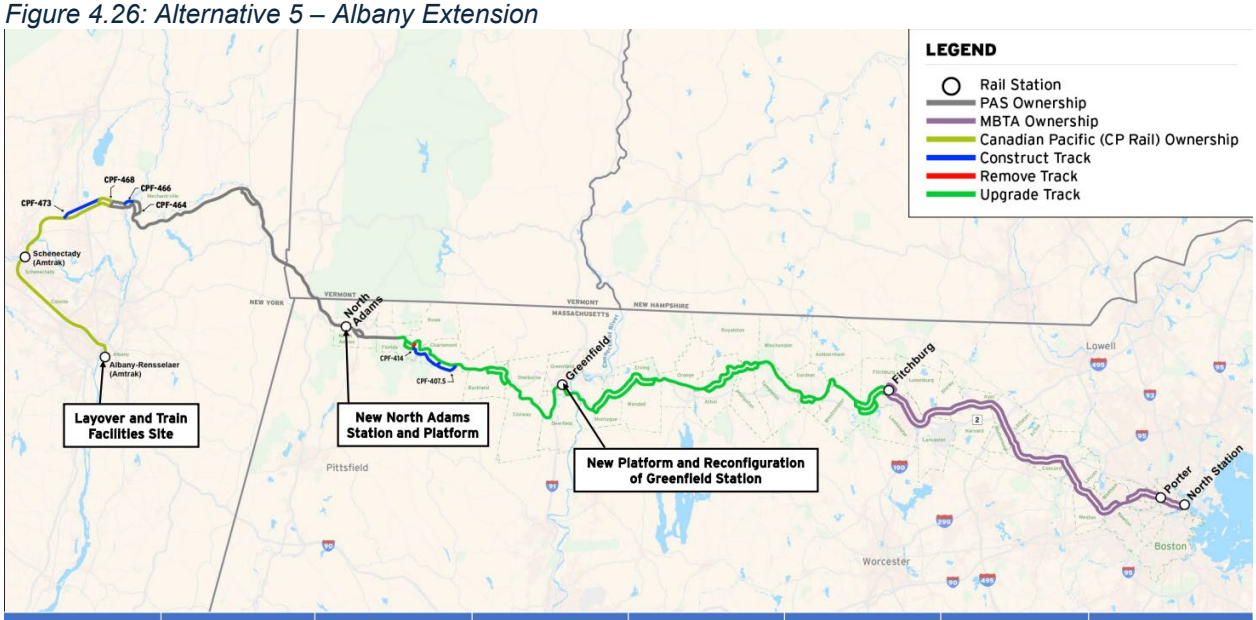
Track Work	Bridges	Signals & Grade Xings	Electrification	Stations	Layover	Rolling Stock	Total
$876,805,373	$429,711,003	$141,368,789	$1,325,887,659	$34,669,646	$15,969,632	$102,087,316	**$2,926,449,410**

Figure 4.25: Alternative 4 – Full Local Service



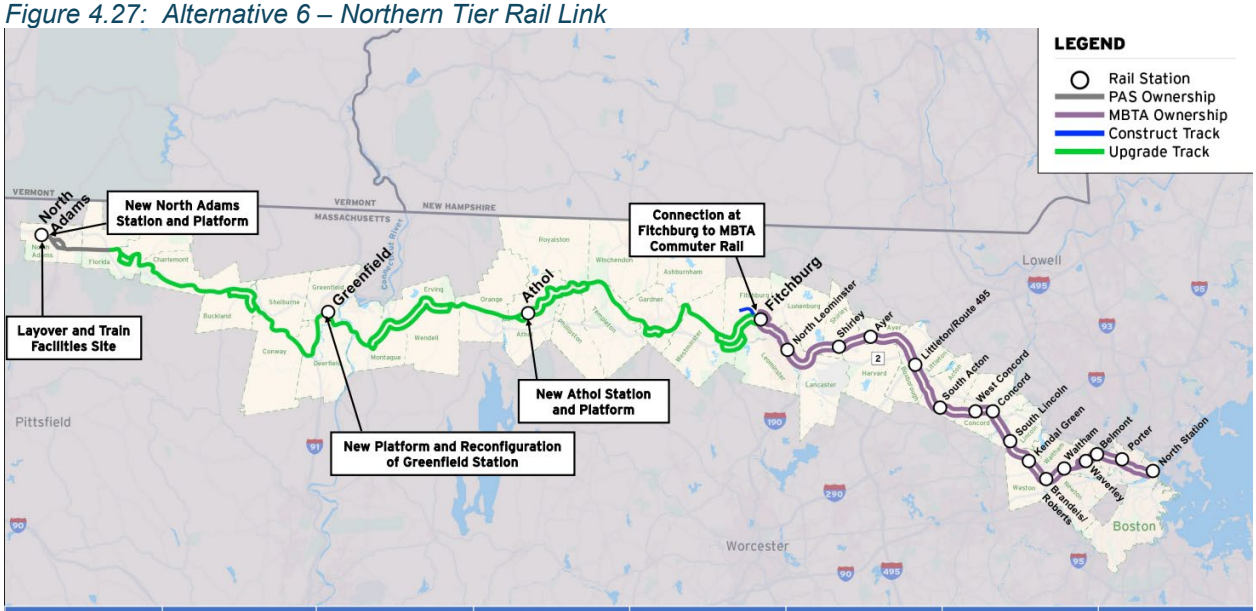
Track Work	Bridges	Signals & Grade Xings	Electrification	Stations	Layover	Rolling Stock	Total
$862,686,962	$429,711,003	$141,368,789	$0	$57,782,743	$15,969,632	$82,945,944	**$1,590,465,076**

Figure 4.26: Alternative 5 – Albany Extension



Track Work	Bridges	Signals & Grade Xings	Electrification	Stations	Layover	Rolling Stock	Total
$1,286,096,089	$429,711,003	$141,368,789	$0	$23,113,097	$0	$82,945,944	**$1,963,234,923**

Figure 4.27: Alternative 6 – Northern Tier Rail Link



Track Work	Bridges	Signals & Grade Xings	Electrification	Stations	Layover	Rolling Stock	Total
$853,049,390	$429,711,003	$141,368,789	$0	$34,669,646	$15,969,632	$82,945,944	**$1,557,714,406**

Table 4.7: Annual Capital Costs for Phase 2 Alternatives

Alternative	Total Capital Cost
Alternative 1 – Lower Investment	$878,593,696
Alternative 2 – Higher Investment	$1,571,101,755
Alternative 3 – Electrified Service	$2,926,449,410
Alternative 4 – Full Local Service	$1,590,465,076
Alternative 5 – Albany Extension	$1,963,234,923
Alternative 6 – Northern Tier Rail Link	$1,557,714,406

Mobility and Access

The two initial service alternatives developed in Phase 1 illustrated the potential mobility benefits of a Northern Tier passenger rail service. Similarly, each of the Phase 2 alternatives provide access benefits arising from the same daily train frequency and create a new mode of travel along the corridor. With five trains per day, all six alternatives provide additional frequency for both work-based and non-work-based trips, such as healthcare-related travel and leisure travel.

The Phase 2 alternatives assume the same higher level of investments of Alternative 3, which allows a 2-hour 49-minute travel time from North Adams to Boston, a travel time that is competitive with driving by personal vehicle during peak travel times. Other attributes of the Phase 2 alternative vary in the number of scheduled station stops. Additional station stops can increase travel time, which sometimes can reduce ridership. Conversely, additional stops can increase the availability of the service to new riders.

Transportation Cost Savings

These estimated transportation cost savings correspond directly to ridership. Alternatives 3 and 4 account for the greatest transportation savings. The lowest savings accrue to Alternatives 6 and 1.

Economic Impact

The inflow of money into an economy produces immediate and longer-term beneficial effects on employment and income and associated secondary (“indirect”) effects. The direct economic activity roughly correlates to the estimated total project cost over the duration of the infrastructure project, while the resulting secondary activity can produce a further boost that can make the overall economic impact of the investment exceed its direct cost. Accordingly, the projects with the two highest total project costs - Alternatives 3 and 5 – have the highest expected economic and employment impacts. The lower investment Alternative 1 has the least impact on both metrics.

The total project cost for Alternative 1 is the lowest of the estimates for the six alternatives. Alternative 3, with its added electrification infrastructure, has the highest total project cost. Construction cost is a factor that has advantages and disadvantages and illustrates some of the tradeoffs of the service alternatives. High initial costs can be a challenge to fund or finance. However, the higher cost of design and construction can increase the economic impact at the outset. Once operational, higher levels of project investment, such as more stations or electrification infrastructure, can lead to higher ridership. Therefore, the higher project costs can lead to lower costs per rider and other beneficial impacts of higher ridership.

Figure 4.28: Comparison of Economic Impacts for the Six Alternatives

Evaluation Criteria	Alt. 1 - Lower Investment	At. 2 – Higher Investment	Alt. 3 – Electrified Service	Alt. 4 – Full Local Service	Alt. 5 –Albany Connector	Alt. 6 – Northern Tier Rail Link
Economic Impacts from Construction Output (in millions)	$1,206 over 3 years	$2,263 over 4 years	$4,298 over 4 years	$2,337 over 4 years	$2,834 over 4 years	$2,285 over 4 years
Peak Employment (direct, indirect + induced)	2,679 jobs	3,763 jobs	7,167 jobs	3,980 jobs	4,745 jobs	3,857 jobs

Cost Effectiveness

Figure 4.29 shows the total project cost per route mile of the service. The Lower Investment Alternative 1 has the lowest cost per route mile. The Albany Alternative 5, with its longer route mileage and added investment level, produces the second lowest cost per mile.

Figure 4.29: Comparison of Cost Effectiveness for the Six Alternatives

Evaluation Criteria	Alt. 1 - Lower Investment	At. 2 – Higher Investment	Alt. 3 – Electrified Service	Alt. 4 – Full Local Service	Alt. 5 –Albany Connector	Alt. 6 – Northern Tier Rail Link
Estimated Annual Ridership	65,880 to 111,460	111,780 to 148,200	196,520 to 304,200	168,040 to 255,460	11,340 to 149,160	3,900 to 23,900
Capital Cost Per Mile	2,679 jobs	$11,064,097	$20,609,150	$11,200,458	$8,803,744	$10,969,819
Capital Cost Per Rider		$10,601 to $15,589	$9,620 to $14,891	$6,225 to $9,464	$13,161 to $19,565	$65,176 to $399,413

Total project cost per rider is shown for the lower end and the higher end of the range for each alternative. Alternative 4, with its full local service and associated estimated ridership, is projected to have the lowest and third lowest total project cost per rider. The higher total project costs may yield higher ridership which may be more cost effective per rider.

The highest costs per rider are associated with Alternative 6, the result of far lower ridership with only modest cost savings.

The annual cost of operations and maintenance (O&M) per rider is another cost effectiveness metric shown in Figure 4.30, with two measures for each alternative corresponding to the ridership range. The lowest O&M costs per rider are associated with Alternatives 3 and 4, as these alternatives are more expensive to design and build, but more cost effective to operate and maintain because they attract more riders. In contrast, the highest O&M costs per rider were produced by Alternative 6. These higher annual costs illustrate the relative impact of lower ridership estimates.

Figure 4.30: Annual cost of operations and maintenance for the Six Alternatives

Alternative	Total Annual Operations and Maintenance Cost*
Alternative 1 – Lower Investment	$29,584,447 ($265 - $449 per rider)
Alternative 2 – Higher Investment	$29,584,447 ($200 - $294 per rider)
Alternative 3 – Electrified Service	$29,584,447 ($97 - $151 per rider)
Alternative 4 – Full Local Service	$29,584,447 ($116 - $176 per rider)
Alternative 5 – Albany Extension	$46,388,580 ($311 - $462 per rider)
Alternative 6 – Northern Tier Rail Link	$19,305,989 ($1,941 – 4,950 per rider)

Note: Annual Operating and Maintenance Costs calculated based on length of operating service

Safety and Air Quality

The ridership estimated for the service alternatives is used to estimate the reduction in vehicle miles travelled per year (VMT) that correlates to the new train riders. Here the reduction in VMTs may be a leading indicator of improved safety and air quality. The new train passengers could result in fewer cars on the road, which could mean lower emissions of pollution and greenhouse gases, a net reduction in traffic congestion may reduce idling in traffic that could mean fewer emissions. And reduced VMT may mean fewer traffic accidents. As noted, this metric has two data points per alternative corresponding to the ridership range. The four largest estimated reductions in VMT were achieved by Alternatives 3 and 4. This illustrates another tradeoff between higher initial capital costs and continuing positive impacts that support service objectives, such as safety and air quality. Conversely, the four lowest VMT impacts were for Alternatives 5 and 1 – both among the lowest ridership alternatives.

Each alternative, except Alternative 5, has 69 current highway-rail at-grade crossings with a variety of warning systems. The Alternative 5 right of way has 119 grade crossings. During the design and permitting process, these grade crossings would be evaluated for average daily traffic (ADT), current warning systems and other characteristics. An array of mitigations could be considered, including grade crossing elimination, quiet zones, and closure and warning system upgrades. A project construction and commissioning plan would include broad and intense public awareness campaigns. Sponsoring agencies usually work with Operation Lifesaver, Incorporated (OLI) a national educational non-profit that specializes in training in prevention of collisions and injuries around railroads and grade crossings across the country.

Social Equity and Fairness

As in Phase 1, the study team evaluated mobility and access, and social equity and fairness by looking at zero-car households and the environmental justice (EJ) communities located near Northern Tier stations. A Northern Tier rail service may expand travel options for zero-car

households around Greenfield, North Adams, and other communities with stations. Phase 2 alternatives provide service more directly to Athol and Shelburne Falls with stations located in those communities, thereby further expanding potential travel options. These stations do increase the ridership of the alternatives that include them.

Impacts on Rail Capacity

The Northern Tier train schedules for all alternatives were developed to work with the MBTA's Commuter Rail service schedule. MBTA Commuter Rail trains and the current freight trains were incorporated into the model and produced minimal impacts on each.

Environmental and Cultural Resources

As with the Phase 1 Alternative 1, most of the infrastructure improvements and the modest increase in service for Phase 2 alternatives primarily stay within the existing right of way. This may minimize or simplify environmental permitting requirements. In the Albany Alternative 5, the North Adam Layover Facility and Yard is replaced by an assumed existing facility in New York State, thereby reducing the alternative's environmental exposure.

Benefit-Cost Analysis

A common methodology for evaluating the impacts of a potential investment through an economic lens is a benefit-cost analysis (BCA), which can provide useful input for selecting a preferred option among various alternatives that are being considered. The study team performed a preliminary BCA of the estimated benefits and costs of the six Northern Tier Passenger Rail service alternatives.

For Northern Tier Passenger Rail, key project benefits include safety, avoided road wear and tear, avoided congestion, avoided emissions, and property value increases near the proposed station areas, while project costs include the up-front capital costs necessary to realize the proposed service, along with ongoing operations and maintenance costs once the service is operational.[19] Notably, many Federal grant programs (including Consolidated Rail Infrastructure and Safety Improvements [CRISI] and Rebuilding American Infrastructure with Sustainability and Equity [RAISE]) require a BCA as part of the application.

The following benefit-cost evaluation measures were developed:

- Net Present Value (NPV): NPV compares the net benefits (benefits minus costs) after being discounted to present values using the discount rate. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.
- Benefit Cost Ratio (BCR): The present value of incremental benefits is divided by the present value of incremental costs to yield the BCR. The BCR expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of the costs.

Table 4.8 presents the Net Present Value, or the overall cash value of the benefits minus the costs,

[19] The conventional BCA approach using Federal guidance results in negative benefits due to the requirement to count operating and maintenance (O&M) costs as disbenefits, rather than as costs. For ease of understanding the outcome of the BCA, this modified approach counts O&M as costs rather than disbenefits.

and the Benefit Cost Ratio, or the value of the overall benefits value divided by the costs.[20] A ratio of 1.0 or higher makes a project more competitive for discretionary grants under current federal rules.

Table 4.8: Modified BCA Summary, millions of 2021 $ (discounted at 7 percent unless otherwise stated)

BCA Metric	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
O&M Net Savings	- $265.7	- $238.5	- $206.5	- $223.5	- $387.4	- $182.5
Safety Benefits	$2.3	$3.8	$6.1	$6.2	$3.8	$0.1
Avoided Road Wear and Tear	~$0.0	$0.1	$0.1	$0.1	$0.1	~$0.0
Avoided Congestion	$2.0	$3.3	$5.4	$5.4	$3.3	$0.1
Avoided Emissions (except CO_2)	- $0.2	- $0.1	$0.1	- $0.1	- $0.2	- $0.1
Avoided Emissions (CO_2 only)*	$0.8	$1.3	$2.4	$2.2	$1.3	~$0.0
Property Value Increase	$21.9	$20.5	$27.9	$42.6	$20.5	$31.9
Total Benefits	- $238.8	- $209.5	- $164.5	- $167.0	- $358.7	- $150.6
Total Costs	$542.1	$941.7	$1,701.3	$953.4	$1,177.8	$964.5
NPV	- $780.9	- $1,151.2	- $1,865.8	- $1,120.4	- $1,536.5	- $1,115.1
BCR	- 0.44	- 0.22	- 0.10	- 0.18	- 0.30	- 0.16
O&M Net Savings	- $265.7	- $238.5	- $206.5	- $223.5	- $387.4	- $182.5

* Discounted at 3% rate

Table 4.9 shows the results of a sensitivity analysis, which examined halving the capital and O&M costs. The Net Present Value range under these reduced cost circumstances ranges from -$370 million to -$893 million.

Table 4.9: Impact of Halving Capital and O&M Costs to Break-Even Ridership Multipliers (millions of 2021 dollars)

BCA Metric	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
O&M Net Savings	-$125.68	-$107.58	-$84.20	-$92.59	-$182.21	-$91.08
Safety Benefits	$2.30	$3.80	$6.10	$6.20	$3.80	$0.10
Avoided Road Wear and Tear	~$0.0	$0.10	$0.10	$0.10	$0.10	~$0.0
Avoided Congestion	$2.00	$3.30	$5.40	$5.40	$3.30	$0.10
Avoided Emissions (except CO_2)	-$0.20	-$0.10	$0.10	-$0.10	-$0.20	-$0.10
Avoided Emissions (CO_2 only)*	$0.80	$1.30	$2.40	$2.20	$1.30	~$0.0
Property Value Increase	$21.90	$20.50	$27.90	$42.60	$20.50	$31.90
Total Benefits	-$98.88	-$78.68	-$42.20	-$36.19	-$153.41	-$59.08
Total Costs	$271.05	$470.85	$850.65	$476.70	$588.90	$482.25
NPV	-$369.93	-$549.53	-$892.85	-$512.89	-$742.31	-$541.33
BCR	-$0.36	-$0.17	-$0.05	-$0.08	-$0.26	-$0.12

* Discounted at 3% rate

[20] The time horizon over which the BCA and NPV was calculated consisted of the construction period plus thirty years of operation. With the years of design and construction varying by scenario, the overall duration varied somewhat across the scenarios.

Each alternative has some advantages. The BCA quantifies some aspects of the relative merits of the alternatives. However, stakeholders and policy makers may balance the tradeoffs among alternatives.

Findings

Each of the six alternatives could provide economic benefits for the region, in proportion to the magnitude of the total project costs. Schedules and service that attract riders could be created that minimize interference with existing freight and passenger rail service. Based on the numerous areas of environmental and cultural sensitivity that have been noted and inventoried, most of the alternatives remain primarily within the existing right-of-way, which should minimize environmental permitting issues.

Each alternative provides some benefits associated with the estimated level of ridership, with more benefits accruing to the alternatives with higher ridership, including:

- Reduced project and operating costs per rider
- Transportation cost savings for individuals
- Air quality and safety benefits
- Mobility and social equity

CHAPTER 5: PASSENGER RAIL PLANNING AND IMPLEMENTATION PROCESS OVERVIEW

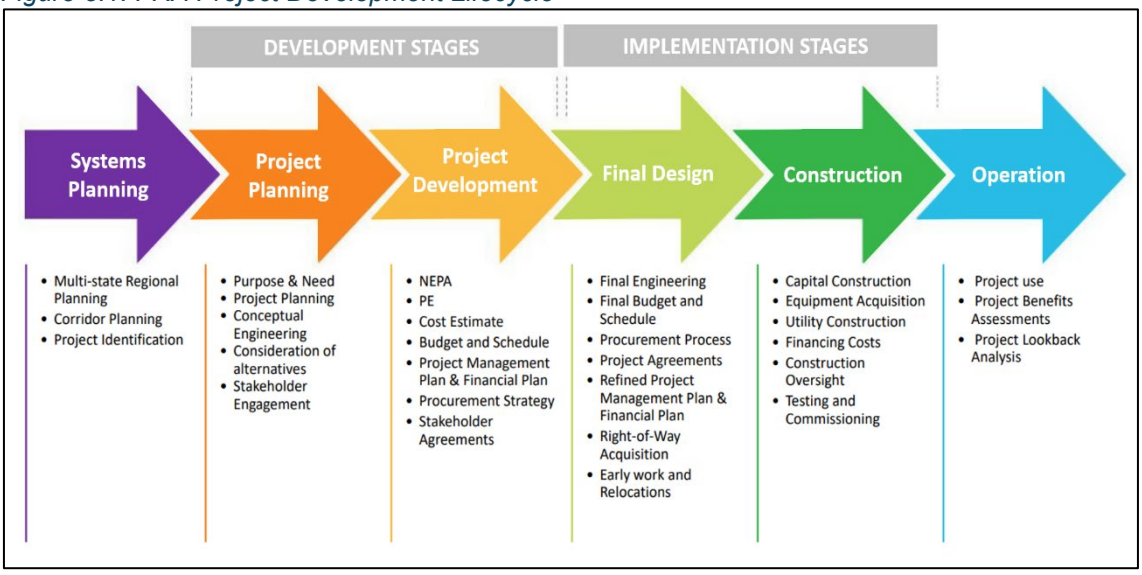
The environmental permitting, engineering, and design that precede construction are essential and often lengthy processes. In addition, the provision of rolling stock is a critical consideration in establishing a timeline to initiate a passenger rail service. These processes have conditions that must be met before they can begin.

This chapter provides a high-level overview of the passenger rail planning and implementation process, including planning, permitting, financial, and institutional coordination activities that must be performed and are necessary for any passenger rail project implementation.

Passenger Rail Project Development

The Federal Railroad Administration organizes the steps required to implement an intercity passenger rail project into six stages.

Figure 5.1: FRA Project Development Lifecycle



Source: Guidance on the Development and Implementation of Railroad Capital Projects U. S. Department of Transportation Federal Railroad Administration January 11, 2023

Systems Planning is "a high-level planning process …[that] examines broad needs, challenges and opportunities that can be addressed with a transportation-related solution, including capital projects."[21] This planning takes place in a multimodal context in which rail is one of the possible transportation solutions. The Northern Tier Passenger Rail Study is in this pre-development stage of corridor planning.

Development Stages

[21] Federal Railroad Administration Guidance on the Development and Implementation of Railroad Capital Projects, page five. https://railroads.dot.gov/sites/fra.dot.gov/files/2023-01/FRA%20Guidance%20on%20Development%20and%20Implementation%20of%20Railroad%20Capital%20Projects.pdf.

During the Project Planning stage, the sponsoring agency "identifies capital project concepts to adequately address transportation needs and opportunities."[22] This stage includes analysis of the project alternatives that supports the decision-making processes to determine the solutions to implement. Also, the sponsoring agency would engage the various stakeholders in the planning process to assist in evaluating project impacts.

The Project Development stage includes design, environmental and related analysis "to ensure the project is ready for implementation."[23]

Implementation Stages

Final Design is the stage at which the Federal Railroad Administration may consider project funding. Final design produces the engineering plans necessary to proceed to construction.

In addition to the actual construction of the railroad infrastructure such as track and signals, the Construction stage includes the acquisition of rail rolling stock and the testing and commissioning of the fixed infrastructure and the rolling stock. Commissioning ensures the railroad system is functioning properly and is ready to begin service in the next stage, Operation.

The Operation stage includes the provision of service to its end users and the continuing assessment of the project and its benefits.

If the project will engage other states or have multistate impacts, the project proponent would have to advance Multi-state Regional Planning. To qualify for Federal Railroad Administration funding, a project would have to be defined and identified in a future Federal Railroad Administration process.

Systems Planning would continue until Project Identification and funding are approved to move into Project Planning. If interim phasing of services is considered, such as seasonal and/or weekend service, the project could extend over several Federal Railroad Administration and state grant cycles.

As the project moves into the Project Planning stage, the project proponent and its partners would need to advance a series of steps to allow for conceptual engineering. Planning with stakeholder engagement would lead to a set of alternatives and a preferred alternative.

Sample Implementation Timeline

The timeline for negotiations for any given agreement is unique to the specific conditions of the project and the relationships and relative negotiating positions of the parties.

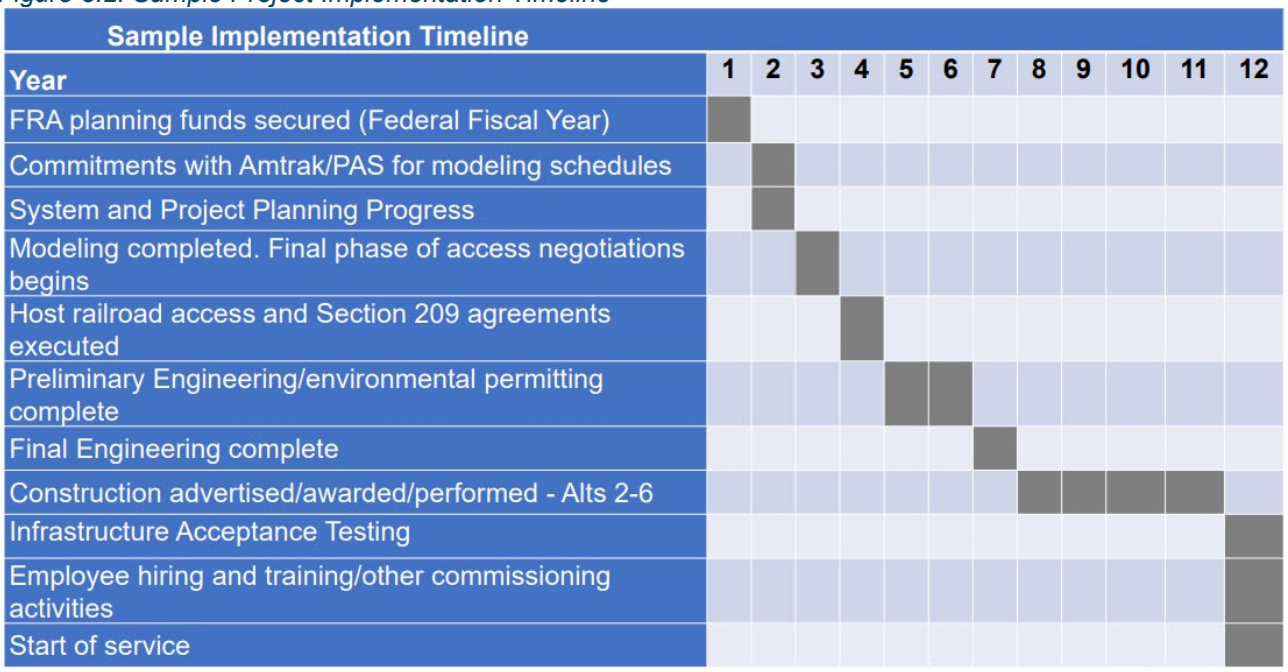
While host railroads often prefer to perform as much work as possible with their own forces, railroads operating along the corridor could contract out construction due to staffing availability and any specialized work that may be needed. For example, any electrified work likely would require specialized workforces. Therefore, a bidding process would be assumed.

The timeline commences with confirmation of funds for rolling stock, design, permitting and construction and assumes necessary additional planning would be performed as funded while the major funding is secured. It illustrates the building blocks that are used in systems planning and

[22] Ibid.
[23] Ibid., 8.

project planning: planning, funding applications, iterative negotiations, and service modeling leading to agreement on infrastructure improvements.

Figure 5.2: Sample Project Implementation Timeline



Source: HNTB

The first step in this timetable is securing funds for additional planning. The sponsoring agency could start to engage with the planned operator and the owner and/or operator to agree on data sharing and an approach to modeling the proposed service. The modeling progresses as System and Project planning continue.

When the modeling is complete, the proposed service alternative schedule and required infrastructure elements are refined. The sponsoring agency and the railroad owner/operator would have the information necessary to negotiate the terms and conditions under which the owner/operator would allow the sponsoring agency to use its right of way for the new passenger rail service. The terms might include the commitment of the sponsoring agency to fund all infrastructure upgrades necessary to operate the passenger service. In parallel with the access negotiations, the sponsoring agency could negotiate a PRIIA Section 209 agreement with the designated passenger train operator.

The passenger rail project would then move into Project Development which ends when preliminary design/engineering and environmental permitting are complete. Project Implementation begins with final engineering. Final design plans allow the project to move into the Construction stage. At various phases of construction, the infrastructure is tested for compliance with the plans and specifications. Final testing and commissioning activities prepare the railroad for service. This includes training of the operating crews on the updated right of way. With testing and commissioning complete, the sponsoring agency and railroad owner/operator can authorize the commencement of service.

Passenger Rail Equipment – Locomotives and Coaches

The arrangement for rolling stock is not included in this sample timetable, as there are several alternatives for the acquisition of rolling stock. The passenger rail service operator may supply the rolling stock for state-sponsored services, unless the sponsoring state chooses to use equipment it owns or plans to purchase.

To address a potential need for additional rolling stock, coaches could be refurbished to cover any gaps.

Potential Funding Opportunities

Intercity passenger rail services are primarily funded through a mix of federal, state, and local sources.

While capital costs are often substantially funded by the federal government, ongoing operating and maintenance costs are typically born by state budgets. One notable exception is the *Downeaster*, which relied in part on federal Congestion Mitigation and Air Quality (CMAQ) Improvement funding to support operations following its inception in 2001.

Federal

At the federal level, most potential sources of funding for capital improvements are in the form of discretionary grants. Presently, these include the following programs:

- The **Consolidated Rail Infrastructure and Safety Improvements** (**CRISI**) Program, which supports projects that improve the safety, efficiency, and reliability of intercity passenger and freight rail.
- The **Federal-State Partnership for Intercity Passenger Rail Grant** Program provides funding for capital projects that reduce the state of good repair backlog, improve performance, or expand or establish new intercity passenger rail service.
- The **National Infrastructure Project Assistance Program** (**MEGA**) supports large, complex projects that are likely to generate national or regional economic, mobility, or safety benefits.
- The **Nationally Significant Multimodal Freight & Highway Projects** (**INFRA)** program is for multimodal freight and highway projects of national or regional significance to improve the safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas.
- The **Rural Surface Transportation Grant Program** supports projects that improve and expand the surface transportation infrastructure in rural areas to increase connectivity, improve the safety and reliability of the movement of people and freight, and generate regional economic growth and improve quality of life.
- The **Railroad Crossing Elimination Grant Program** provides funding for highway-rail grade crossing improvement projects.
- The **Rebuilding American Infrastructure with Sustainability and Equity** (**RAISE**, previously BUILD and TIGER) program can fund road, rail, transit, and port projects that promise to achieve national objectives.
- Under the **Restoration and Enhancement** grant program, federal funds may be used to cover a share of the operating costs of new passenger train services that decline from 90% to 30% over six years.

These programs are highly competitive, with success depending in part on presenting a strong case with respect to benefit-cost analysis and mobility improvements, and typically require non-

federal matching funds to be eligible.[24] Applications through the INFRA, MEGA, and Rural programs would need to make a freight-focused case.

The Intercity Rail Corridor Identification and Development (Corridor ID) Program is intended to create a pipeline of intercity passenger rail projects ready for implementation. Corridors selected to be part of the program will be eligible for future federal formula funding. Currently in its initial implementation phase, the first round of Corridor ID applications was on March 20, 2023, with selections announced in late 2023. All selected recipients receive $500,000 in initial funding that can be applied towards various planning efforts, depending on the current state of the corridor and planning needs. Additional funding would then be provided on a formula basis.

In addition, passenger rail projects are eligible under two federal loan programs (the Railroad Rehabilitation and Improvement Financing (RRIF) program and the Transportation Infrastructure Finance and Innovation Act (TIFIA) program) both require a revenue source for repayment. Environmental permitting strategies have to be coordinated with funding strategies to ensure permitting approach meets federal requirements.

State

Funding sources could include direct legislative authorization or use of State Bond Cap funds. The Bond Cap is Commonwealth General Obligation bond proceeds that are allocated to specific projects, primarily for project design, management, operations, and other construction support. In addition, the Commonwealth Rail Enhancement Program (REP) is a dedicated initiative for reliability, modernization, and expansion initiatives.

MassDOT contributes money from its operating budget to support operations on the Amtrak Hartford Line, *Valley Flyer*, and *Vermonter*, consistent with requirements for PRIIA Section 209 State-Supported Amtrak Services. MassDOT's non-toll operating budget is primarily funded through the Massachusetts Transportation Trust Fund and Commonwealth Transfer Fund.

Local

Some transportation agencies have formalized agreements and/or cost allocation formulas defining how much funding will be allocated every year by municipal partners and how cost sharing by funding partners is determined. These transit agencies generally do not have a dedicated funding source, and most of their revenue comes from jurisdictions in the service area. Examples include Hampton Roads Transit and Washington Metropolitan Area Transit Authority (WMATA) in the Washington, D.C. area. In these cases, the local funding model distributes operating and capital funds across the jurisdictions.

Value capture is one funding strategy by which public or private entities capture a portion of the increased land value resulting from infrastructure improvements, rezoning, or other development activities. This mechanism allows these entities to fund public projects or initiatives by harnessing the enhanced value that arises due to the improvement, ensuring that the public benefits from the economic gains generated by real estate growth and transformation.

Tax increment financing (TIF) is a second approach to capturing new value generated by rail line development. In Massachusetts, the Urban Center Housing Tax Increment Financing Program limits those improvements to promotion of housing and commercial development. Using a TIF, a

[24] Higher local shares are viewed more favorably in many instances.

municipality issues bonds to pay for improvements in a designated district and then repays those bonds with the additional tax revenue generated from the resulting property value increases. In this case, station improvements, local transportation facilities, or other capital improvements related to the rail service could be funded through a TIF.

Parking User Fees

Parking revenues from surface lots and structured parking facilities alongside stations and owned by the local municipality or the rail service operator, could contribute to funding the service. There are a number of different approaches to pricing the parking in these facilities, including charging daily parking fees, monthly reserved parking, short-term metered parking, and long term/multiday parking.

Joint Development

Joint development refers to private real estate development or development partnerships on transit agency properties within or adjacent to transit stations to promote Transit-Oriented Development (TOD). A variety of development solicitation structures are used for joint developments.

Most agencies prefer to use long-term land leases to secure a long-term revenue stream and maintain control over development and land use surrounding stations and protect transportation functions. However, land leases are not always appropriate, and agencies employ a variety of techniques to partner with private developers. Developer agreements and deed restrictions (e.g., covenants, codes, and restrictions) can be used to specify the nature of development and land use if agency property is sold to a private party. Deed restrictions specify allowable uses and other criteria and can be attached to a property in perpetuity if desired. Subdividing critical property such as parking, pedestrian circulation, and the station platform from the larger transit-oriented development is also a way to ensure that operations are protected.

The expected rate of return on the land varies greatly depending on a variety of factors, including the real estate market and the relative importance of revenue generation in comparison to other objectives. An acceptable land lease or sale rate will vary within an individual market depending on the attractiveness of the location and the immediate area real estate conditions.

Naming Rights

Naming rights are a payment for the right to put a company name on a piece of infrastructure. In the context of transit, this could mean a transit station or rail line. Commonly used in other settings such as sports stadiums or arenas, there are relatively few examples in transit. Southeastern Pennsylvania Transportation Authority (SEPTA) and Metropolitan Transportation Authority (MTA) have sold naming rights to stations near sports arenas, Cleveland's Bus Rapid Transit (BRT) line is sponsored by a medical center, and Dallas Area Regional Transit (DART) is offering the naming rights for four train lines and 61 stations. In 2016, RTD-Denver sold naming rights for the A train (between Downtown and Denver International Airport) to the University of Colorado for $5 million for 5 years (annual revenue of $1 million). Naming rights for transit lines and stations are somewhat controversial, in particular in cases where the name might reduce the ease of wayfinding.

Permitting Requirements

Projects supported in part by funding from the Federal Railroad Administration (FRA) may warrant regulatory review in compliance with the National Environmental Policy Act (NEPA). NEPA requires

that a federal agency disclose the effects of any agency action (including permitting or financial assistance) on the environment.

There are three classes of action that direct the level of documentation required to comply with NEPA, ranging from the simplest (Categorical Exclusions (CE)) to the most complex (Environmental Impact Statements (EIS)).[25] A class of action determination is dependent on the scope of work and due to the level of reporting and agency coordination requirements, has varying implications on project schedule.

The project sponsor and recipient of FRA funds, in coordination with FRA, would be responsible for identifying and preparing the appropriate level of NEPA documentation. The class of action determination must be approved by the lead federal agency in advance of preparation.

Categorical Exclusion (CE)

A CE is a category of federal agency action that does not individually or cumulatively have a significant effect on the human environment.[26] The project sponsor must demonstrate that the scope of work meets the criteria for categorical exclusion and does not involve any unusual circumstances that may require additional NEPA documentation. The FRA lists actions that typically meet the criteria for Categorical Exclusion at 23 CFR 771.116(c). NEPA review is complete when the lead federal agency approves the application of a CE for the project. A typical timeline for processing a CE is 90 days.

Environmental Assessment (EA)

An EA is a category of federal agency action that has the potential to result in significant impacts to the human environment. The Fiscal Responsibility Act, which was signed into law by President Joseph Biden in June 2023, requires that an EA be completed by the project sponsor within one-year.[27]

The EA should include the purpose and need for the proposed action, discussion of alternatives, and the environmental impacts associated with each.[28] If the lead federal agency determines that the proposed action will not result in significant environmental impacts, the agency will issue a Finding of No Significant Impact (FONSI) to complete the NEPA process. If the EA concludes that the proposed action will result in significant environmental impacts, the proponent will prepare an Environmental Impact Statement.[29]

Environmental Impact Statement (EIS)

An EIS is a category of federal agency action that will result in significant impacts to the human environment. The Fiscal Responsibility Act requires that an EIS be completed within two years.

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[25] https://railroads.dot.gov/rail-network-development/environment/fra-nepa-documentation

[26] https://railroads.dot.gov/rail-network-development/environment/fra-nepa-documentation#:~:text=Categorical%20Exclusion%20(CE),required%20(40%20CFR%201508.4)

[27] https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section4336a&num=0&edition=prelim#:~:text=(A)%20Right%20to%20petition,order%20under%20subparagraph%20(B).

[28] https://www.epa.gov/nepa/national-environmental-policy-act-review-process#:~:text=Summary%20of%20the%20EIS%20Process&text=A%20draft%20EIS%20is%20published,provides%20responses%20to%20substantive%20comments.

[29] https://railroads.dot.gov/rail-network-development/environment/fra-nepa-documentation

The project sponsor must prepare a Draft EIS (DEIS), which includes the purpose and need for the proposed action, discussion of alternatives, and the environmental impacts associated with each. The DEIS is then subject to public comment for a minimum of 45 days. The nature and extent of public comments will inform the need for further analysis. A Final EIS is then published, which refines the proposed action and provides responses to substantive public comments. An EIS is developed in parallel with Preliminary Engineering. The EIS process concludes with the issuance of a Record of Decision (ROD), which summarizes the federal agency action, evaluated alternatives, and plans for mitigation and monitoring.[30]

For complex projects that will result in significant impacts to the human environment, the lead federal agency may adopt a tiered approach to complete the NEPA process. A tiered approach provides a broad project-wide analysis of environmental impacts through preparation of a Tier 1 EIS and a more detailed analysis of specific project components through preparation of a Tier 2 study. Tier 2 studies may be an EIS, EA, CE, or a combination of classes of action. As funding becomes available, FRA should be consulted to confirm the appropriate class of action for compliance with NEPA. Except for the circumstances provided in 23 CFR 771.113(d), the final design, property acquisition, purchase of construction materials or project construction cannot begin until the NEPA process has been completed.

[30] https://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(38)_FR.pdf

CHAPTER 6: FINDINGS & RECOMMENDATIONS

In the preceding chapters, the estimated benefits, costs, and investments related to Northern Tier Passenger Rail have been outlined. Thus, this chapter begins with the key findings and conclusions of the study, and the opportunities and challenges that must be addressed.

The chapter concludes with recommended next steps for consideration.

Key Findings

The following travel patterns were identified along the corridor:

- The majority of daily trips stay within the segment of the Northern Tier corridor from which they originate.
- The East segment shows a strong orientation toward communities in and around Boston. The Central segment shows Fitchburg, Leominster, and Gardner as the top three destinations for trips originating in the segment. The West segment has a strong north-south orientation for trips, suggesting that many people living in the region travel to Pittsfield and Springfield for work, medical care, or other trip purposes.
- West of I-495, travel in the corridor is predominantly by motor vehicle use.
- Typical travel time between North Adams and Boston ranges from 2.5 to 3 hours.

With respect to the potential service alternatives, while all of the service alternatives provide connectivity, mobility, and transportation choice in the Northern Tier corridor, Alternative 3 (Electrified Service) and Alternative 4 (Full Local Service) achieve the highest ridership levels of the six potential alternatives. Alternative 3 is estimated to have its estimated annual ridership range between 196,520 and 304,200 riders. Alternative 4 is estimated to have its annual ridership range between 168,040 and 255,460 riders.

Higher ridership levels represent more reductions in vehicle miles travelled (VMT) and equate to reduced automobile emissions and crashes. Alternatives 3 and 4 also lead this ridership-based metric of the six service alternatives examined.

Alternative 3, with its extensive electrification infrastructure, has the highest total capital cost with accompanying economic benefits.

The community and safety impacts are the same for all alternatives except the Albany Extension Alternative 5, which has more grade crossings over its longer route. The other alternatives have the same number of crossings and trains and therefore the same safety exposure.

Stakeholders have expressed support for Alternative 3 and Alternative 4, as well as Alternative 5 (Albany Extension) and have expressed interest in additional stops along the corridor (e.g., Williamstown and Charlemont).

The lowest annual cost of operations and maintenance per rider are associated with Alternative 3 and Alternative 4. These alternatives are more expensive to design and build, but more cost effective to operate and maintain because they are estimated to have the highest ridership of the six alternatives.

Given the estimated benefits and costs associated with each of the six alternatives, the benefit-cost analysis indicates that the benefits may not offset the capital costs required for implementation.

Conclusions

While the fundamental scale of ridership and cost is established, more work would be needed to further develop the markets, ridership, costs and benefits from a transportation planning perspective. The benefit-cost analysis detailed in Chapter 4 indicates the challenges presented in applying for and receiving federal funding under current discretionary grant program criteria.

This assessment reveals a complex set of opportunities and challenges. It represents the beginning of a process of further action that may lead to enhanced transportation access and improved economic opportunities for Massachusetts' Northern Tier corridor. Key conclusions are as follows:

1. **Based on current demographic and economic trends, much of the projected ridership is concentrated on the section east of Fitchburg** where the opportunity for a 30-minute reduction in travel time to Boston could attract new riders who are not using the existing MBTA Commuter Rail service.
2. **Due to the timeline for implementing any passenger rail service corridor, mobility improvements should be explored** that could provide connectivity in the shorter term. Similarly, coordinated regional and municipal planning to support any implementation should be undertaken.
3. **The rail along the Northern Tier corridor is a strategic asset for the entire Commonwealth and should be treated as such**. The line provides a vital alternative to the CSX former Boston and Albany route between Selkirk, NY, Springfield, and Worcester. Given the competitive options for freight service that this route offers, the societal and environmental benefits of freight rail, as well as utility for mitigating increasing climate risks, ensuring a long-term future for this route is warranted. The significance of this route for handling freight should also be considered in the context of service between Pittsfield and Boston, which will see increased use of the CSX main line for passenger rail service and thus the potential need to provide alternative routing for freight traffic.

Although the creation of the Pan Am Southern joint venture between Pan Am and Norfolk Southern in 2009 brought significant improvements to the corridor through a series of rail and tie upgrades, overall conditions west of Wachusett may necessitate significant investment to achieve a state of good repair (not including capacity improvements for passenger rail service).

At present, most of the route west of Wachusett is being operated at speeds of up to 30 miles per hour for freight. While much of the expense for improvements may be borne by the private owners, some public investment may be necessary such as renewal of the Hoosac Tunnel. Furthermore, to ensure the long-term vitality of the route for freight, clearances should be raised to accommodate domestic double-stack intermodal service. MassDOT has progressed this process with its Patriot Corridor Double-Stack Clearance Initiative evaluation of the corridor from Ayer to the Vermont state line.[31] The study identified 23 structures that require modification for double-stacked container trains. Further action will depend on the availability of funding for design and construction.

[31] https://www.mass.gov/patriot-corridor-double-stack-clearance-initiative

Issues and Opportunities

Passenger rail service development involves a variety of agencies, communities, and other stakeholders. As a result, the potential re-introduction of passenger rail service presents a number of challenges and opportunities.

Governance. As part of Chapter 176 of the Acts of 2022, the Western Massachusetts Passenger Rail Commission was established to identify entities that could build and manage intercity passenger rail service. Comprised of elected officials and planning and transportation agency representatives, the Commission conducted several meetings across Western Massachusetts, hearing testimony and presentations. The Commission released its final report in November 2023 which determined that MassDOT should continue to lead the Commonwealth's programs for planning, developing, and managing intercity passenger rail services.

Integration with Other Services. MassDOT through its Rail and Transit Division announced a new approach and brand for the Commonwealth's present and future intercity rail services: Compass Rail. This approach, with includes Amtrak, CSX, the states of Connecticut, New York and Vermont and other partners, aims to unify east-west and north-south services with a robust hub in Springfield where intercity services meet. Should potential service along the Northern Tier advance to further stages of development, it could become part of Compass Rail.

Access Considerations. MassDOT has determined that intercity services would be operated by Amtrak as a state-supported service under Section 209 of the Passenger Rail Investment and Improvement Act (PRIIA) of 2008. Section 209 of PRIIA established the framework for cost allocation between state-sponsors of intercity service and Amtrak.

Amtrak has a statutory right to access the rights-of-way of other railroads in order to operate passenger rail service. Under federal law, Amtrak has the right to operate its trains on any railroad, including private freight railroads. However, securing those rights requires the negotiation of terms and conditions of access with the host (owner) railroad. The terms and conditions include changes or additions to the railroad infrastructure, liability, maintenance and on-time performance standards and fees for access.

An arrangement with Amtrak would include an agreement in principle as to whether Amtrak or MassDOT would take the lead in the negotiation of the access rights with the host railroad. On the Northern Tier corridor, the host railroads are the MBTA and the Pam Am Southern, owned by CSX and Norfolk Southern. Regardless of who takes the lead in the negotiation of the access agreement, the negotiation likely would be preceded by an agreement on a process to model the operation for one or more alternatives on the host railroad right-of-way. This modeling has several purposes, chief among them is to provide an understanding of the impact of the proposed passenger schedule on the host railroads' services.

The modeling also demonstrates the infrastructure elements that are required to operate new and current services at the required level of performance. With this information, MassDOT (directly or as Amtrak's client) can initiate the negotiation of access agreements with the host railroads; these agreements would confirm the infrastructure elements that are required for the service. This coordination on infrastructure is essential to moving into the Project Development Phase when environmental permitting and preliminary engineering can advance.

This discussion of timeline assumes that MassDOT would be able to negotiate with the MBTA for the use of the Fitchburg Line because the Northern Tier service alternatives are based on compatibility with existing MBTA infrastructure and current MBTA service.

MassDOT's experience with the East-West Passenger Rail project illustrates part of this process. The East-West Passenger Rail Study concluded in 2021, which examined rail service alternatives along the Boston-Worcester-Springfield-Pittsfield corridor. The CSX acquisition of Pan Am Railways and its share of Pan Am Southern needed to be resolved before additional actions could progress. The Surface Transportation Board's approval of the CSX acquisition included certain CSX commitments to work with Amtrak and MassDOT on passenger rail service on the East-West corridor.

In December 2022, MassDOT, in partnership with Amtrak and CSX, applied for a Consolidated Rail Infrastructure and Safety Improvements (CRISI) grant from the FRA to fund certain capacity improvements between Worcester and Springfield. The grant is specifically geared to the Inland Route; however, its improvements would be an essential foundation to an East-West Service. In the summer of 2023, MassDOT, CSX, and Amtrak worked together to initiate the modeling of the CSX right of way, to be completed in the spring of 2024. The modeling results will refine the list of infrastructure improvements to be designed and constructed under the CRISI grant. This information is one of the elements required to complete CSX, Amtrak, and MassDOT discussion of the implementation of the design/construction and operation of the service. While such discussions can progress before this information is developed, typically the infrastructure needs are part of an agreement for access on the host railroad. FRA can require that MassDOT, the host railroads, and the operator Amtrak agree on the infrastructure requirements as a condition to moving into Project Development.

An additional factor that affects the timeline before permitting, design and construction could begin is funding of the infrastructure improvements. The host railroad may require that infrastructure funding be in place before it undertakes negotiation of one or more elements of an access agreement (e.g., service schedule).

Existing Infrastructure. The Pan Am Southern corridor is a critical asset for Massachusetts over and above its potential for intercity passenger rail service. It is a strategic asset for freight and provides resiliency for the state's rail network as a parallel route.

Detailed information about the Pan Am Southern bridges is not known, however, contingencies in the cost estimates likely would cover most costs. Another structure, the Hoosac Tunnel, has well known infrastructure issues. Future efforts to rehabilitate or upgrade the single-track tunnel may require diversions of rail service – both freight and passenger. The cost estimates Pan Am Southern bridges are structures to account for unknown factors using contingencies. However, it is possible that some of these key assets may need work that exceeds the standard contingencies.

The Northern Tier rail corridor currently has two distinct characteristics: the MBTA Fitchburg Line service for commuter rail and the Pan Am Southern segment west of Wachusett for freight service. Therefore, infrastructure improvements would be required to accommodate intercity passenger service and limit impacts to existing and future freight and passenger services. The western Pan Am Southern segment traverses hilly terrain that has led to a railroad right-of-way with many curves and elevation changes that constrain train speeds and capacity. In addition, over the years double tracking has been removed, however the right-of-way remains making capacity improvements feasible.

Historic stations have evolved from their original uses to a variety of new uses, although some retain the physical capacity for a modern, accessible intercity passenger service.

Current Population Projections. Population growth and economic development along the Northern Tier corridor in recent years has varied considerably, with substantial growth between Boston and Fitchburg, and slower growth and/or decline as areas get further west. The variations in population growth are reflective of complementary trends, where total jobs and real estate values in the east are large and growing while these indicators are steady or in decline further west. If these trends persist, it is probable that more households will be pushed further out into the west by the cost of housing but anchored to the Boston region through the employment and services it offers.

The population in the study corridor, particularly west of Fitchburg, is currently static and has been projected for long-term decline. Part of the rationale for Northern Tier Passenger Rail is to potentially reverse this trend.

When considering these factors, the proposed project may help to support economic development if it can generate new employment from this expanded connection. Therefore, any expectation of induced demand from population growth as a result of this project should be sufficiently modest. While current population, employment, and travel trends, as well as attracting an auto-reliant population to a new rail service may pose challenges, attractors are present along the entire length of the corridor which may induce recreational as well as work and other trips.

Potential service options – with varying travel times and frequencies, as well as stops and station locations – may influence the degree to which train service could draw existing travel from highway to rail.

Further evaluation would be required to demonstrate whether pandemic-induced changes in population trends and travel patterns will alter current projections. Regional and local planning efforts can explore factors that may leverage a rail service to attract migration and support economic growth in the corridor. Further analysis of the tourism market and the college and university transportation trends may yield additional actions.

Intersection of Housing and Transportation. Transportation and land use have strong linkages that are increasingly being recognized by the Commonwealth of Massachusetts. The enacted Massachusetts General Laws, Chapter 40A, Section 3A (the MBTA Communities Law) recognized this connection, requiring communities to update local zoning to allow for multi-family housing by-right near MBTA stations. Higher capacity transportation not only benefits from greater residential density nearby, but the inverse is also true – higher residential density benefits from having higher capacity transportation serving it. For instance, the presence of a rail line may incentivize households to move nearby for their work commute or other purposes; ridership is then enhanced by having people nearby frequently using the new service.

New transit options could benefit the residents in zero-car households identified in the corridor, while increasing choice for others.

Communities along the Northern Tier may need to develop plans that both attract new residents and visitors, as well as accommodate their service needs. In preparing for any increase in population, communities should consider master planning and zoning for opportunities to increase the supply of housing and supporting municipal services and infrastructure.

As discussed, many of the communities along the proposed corridor have seen population leveling and/or decline. Should that trend reverse, communities would need to consider:

- **Zoning**: Existing land use regulations may not be able to support new housing to the extent needed by new population growth. The zoning bylaws created decades ago were

developed when the average household size was larger than today, meaning that a larger population could fit into a smaller number of housing units. Furthermore, there may be interest or need to build mixed-use developments in downtown areas, which is not necessarily supported by the underlying zoning.

- **Infrastructure**: A growing population would put increased pressure on infrastructure, which may necessitate investments, as new residential, commercial, industrial, or institutional development requires utilities, water and sewer, and transportation facilities, etc.
- **Municipal Services**: Similar to infrastructure, a growing population may necessitate investment in emergency services and education – more teachers, paraprofessionals, specialists, and physical infrastructure (e.g. school buildings).
- **Topography**: Many of the communities in this corridor are located in mountainous areas. For example, Orange and Athol have relatively small footprints of their built environment, partially due to the mountains running through them. Therefore, the importance of zoning – and especially zoning for density – is particularly relevant in these areas.

Recommended Next Steps

Stakeholders recognize the importance of and the opportunities for the Northern Tier region to help advance economic and transportation development that benefits the entire Commonwealth. Therefore, a series of next steps should be considered to continue enhancing regional mobility and connectivity.

Funding would be necessary to enact these recommendations.

Continue to improve understanding of travel demand along the Northern Tier corridor, corridor segments, and linkages to key regional destinations

In particular, the analysis identified two important gaps: key drivers of travel demand in the corridor and the New York City travel market to northern Berkshire County.

The potential for passenger rail service (or public transportation more generally) is heavily dependent on the nature of travel along the corridor such as work, medical, personal, and tourism. While the Statewide Travel Demand Model does have information on trip purpose, more granular and current data on travel along the Northern Tier (including understanding whether the COVID-19 pandemic has resulted in any long-lasting changes) would be beneficial.

This could also include a closer examination of traffic along the corridor associated with nearby communities in Vermont and New Hampshire and with academic institutions in the area.
The Albany extension scenario considered travel demand to and from the Capital region, and not the tri-state area around New York City. Understanding this market and how it might be served could significantly affect the potential for service along the western section of the Northern Tier. A variety of service options should be considered, including linkages with the Knowledge Corridor at Greenfield, as well as various options through New York's Capital Region and Connecticut.

MassDOT, in partnership with regional planning agencies along the corridor, could potentially undertake these efforts.

Advance planning efforts at the intersection of economic development needs and opportunities and serving travel demand

The creation of a coordinated economic development strategy for the Central and Western sections of the Northern Tier would provide a platform to realize sustainable economic growth in the region by in part leveraging investment in intercity public transportation. This could entail assessing conditions that have limited growth including land use, zoning, employment opportunities, education, affordable housing, and public infrastructure, as well as early planning for potential station and facility locations and implications for area infrastructure and connections to regional transit authority services.

Entities such as regional planning agencies and economic development organizations could potentially undertake these efforts.

Explore scheduled motor coach service to Northern Tier corridor destinations

Motor coach service can be a relatively low cost means of improving the mobility along the corridor and developing demand for any future rail service. Examples of where it was an effective precursor to implementing passenger rail include the *Downeaster*, for which motor coach service was enhanced a decade before the startup of train service. More broadly, other successful examples of state supported intercity motor coach services include Colorado, with the Bustang network serving key travel corridors across the state, and California's extensive Thruway operation.

MassDOT and its partners could potentially undertake these efforts with positive stakeholder feedback for this recommendation.

Evaluate alternative phasing or implementation strategies

The Working Group and members of the public have expressed interest in exploring avenues for expediting restored connectivity and mobility along the corridor.

Most of the Northern Tier corridor is served by regional transit authorities, with a focus on serving the needs of their immediate service area. In May of 2024, MassDOT awarded a Regional Transit Innovation Grant (RTIG) to a joint effort by Berkshire Regional Transit Authority (BRTA), Pioneer Valley Transit Authority (PVTA), and Franklin Regional Transit Authority (FRTA) which aims to rehabilitate seven buses and operate a commuter bus network to increase regional connectivity between BRTA, PVTA, and FRTA. Such enhancements and further coordination among these services would improve intra-corridor mobility and connectivity, while also offering the potential for improved efficiency.

MassDOT and entities such as regional transit authorities could potentially undertake these efforts.

Evaluate express service between Fitchburg and Boston

With the largest projected volume of traffic occurring between Fitchburg and Boston, implementation of express service between these markets could offer a relatively low-cost option to initiate upgraded public transportation along part of the corridor. Furthermore, if these improvements were undertaken as part of the MBTA Commuter Rail system, it could open access to other sources of funding for capital improvements, such as eliminating the single-track operation through Waltham.

A potential impediment may be limitations on additional train traffic into Boston's North Station prior to replacement of Draw One in Boston. Draw One is a four-track drawbridge that carries MBTA Commuter Rail trains (including the Fitchburg Line) across the Charles River into North Station. The MBTA currently is considering increasing the number of tracks, thereby increasing capacity

and operational flexibility. Therefore, if MBTA increases its North Station capacity in the future, the ability to accommodate additional service could be maintained.

MassDOT and the MBTA could potentially undertake these efforts.

Monitor freight use and trends in the corridor to explore needs/opportunities for public investment

Federal grant funding offers potential opportunities to advance improvements along the Pan Am Southern corridor, including needed potential projects such as Hoosac Tunnel renewal, bridge strengthening, clearance projects to allow double-stack service, Ayer intermodal terminal improvements, and investments that may mitigate severe damage from flooding caused by climate change. Underlying such an effort will be close coordination with Pan Am Southern ownership, and in the context of a coordinated strategy for rail system improvements on the two east west main lines.

MassDOT and its railroad partners could potentially undertake these efforts.

Develop strategies for improving rail connections within the corridor to meet study goals of supporting economic development, transportation equity, and minimizing impacts to public health/environment

A Northern Tier passenger rail service would involve several entities. MassDOT works with FRA, Amtrak, the MBTA, freight railroads and area stakeholders on a variety of projects. A successful strategy to develop a Northern Tier passenger rail service would require all of these entities and groups to communicate and coordinate effectively, as funding and permitting entities look for unified support for projects. Host railroads and operators apply their resources and efforts to projects with credible strategies and plans.

While the metrics show the more effective alternatives, policy decisions and strategy are the required next steps to determine if and how the Commonwealth will proceed. These require, at a minimum, continuing effective communication and coordination across all stakeholders.

The existing Compass Rail plan anticipates enhancing connectivity and transportation equity across the Commonwealth. The connection between Greenfield, Springfield, and Boston is in the implementation stages and could be a mechanism to achieve increased west-east mobility.

MassDOT and its public sector and railroad partners could potentially undertake these efforts.