Lehigh Valley Passenger Rail Feasibility Analysis

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Final Report

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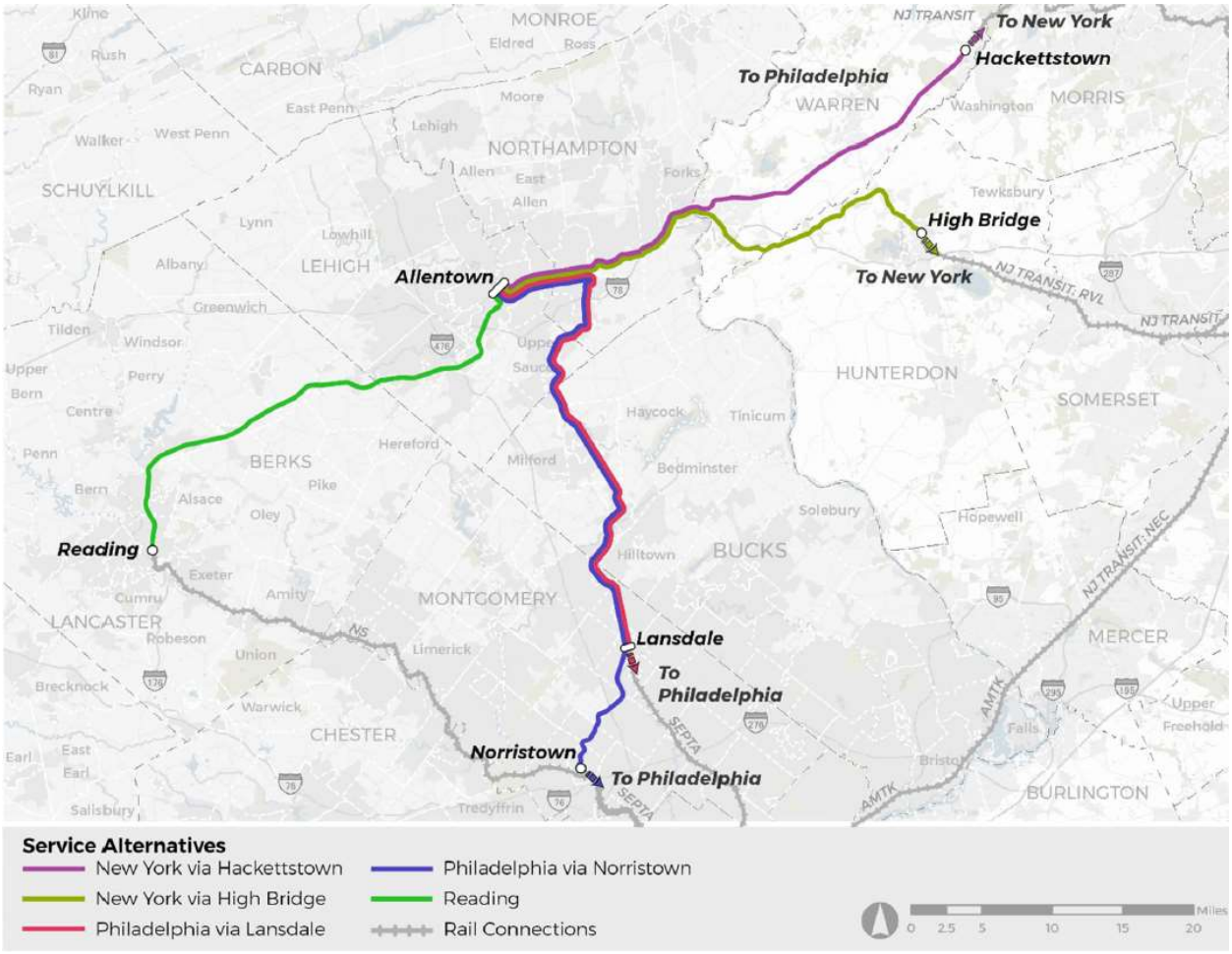
Executive Summary

Since 1979, when passenger train service was last operated to the Lehigh Valley, there has been public and private interest in the potential restoration of passenger train services. This interest has grown over time, with multiple studies examining the potential for service along specific corridors previously linking the Lehigh Valley to New York and Philadelphia. These efforts were largely isolated to individual rail lines or corridors, however recent population and economic growth has spurred interest in new passenger rail transportation services to the Lehigh Valley as a whole. To date, no effort has broadly examined the potential for restoration of passenger rail services across former corridors between the Lehigh Valley and New York, Philadelphia, and Reading, all of which are nearby cities with current or planned intercity passenger rail services.

By providing an initial inquiry into these corridors, this study provides a framework for a future passenger rail project sponsor to advance the feasibility studies and alternatives analyses that would be required to restore service. In doing so, this study provided analysis of twelve former rail corridors, examining modern land use development along the corridors, environmental considerations, current rail operations (where extant), engineering constraints, and high-level capital costs.

Of the twelve former corridors examined, five consolidated corridors stand out as the most likely candidates for passenger rail restoration. These are the existing corridors which are mostly comprised of active rail lines and provide the most direct connections to existing or planned passenger rail services. These include:

- Allentown to New York via Hackettstown
    - Utilizing the Norfolk Southern Railway to Phillipsburg and Dover & Delaware River Railroad to connect with the NJ TRANSIT Morris & Essex Line in Hackettstown.
- Allentown to New York via High Bridge
    - Utilizing the Norfolk Southern Railway to connect with the NJ TRANSIT Raritan Valley Line in High Bridge
- Allentown to Philadelphia via Lansdale
    - Utilizing the Norfolk Southern Railway to Bethlehem, Lehigh Valley Rail Management within Bethlehem, Saucon Rail Trail (SEPTA) to Coopersburg, Upper Bucks Rail Trail (SEPTA) to Quakertown, East Penn Railroad (SEPTA) to Telford, and Pennsylvania Northeastern Railroad (SEPTA) to connect with the SEPTA Lansdale Doylestown Line in Lansdale
- Allentown to Philadelphia via Norristown
    - Utilizing the Norfolk Southern Railway to Bethlehem, Lehigh Valley Rail Management within Bethlehem, Saucon Rail Trail (SEPTA) to Coopersburg, Upper Bucks Rail Trail (SEPTA) to Quakertown, East Penn Railroad (SEPTA) to Telford, Pennsylvania Northeastern Railroad (SEPTA) to Lansdale, and CSX/Norfolk Southern (SEPTA) to connect with the SEPTA Norristown Line in Norristown
- Allentown to Reading
    - Utilizing the Norfolk Southern Railway to connect with the planned Schuylkill River Passenger Rail Authority service between Reading and Philadelphia



For these five major candidate corridors, conceptual operating plans, operating cost estimates, and high-level demand analyses are presented within the report. These concepts were developed independently by the study team, and did not include consultation with NJ TRANSIT, SEPTA, Amtrak, Norfolk Southern, CSX, and/or any other impacted rail carriers. A summary of the advantages and concerns of each of the corridors, as well as high-level cost estimates, is shown in the table on the following page.

Service Alternative	Advantages	Concerns	Estimated Trip Duration	Estimated Capital Costs[1]	Estimated Annual Operating Costs[2]
Allentown to New York via Hackettstown	• Entirely utilizes active rail corridors. • Class 1 freight rail infrastructure is in place over Norfolk Southern segment, albeit with passenger service upgrades needed. • Minimizes need to operate over Norfolk Southern by utilizing Dover & Delaware River Railroad, a short-line railroad which may be amenable to passenger service upgrades.	• Operations over Norfolk Southern may impact the freight rail supply chain to the Lehigh Valley and Port of New York and New Jersey. • Hackettstown routing to New York is less direct than High Bridge Routing • Operations must use NJT and Amtrak lines east of Hackettstown. Surplus capacity on these lines is unknown. • Bi-state cooperation on New Jersey portion of route adds complexity.	2:30	$474.9M Rolling Stock: $145.0M	$23.6 – $28.8M/year
Allentown to New York via High Bridge	• Most direct route to New York City from Allentown. • Class 1 freight rail infrastructure is largely in place, albeit with passenger service upgrades needed.	• Operations over Norfolk Southern may impact the freight rail supply chain to the Lehigh Valley and Port of New York and New Jersey. • Operations must use active NJ TRANSIT, Conrail (freight), and Amtrak lines east of High Bridge. Surplus capacity on these lines is unknown. • Bi-state cooperation on New Jersey portion of route adds complexity.	2:20	$469.9M Rolling Stock: $145.0M	$16.5 – $20.1M/year
Allentown to Philadelphia via Lansdale	• Most direct route to Philadelphia, utilizing (mostly) in-service rail corridors.	• Almost 12 miles of this route has had the track removed and been converted to public rail trails. • Operations over Norfolk Southern may impact the freight rail supply chain to the Lehigh Valley and Port of New York and New Jersey. • Optimal routing through Bethlehem is unclear. • Operations over SEPTA south of Lansdale will directly conflict with dense commuter rail operations. • SEPTA may not permit dual-mode diesel/electric locomotives through the Center City, Philadelphia tunnel.	1:46	$635.8M Rolling Stock: $102.0M	$5.1 – $10.2M/year
Allentown to Philadelphia via Norristown	• Can provide a diesel-only route to 30th Street Station in Philadelphia.	• Almost 12 miles of this route has had the track removed and been converted to public rail trails. • Operations over Norfolk Southern may impact the freight rail supply chain to the Lehigh Valley and Port of New York and New Jersey. • Optimal routing through Bethlehem is unclear. • Operations over the SEPTA Norristown Line will directly conflict with dense commuter rail operations.	1:52	$739.0M Rolling Stock: $102.0M	$5.5 – $10.8M/year
Allentown to Reading	• Lowest anticipated operating costs of all rail alternatives • Class 1 freight rail infrastructure is largely in place, albeit with passenger service upgrades needed.	• Operations over Norfolk Southern may impact the freight rail supply chain to the Lehigh Valley and Port of New York and New Jersey. • Future proposed passenger rail connections to Philadelphia are proposed by the Schuylkill River Passenger Rail Authority, but not yet certain. • Downtown Reading may not have the same travel demand characteristics of New York and Philadelphia.	0:46	$450.3M Rolling Stock: $102.0M	$2.2 – $4.3M/year

[1] Planning-level, order-of-magnitude capital estimates developed to allow for a comparative assessment of the infrastructure needs and estimate rolling stock procurement costs. New track alignment, earthwork, flyovers, and stations were based on new track mileage from each of the corridors that composed each service Alternative, and major bridge structures and flyovers were based on whether or not these items would be needed on the specific segments that each service alternative used. One rail maintenance facility was assumed to be part of every service alternative. A rough estimate of additional ROW acquisition costs was noted separately but is not included in the capital cost totals. Items not considered in cost estimates include financing, utility relocation, and environmental mitigation. Capital cost methodology is discussed further in Chapter 6 or this report and in the *Infrastructure and Capital Costs Technical Memorandum*.

[2] Operating cost estimates are based on hypothetical service plans developed solely to identify approximate run times and potential service levels (trains per day) to allow for a high-level order-of-magnitude estimate of annual operating costs for these service options. Operating cost estimates only include train-related expenses; they do not include the ongoing costs of operating and maintaining stations. No effort has been made to determine if this assumption is acceptable to NJ TRANSIT, SEPTA, Amtrak, or any other passenger service provider or with any freight carrier. Likewise, no effort was made to integrate these service schedules into existing patterns of service. Capital cost methodology is discussed further in Chapter 6 or this report and in the *Infrastructure and Capital Costs Technical Memorandum*.

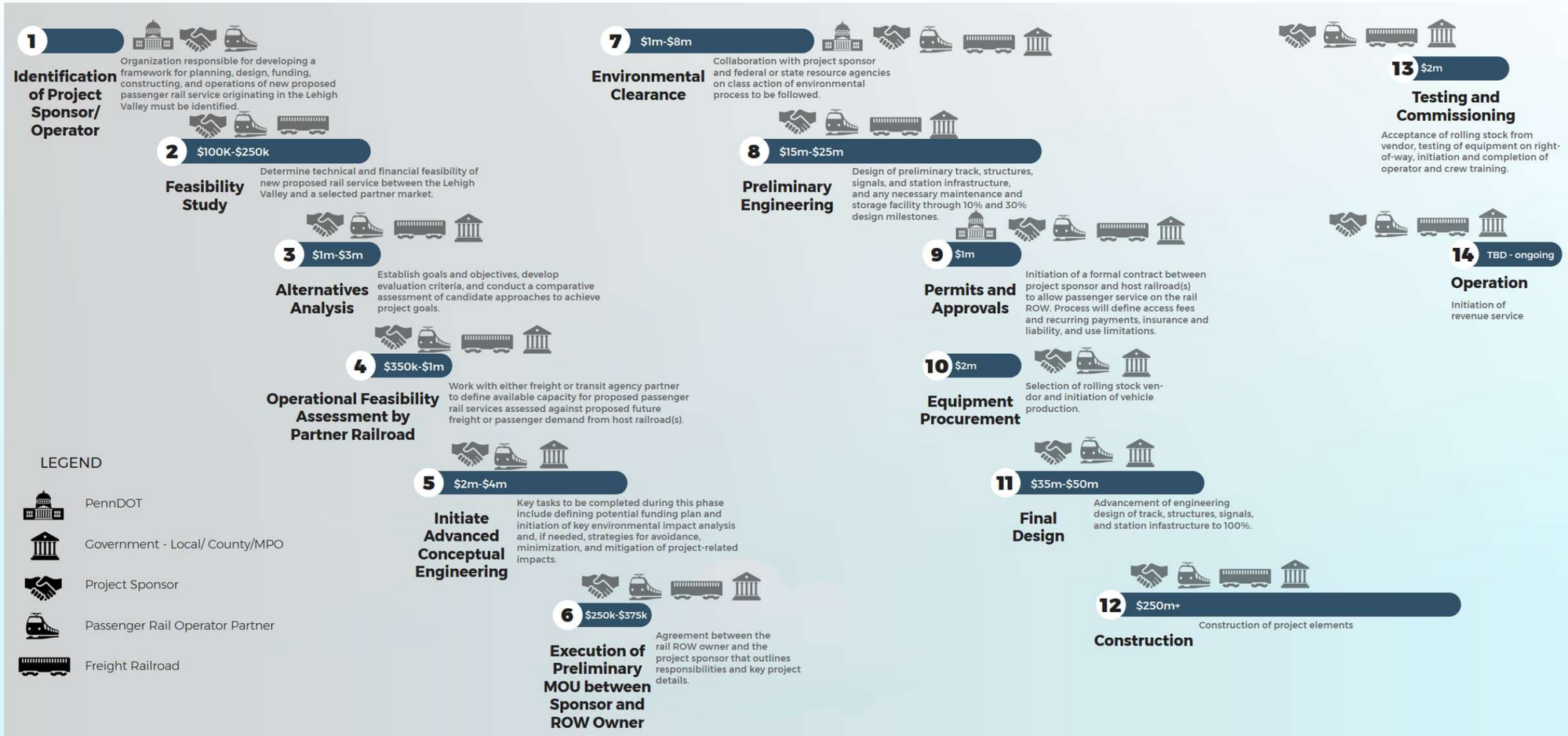
Development of any of the Lehigh Valley passenger rail corridors will require a future project sponsor to lead the project process and overcome significant challenges during the initial years of the project development lifecycle. These challenges include:

1. Missing or re-developed sections of former rail lines – Of all former passenger rail corridors between Allentown and Philadelphia/New York, not a single one remains intact in its entirety. Every corridor has had portions of the rail line removed and abandoned, with the formerly active railroad property sold and repurposed. Common uses of the former lines include rail trails, parks, roadway alignments, commercial development, and private property. For new passenger services to be established where these conditions exist, property will need to be acquired.
2. Operational conflicts with freight railroads – Any future passenger service to the Lehigh Valley will need to share corridors with active privately-owned freight railroads. The Lehigh Valley is a critical freight rail access point to the New York City metropolitan area and is itself a major freight rail logistics center. Any future passenger service will require significant capital investment on freight railroad properties to ensure that critical freight rail services can continue unimpeded by passenger trains, which have dramatically different operational characteristics and needs.
3. Operational conflicts with existing passenger railroads – With the exception of the potential Reading service, routes from the Lehigh Valley to New York and Philadelphia require operations over NJ TRANSIT, SEPTA, Amtrak, or a combination thereof. These are well-established commuter and intercity rail operations with a high train density during peak rush hour periods. Existing operations may limit capacity for a new Lehigh Valley service, and agreements would need to be reached with these existing rail operators to permit the new service.
4. Missing facilities – Although there was historically passenger service to the Lehigh Valley, few of the former stations exist and those that do would certainly not comply with modern standards. It can be safely assumed that all stations would be required to be constructed new. Additionally, an equipment maintenance facility would likely need to be constructed in the Allentown area to support the new service.
5. Cost and Funding – Estimated capital costs for the new service range from $450 million to $739 million, and estimated annual operating costs range from $2 million to $29 million. This report outlines many potential sources of funding for capital investments, however operating costs will require a permanent subsidy, the source(s) of which will need to be determined.

To assist in guiding the development process should a project sponsor be identified, this study also provides a typical project development lifecycle (shown on the following page) which can inform the project sponsor on the steps, roles, and responsibilities required to realize passenger service within an approximately 10- to 12-year timeline.

Lehigh Valley Rail Study

Project Lifecycle 10 to 12 Years



1. Introduction

The *Lehigh Valley Passenger Rail Feasibility Analysis* investigates and defines the critical path necessary for restoring passenger rail service to Pennsylvania's Lehigh Valley, with connections to existing or planned rail services in the Newark/New York, Philadelphia, and Reading market areas. This document (including appendices) summarizes the various efforts to date to restore rail service, identifies the key infrastructure and institutional challenges, estimates costs, defines the necessary approvals and operational requirements, and highlights key steps for both a technical and non-technical audience.

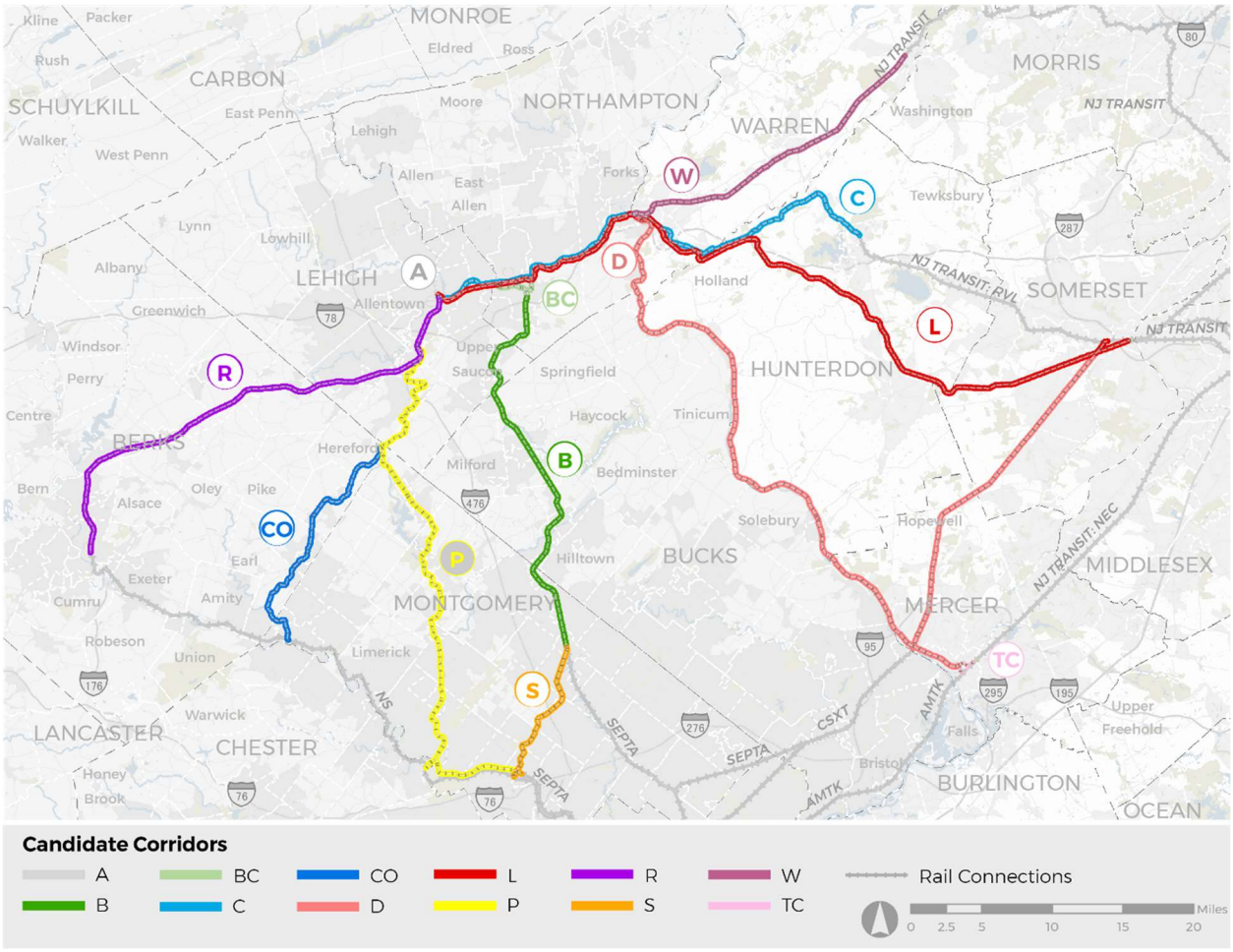
Chapter 2 – Previous Rail Studies summarizes the numerous previous rail service studies investigating options for improved transit between the Lehigh Valley and the three market areas. These studies were published subsequent to the termination of Lehigh Valley passenger rail service in 1979, which had operated since the mid-1850s. The documents were prepared by county, regional, and state entities in Pennsylvania and New Jersey, using different approaches and various assumptions, to restoring passenger rail service. The studies identified numerous challenges, including transit underserving suburban areas, potentially high capital costs, low anticipated farebox recovery, the presence of environmental constraints, and conflicts with existing SEPTA passenger rail service. Additional details are provided in the *Previous Rail Service Studies Technical Memorandum.*

Chapter 3 – Service Corridors introduces the 12 identified corridors which historically supported passenger rail service to the three market areas. There were four overall corridors analyzed between the Lehigh Valley and New York market area, four corridors analyzed between the Lehigh Valley and Philadelphia market area, one corridor analyzed between the Lehigh Valley and Reading market area, and an additional three "connector" corridors analyzed which facilitate train movements between other corridors. These corridors, shown in Figure 1, were further divided into 99 segments for deeper analysis. Because most of the former corridors are no longer completely intact, this segmentation allows for portions of former corridors to be combined for realistic modern routings.

While 12 corridors are examined as part of this effort, the corridors have widely varying degrees of viability for future passenger service. A deep analysis of corridors and segments is presented here to fully consider all potential passenger train routings and to help a future project sponsor understand the granular challenges and opportunities along each corridor. Additional detail can be found in the *Service Alternatives Technical Memorandum.*

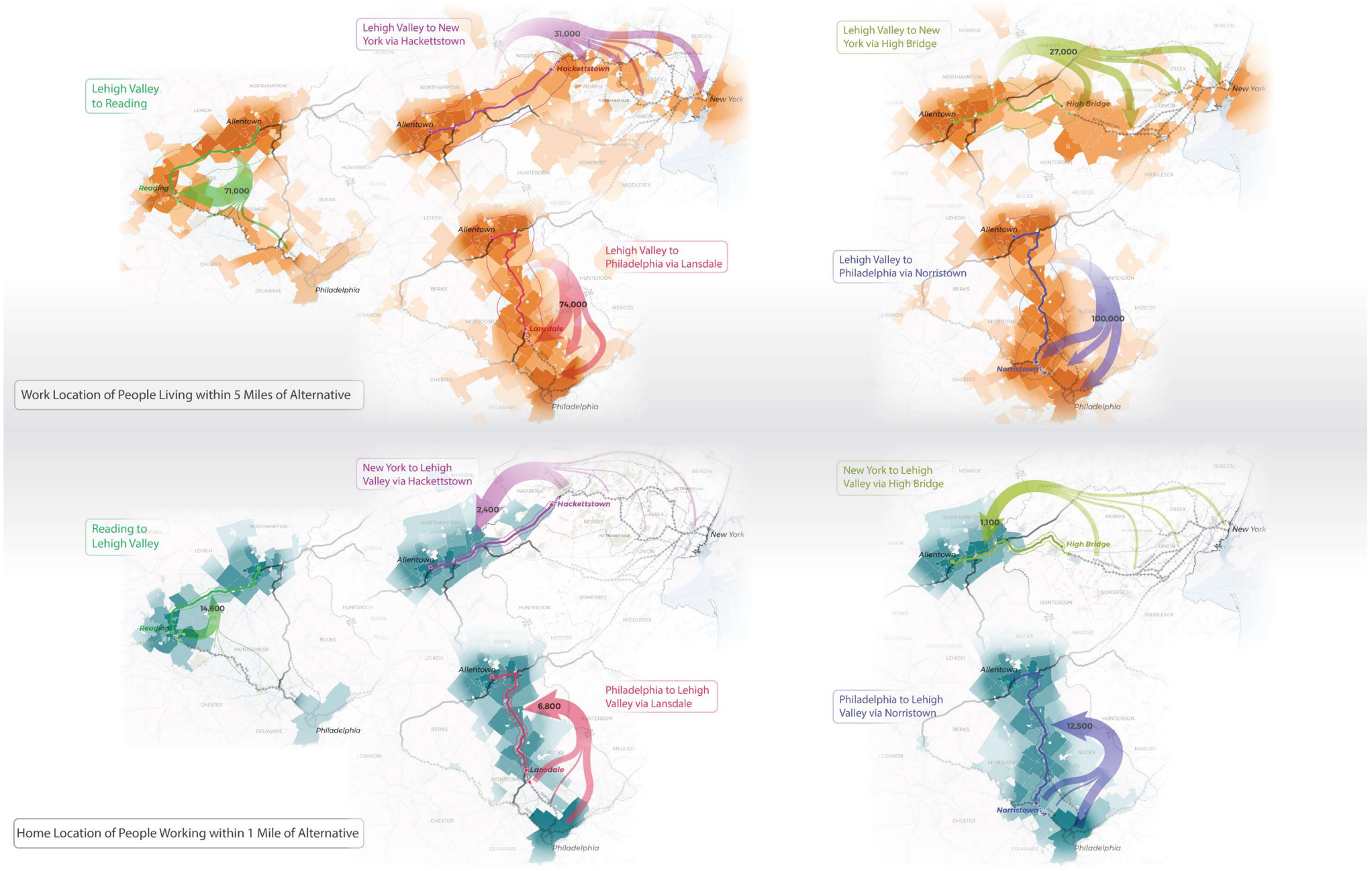
Chapter 4 – Environmental Screening discusses environmental constraints along the 12 identified corridors. Constraints were identified through a combination of geographic information system (GIS) analysis and desktop research. The environmental screening represents the first step in identifying potential constraints. Constraints include parks, wetlands, preserved areas, historic districts, and flood zones, among others. Additional flagged constraints identified via desktop research include the need for new bridges, operational conflicts with freight rail, and missing sections of right-of-way. The *Environmental Screening Technical Memorandum* provides additional detail on environmental constraints, including the 12 corridors and 99 segments displayed across 34 maps.

Figure 1. Lehigh Valley Passenger Rail Feasibility Analysis Candidate Corridors



Chapter 5 – Service Alternatives and Demand Analysis summarizes five service alternatives developed from segments of the 12 corridors. Two alternatives connect the Lehigh Valley to the New York market area, two connect to the Philadelphia market area, and one connects to the Reading market area. These alternatives combine segments of various corridors to provide feasible potential routes between the Lehigh Valley and the three market areas. Environmental constraints, operational considerations, and a qualitative consideration of ridership demand informed the selection of alternatives. In addition to detailing the five corridors, this chapter includes a demand analysis using U.S. Census data to review existing demographics and commuting data between the Lehigh Valley and three market areas along the five alternative routes. This analysis is not intended to provide ridership estimates, but rather to demonstrate that there is existing potential demand for renewed passenger rail service from the Lehigh Valley (Figure 2), although the portion of travelers who would choose to take the train instead of driving is uncertain and dependent on many variables. Additional detail can be found in the *Service Alternatives Technical Memorandum.*

Figure 2. Demand Analysis Mapping



Chapter 6 – Costs provides planning-level conceptual cost estimates for each of the 12 corridors and 5 service alternatives. Cost estimates considered geographic and topographical constraints, required infrastructure upgrades and modifications, station facilities, rolling stock, and maintenance and layover facilities. A rough estimate of additional ROW acquisition costs was noted separately but is not included in the capital cost totals. Items not considered in cost estimates include financing, utility relocation, and environmental mitigation. A high-level operating plan and range of costs, subject to project operators, are also provided for each service alternative under this chapter.

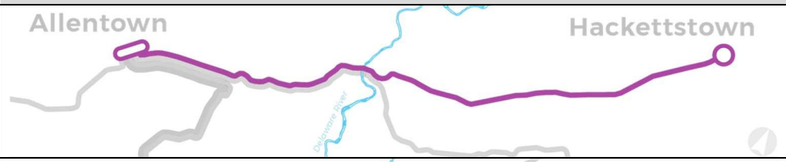
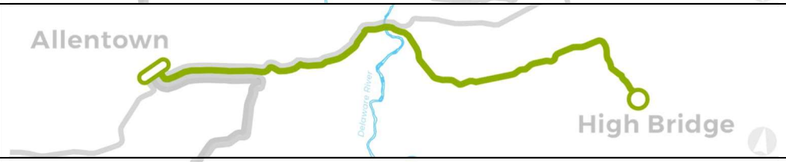
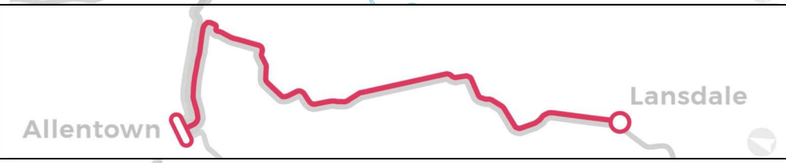
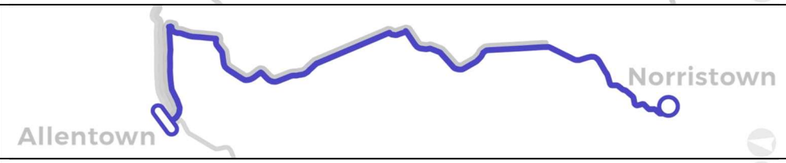
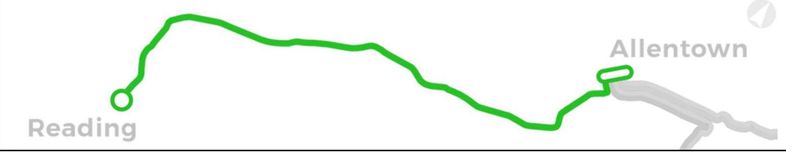
The *Infrastructure and Capital Costs Technical Memorandum* provides detailed breakdowns of the cost estimates for each corridor, including the methodology for estimating unit costs.

Chapter 7 – Operations, Approvals, and Funding discusses the key requirements to restore passenger rail operations between the Lehigh Valley and the three market areas. The conditions under which services could be provided are described, including a general legal framework governing agreement between freight railroads and a passenger service sponsor. Additionally, potential federal, state, and local funding sources that could support restoring passenger rail service are identified and briefly described. The funding and financing portion of the chapter discusses potential capital, operations, and maintenance funding sources from federal, state, and regional programs, as well as potential local tax and fee opportunities. Additional details about operations, approvals, and funding can be found in the *Operations, Approvals, and Funding Technical Memorandum*.

Together, this final report and its appendices lay the foundation for a future project sponsor to restore passenger rail service to the Lehigh Valley. A critical next step is identifying a project sponsor. This entity will be the organization responsible for developing a framework for planning, designing, funding, constructing, and operating the new passenger rail service.

The analysis conducted as part of this *Lehigh Valley Passenger Rail Feasibility Analysis* will be essential to informing potential project sponsors of the opportunities and challenges associated with this effort. If passenger rail is pursued, a project sponsor will need to be identified, and subsequent steps include conducting a detailed feasibility study and alternatives analysis and assessing the operational feasibility of partner railroads. This analysis occurs early in the process; operation of passenger rail service in the Lehigh Valley can be reasonably expected to take at least another 10 years; however, this study and subsequent elements will help guide a project sponsor and support the desired outcome for the Lehigh Valley.

Table 1. Service Alternatives Summary

Market Area Served	Alignment	Estimated Costs (in million $)			Environmental Constraints	Flagged Constraints	Travel Time
		Capital	Rolling Stock	Operation (Yearly)			
To New York via Hackettstown		$474,909,110	$145,018,585	$23,564,400 – $28,776,600	• Historic properties and preserved farmlands are located along the route	Operations over freight lines	2 hours, 30 mins
To New York via High Bridge		$469,923,680	$145,018,585	$16,471,500 – $20,114,800	• Historic properties and preserved farmlands are located along the route • Contaminated site along route	Operations over freight lines	2 hours, 20 mins
To Philadelphia via Lansdale		$635,811,084	$102,016,680	$5,132,200 – $10,186,900	• Historic properties are located along the route	Operations over freight lines, Portions of route have been converted to rail-trail	1 hour, 46 mins
To Philadelphia via Norristown		$739,026,613	$102,016,680	$5,451,200 – $10,820,000	• Historic properties are located along the route • Contaminated site along route	Operations over freight lines, Portions of route have been converted to rail-trail	1 hour, 52 mins
To Reading		$450,325,639	$102,016,680	$2,174,700 – $4,316,500	• Historic properties and preserved farmlands are located along the route • Potential reconstruction of a creek crossing	Operations over freight lines	46 mins

2. Previous Rail Service Studies

The project team reviewed previous service studies as part of the *Lehigh Valley Passenger Rail Feasibility Analysis*. These studies explore the restoration of passenger rail service in Pennsylvania's Lehigh Valley, and all have been conducted since 1979, when passenger rail service to the Lehigh Valley was terminated after operating since the mid-1850s. The studies are summarized below, with additional detail provided in the *Previous Rail Service Studies Technical Memorandum*, which is included as an appendix to this final report. The technical memorandum provides the agency, date, estimated costs, study summary, and relevant issues to consider for each reviewed document. The summaries report key findings and facts, including ridership estimates, capital cost estimates, and operating plans, where applicable.

Studies concerning restoring passenger rail service to the Lehigh Valley from New York and Philadelphia are listed in *Table 2* and summarized below.

Table 2. Reviewed Studies (as of February 2023)

Study Name	Study Publisher	Publication Date	Service Area
I-78 Corridor Transit Study	North Jersey Transportation Planning Authority	2007	New York
Central New Jersey/Raritan Valley Transit Study – Pennsylvania Component	Northampton County, Lehigh County, Lehigh Valley Economic Development Corporation	2010	New York
Central New Jersey/Raritan Valley Transit Study – New Jersey Component	NJ TRANSIT	2011	New York
Raritan Valley Line Capacity Expansion Study Final Report	NJ TRANSIT	2013	New York
Raritan Valley Line One-Seat Ride Service to Manhattan Study Report	NJ TRANSIT	2020	New York
Quakertown-Stony Creek Rail Restoration Study	Bucks County Planning Commission	2000	Philadelphia
Quakertown Stony Creek Passenger Rail Restoration Business Plan	Bucks County Transportation Management Association	2006	Philadelphia
Quakertown Rail Restoration Travel Forecasts Study Technical Memorandum	Delaware Valley Regional Planning Commission	2008	Philadelphia

Service to the New York/New Jersey Urban Core

Three interconnected studies were conducted concerning transit service on the Interstate 78 (I-78) corridor west of the Bridgewater area as far west as the Lehigh Valley. The studies explored how regional transit service could be expanded and improved to facilitate transit trips to the urban core and reduce intra-suburban regional vehicle trips. These studies generally explored commuter rail and

commuter bus alternatives. Two additional studies investigated improving capacity and providing a full-time one-seat ride along the Raritan Valley Line into New York City.

I-78 Corridor Transit Study (2007)

The I-78 Corridor Transit Study evaluated potential improvements to enhance transit service on the I-78 corridor between Bridgewater, New Jersey, and the Lehigh Valley, including evaluating existing transit services, facilities, and future traffic conditions. The study focused on express bus patterns and new park-and-ride facilities along the corridor and largely deferred decisions about rail expansion to the subsequent NJ TRANSIT-led study. The study endorsed a commuter bus service with 20-minute peak headways originating at the William Penn Park & Ride west of Easton, with service to Bridgewater making intermediate stops. The study acknowledged that transit underserves the suburban region within the study area, as well as Lehigh County.

Central New Jersey/Raritan Valley Transit Study – Pennsylvania Component (2010)

The Central New Jersey/Raritan Valley Transit Study – Pennsylvania Component assumed an NJ TRANSIT Raritan Valley Line extension to Phillipsburg and explored transit options to connect to the rail corridor. The study identified three alignments for a Raritan Valley Line rail extension into the Lehigh Valley but ultimately shortlisted only the southern alignment using the existing Norfolk Southern Lehigh Line tracks. The study also considered a commuter bus service offering direct, non-stop, peak-hour service from park & rides in Allentown, Bethlehem, and Easton to New York City. Reviewed rail service was expected to garner 800 daily riders with a 155-minute ride between Allentown and New York City, while reviewed bus service was expected to garner 600 daily riders with a 129-minute ride between Allentown and New York City.

Central New Jersey/Raritan Valley Transit Study – New Jersey Component (2011)

The Central New Jersey/Raritan Valley Transit Study – New Jersey Component reviewed a series of regional transit improvements along the Raritan Valley Line/I-78 corridor between Bridgewater and Phillipsburg. The study considered new express bus services, extensions of the Raritan Valley Line and Morris & Essex commuter rail lines, construction of park & rides to complement commuter rail and new express bus services, and improvements to existing rail stations. The study ultimately envisioned a hybrid commuter bus/rail hybrid service for the Raritan Valley oriented toward serving the urban core around New York City as a primary destination and the Bridgewater area as a secondary destination. Assuming a Raritan Valley Line extension to Phillipsburg, full construction of proposed park & rides, and completion of proposed upgrades to rail stations, the extension was expected to serve up to 1,475 daily riders. The study assumed that more train slots would be available on the Raritan Valley Line and at New York Penn Station due to the construction of the ARC (Access to the Region's Core) tunnel. While other capacity improvements are now in progress, the assumptions used in this study for train slots and service patterns may no longer be applicable.

Raritan Valley Line Capacity Expansion Study Final Report (2013)

The Raritan Valley Line Capacity Expansion Study Final Report investigated several capacity enhancement options along the central segment of the Raritan Valley Line between Cranford (Union County) and Raritan (Somerset County). The purpose of the study was to begin outlining a framework for additional analysis to firmly establish a future Raritan Valley Line infrastructure improvement plan.

The study reviewed four capacity enhancement scenarios. The analysis assumed all Raritan Valley Line trains would terminate at Newark Penn Station and concluded that increasing train lengths could accommodate much of the line's forecasted growth.

Raritan Valley Line One-Seat Ride Service to Manhattan Study Report (2020)

The Raritan Valley Line One-Seat Ride Service to Manhattan Study Report reviewed the feasibility of providing a one-seat ride during peak and off-peak hours on weekdays and weekends along the Raritan Valley Line to Penn Station New York. The study reviewed two short-term scenarios, two medium-term scenarios, and one long-term scenario and determined that any scenario reducing service along the Northeast Corridor or North Jersey Coast Line routes would negatively affect customers, reducing ridership and carrying capacity and leading to additional overcrowding at Newark Penn Station and Secaucus Junction. The study determined that full-time direct rail service to New York Penn Station would be best achieved by expanding trans-Hudson and Penn Station infrastructure capacity, such as that included in the Gateway Program.

Service to Philadelphia

Three studies reviewed the feasibility, considerations, and demand for restoring passenger rail service to the Quakertown-Stony Creek rail corridor between Quakertown and Norristown. Each study also reviewed the feasibility of extending this service along other rail lines into Center City, Philadelphia. These three studies can be seen as operating along a single continuum, proposing adjustments from the previous study's recommendation in an effort to advance passenger rail along the corridor. No known recent studies investigated restoring transit service directly between Philadelphia and the Lehigh Valley.

Quakertown-Stony Creek Rail Restoration Study (2000)

The Quakertown-Stony Creek Rail Restoration Study investigated linking the Upper Bucks and North Penn communities with the employment centers of King of Prussia and Center City, Philadelphia, through restored passenger rail service along SEPTA's Bethlehem and Stony Creek branches. Three broad preliminary alternatives were developed. A key element of developing alternatives was maximizing the use of existing or immediately pending rail facilities. Criteria for selecting a lead alternative included infrastructure and vehicle capital costs, annual operating costs, and patronage affinity scores for accessing Philadelphia and King of Prussia. Under the selected lead alternative, new diesel train service would operate via Amtrak's Northeast Corridor to the lower level of the 30th Street Station. Service would operate non-stop between Norristown and 30th Street Philadelphia. The corridor would serve 22 stations (11 new), 11 daily round trips, and serve up to 7,000 daily riders.

Quakertown Stony Creek Passenger Rail Restoration Business Plan (2006)

The Quakertown Stony Creek Passenger Rail Restoration Business Plan documented the project background, reviewed requirements for the Bucks County Transportation Management Association as a potential federal grant recipient, and outlined an action plan and next steps. This plan proposed advancing passenger rail service in three successive stages. This approach would significantly reduce the expense and complexity of initial service startup. Ultimately, 21 round trips would be offered on weekdays and 17 on weekends. Phase 1 was estimated to have between 1,200 and 2,000 weekday trips.

Quakertown Rail Restoration Travel Forecasts Study Technical Memorandum (2008)

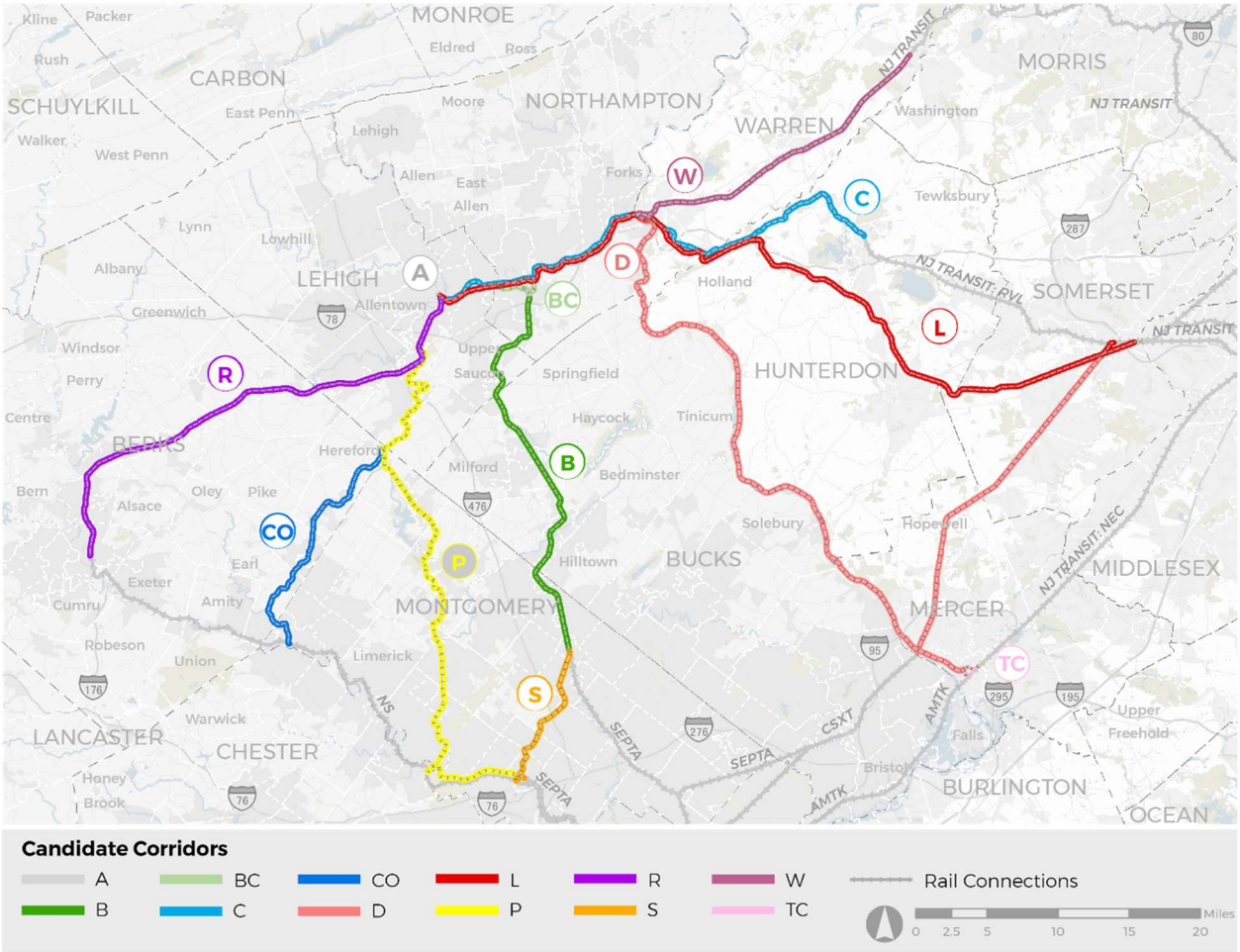
The Quakertown Rail Restoration Travel Forecasts Study Technical Memorandum focused on projecting travel demand for the portion of the study corridor between Lansdale and Bethlehem/Allentown. The model incorporated expected residential and employment change in each study area municipality. The study area population was expected to grow by 31.9% from 2005 to 2030. Four alternatives were developed. The Shuttle alternative was expected to result in more than 8,000 new daily train trips, while the Regional Rail alternative resulted in 11,000 new daily train trips.

3. Service Corridors

The project team developed several service corridors for the three market areas of Newark/New York, Philadelphia, and Reading. Twelve corridors were ultimately identified and reviewed, offering several options for routes to the market areas. The 12 corridors were further divided into 99 segments based on right-of-way (ROW) conditions, existing rail usage characteristics, and junctions with other corridors. Each corridor extends to the location of an existing (or, in the case of Reading, planned) rail service. Connections are available at these locations to SEPTA Regional Rail, NJ TRANSIT commuter rail, or planned Amtrak intercity rail service. No assumptions were made about potential operators.

This section summarizes the corridor identification methodology and each corridor. Additional details are found in the *Service Alternative Technical Memorandum*. The 12 corridors are shown in *Figure 3*.

Figure 3 Candidate Corridors



Methodology

The identified routes largely consist of existing or former railroad ROWs and, in some cases, include limited sections of greenfield alignment that connect rail segments. More capital-intensive ROWs that might predominantly follow highway alignments or use significant greenfield alignments were excluded from this initial feasibility analysis.

The inventory of ROWs consists of 12 corridors. These corridors were identified as physically continuous ROWs that, combined with other corridors, connect the Lehigh Valley to reasonable hand-off locations with existing passenger rail providers, including NJ TRANSIT and SEPTA, or to the proposed future passenger rail project presently being evaluated by the Schuylkill River Passenger Rail Authority. Three corridors are collections of smaller branches that provide alternatives for a precise station location or junction within a city.

Segmentation

Each corridor was subdivided into segments. The segments and their breakpoints were distinguished based on the following:

- ROW condition – this includes active, lightly used, inactive, abandoned, and repurposed conditions
- Existing rail usage characteristics – which considers the existence and nature of existing freight rail service
- Junctions with diverging corridors or other segments

Organizing the ROWs into corridors and subdividing them into segments permits a granular analysis of the ROWs and creates a comprehensive picture of the operational issues a particular passenger rail service sponsor in the region may face.

Corridor Summaries

The following sections summarize the conditions of the identified service alternatives.

Newark/New York Service Area

Corridor W

Corridor W is made up of a shortline railroad serving industries in northern New Jersey that connects them to the interchange with Norfolk Southern in Phillipsburg. Present freight volumes on this corridor are relatively low but subject to change. While Norfolk Southern trackage would need to be used beyond Phillipsburg into the Lehigh Valley, present freight rail traffic volumes suggest that Corridor W offers minimal conflicts between passenger and freight operations.

Corridor W comprises Federal Railroad Administration (FRA) Class I tracks, confining trains to speeds of 10 miles per hour (mph). The use of this line would require a total reconstruction of the ROW to make it suitable for passenger rail operations and a new signaling system to accommodate that operation.

Corridor W would require substantial capital work but offers a low freight traffic alternative to accessing the Lehigh Valley from Newark/New York. However, passenger rail services would need to use Corridor C or Corridor L west of Phillipsburg to access Corridor W.

Corridor C

Corridor C starts as an abandoned railroad ROW in Allentown, crossing the Lehigh River on a single-track bridge. The corridor passes Allentown Yard, which poses operational challenges for passenger rail service because while yard rules that limit train speeds do not apply here, freight trains entering, leaving, or being assembled can foul the main line and interfere with passenger rail operations. The entire portion of Corridor C between Allentown and Bethlehem is characterized by slow 20 mph freight movements and heavy freight traffic in a constrained area. Physical constraints between the cliffs and the Lehigh River also present a constructability challenge for any new tracks dedicated to passenger use. Most of the ROW between Bethlehem and Easton is abandoned or inactive, with one segment repurposed as a rail trail. The corridor continues into New Jersey, where a significant portion is abandoned. Two new bridges need to be constructed: one over 3rd Avenue and another over I-78, both in Alpha. The corridor is inactive between Bloomsbury and High Bridge. At Pine Hollow Road in Bloomsbury, Corridor C connects to Corridor L. Currently, trains are restricted to 10 mph along this segment. Restoring this segment to operating condition for passenger rail requires reconstruction of the tracks and a new signaling system. Use of this segment would result in a passenger-exclusive ROW and permit access to the Raritan Valley Line at High Bridge.

Making use of Corridor C generally minimizes interaction with freight railroad traffic and maximizes opportunities for passenger rail exclusive ROWs, but it also requires costly rehabilitation and reconstruction in many cases. Corridor C within the Lehigh Valley may also have greater impacts on recreational sites and residential communities than other corridors.

Corridor L

Corridor L begins in Allentown and continues east as a lightly used industrial track that requires total reconstruction for passenger service. In Bethlehem, the corridor is heavily used for freight; it functions as an important conduit for freight traffic moving between the West Coast, Midwest, and New York area. The ROW can accommodate an additional track. An existing interchange yard in Bethlehem results in slow freight trains entering and exiting the yard. Passenger rail operations might also necessitate the use of tracks within the yard, further complicating both freight and rail operations. Between Bethlehem and Easton, an additional track for passenger service and signaling upgrades is necessary to comfortably accommodate both passenger and freight services.

Corridor L crosses the Delaware River along an abandoned railroad bridge. South of Bloomsbury, the Lehigh Line continues as a single-tracked main line with passing sidings interspersed throughout the corridor to Port Reading Junction near Manville. Near Flemington, underused or abandoned rail ROWs parallel Corridor L for nearly 10 miles. This ROW provides an opportunity to create an exclusive ROW for passenger services for at least some distance along the corridor. East of Manville, Corridor L splits into several approaches to join with the Raritan Valley Line. Segment L12b offers a direct connection to the Raritan Valley Line but requires a significant reconstruction of the ROW and of the existing bridge over the Raritan River; it also requires accommodating space for industrial usage along the segment.

Corridor L offers a highly viable ROW for passenger rail service in the Lehigh Valley and New Jersey west of Bloomsbury, but it also offers challenges associated with existing freight rail mainline traffic. Corridor L may also require capital investment to make the ROW suitable for passenger use and to minimize conflict with freight rail traffic.

Corridor D

Corridor D begins as an abandoned ROW in Phillipsburg, integrated into the surrounding Delaware River Park. The corridor becomes active to the south, limited to speeds of 10 mph. Using this branch requires significant reconstruction of the ROW and new signaling, and existing curvature is likely to limit overall speeds on this route. Existing freight traffic is light, but regular passenger excursion trains run on weekends.

Between Milford and Trenton, the ROW is largely occupied by the Delaware & River Canal Trail. ROW width here is highly restricted, which precludes the inclusion of both a railroad ROW and a rail trail. In Ewing, the corridor meets the CSX Trenton Subdivision. Connecting the two requires a new ramp. The corridor then continues south into the densely developed city of Trenton, with multiple potential connections to the Trenton Transit Center, with connecting service to Amtrak, NJ TRANSIT's Northeast Corridor service, SEPTA Regional Rail's Trenton Line, and NJ TRANSIT's River Line.

Corridor D offers access to the Lehigh Valley and Trenton, which other corridors cannot access. It also offers access to various population centers along the Delaware River. Corridor D has the opportunity to indirectly serve both the Newark/New York and Philadelphia markets via connections to the Northeast Corridor in Trenton. However, Corridor D also substantially impacts recreational trails and lands along the Delaware River. The demand for Lehigh Valley-Trenton services is likely substantially lower than services toward Newark/New York and Philadelphia. Passenger rail services using the CSX Trenton Subdivision to access Newark/New York or Philadelphia also add considerable mileage to either of these destinations over other corridors.

Philadelphia Service Area

Corridor B

Corridor B consists of the former Reading Railroad Bethlehem Branch between Bethlehem and Lansdale. Corridor B was historically the primary rail corridor between the Lehigh Valley and Philadelphia. Today, SEPTA owns almost the entire corridor. The corridor is a formerly double-tracked, relatively direct route with a wide ROW that allows for multiple uses. Corridor B on its northern half is inactive, but on its southern half, it serves as a branch line for local freight service. At its southern end in Lansdale, Corridor B connects to the SEPTA Doylestown Line and Corridor S for additional connections to Philadelphia. Also in Lansdale, local shortline railroads that operate on Corridor B interchange with CSX via the Stony Creek Branch. At the northern end of the corridor, connections to Corridors L and C are available through a collection of branches described in Corridor BC.

Various portions of the corridor operate as the Upper Bucks and Saucon rail trails, which are owned by SEPTA and leased to local municipalities. Between Shelly and Lansdale, two tracks are present, but one is generally used for storage. Use of this line requires the total reconstruction of the ROW and a new signaling system to make it suitable for passenger rail operations.

Corridor B offers a straightforward route from the Lehigh Valley to Philadelphia with a comparatively straight ROW. Connections with the SEPTA Doylestown Line enable service to minimize interfacing with heavy freight traffic south of Bethlehem. Using Corridor B also minimizes the capital cost of rail corridor acquisition and construction needed to reach Philadelphia from the Lehigh Valley relative to other corridors that connect directly to Philadelphia.

Corridor S

Corridor S begins on SEPTA's Doylestown Line at the Lansdale station, where Corridor B ends and merges with the Doylestown Line. All services using the Stony Creek Branch need to follow the Doylestown Line for at least a quarter mile to meet Corridor B. This sharing of tracks creates potential scheduling conflicts between crossing trains. An additional track can be constructed to the west to allow Lehigh Valley trains connecting from Corridor B to the Stony Creek branch to bypass tracks currently used by SEPTA trains. Such construction requires the reconstruction of a platform at Lansdale station and the relocation of grade crossing infrastructure and approximately 400 feet of a bike trail.

New passenger rail service would have to contend for slots where the corridor meets SEPTA's Norristown Line. SEPTA operations in Norristown are slow and carry the risk of scheduling conflicts between the Lehigh Valley and Manayunk/Norristown Line services.

The advantage to Corridor S over continuing services down the Doylestown Line to Philadelphia is that Corridor S permits access to 30th Street Station without passing through SEPTA's City Center Tunnel and without the use of active mainline freight rail ROW in Philadelphia. Avoiding use of the City Center Tunnel permits diesel operation of the Lehigh Valley passenger rail service. This comes at the tradeoff of having to invest in 15 miles of capital improvements to the Stony Creek Branch. Additionally, Corridor S has historically been a lower speed, branch line alignment, and geometry may not permit higher passenger speeds along this route.

Corridor P

Between Emmaus and Pennsburg, Corridor P remains intact as a shortline railroad operated by the East Penn Railroad. The railroad is limited to speeds of 10 mph, and the ROW has exceptionally sharp curves. Using this branch requires significant reconstruction of the ROW and new signaling. However, even with significant infrastructure improvements, passenger rail services would likely be confined to low speeds because of the curvature of the ROW. Between Pennsburg and Arcola, the Perkiomen Trail occupies significant portions of the ROW. Elsewhere, parcels have been sold to private owners and developed. Between Arcola and Oaks, the ROW is abandoned and largely consumed by new development and other infrastructure. An alternative branch avoiding the use of Norfolk Southern's ROW is an abandoned railroad ROW that passes through the Greater Philadelphia Expo Center and follows the Schuylkill River Trail to Norristown, where it connects with the SEPTA network. Using the Expo Center site requires the taking of portions of the parking lot and realignment of an access road.

The Perkiomen Branch offers an alternative to get to Philadelphia but leans heavily on acquiring property currently repurposed for other uses. The use of Corridor P also likely requires sharing tracks with Norfolk Southern freight trains at either end of the corridor.

Corridor CO

Corridor CO is composed of a shortline railroad, an abandoned railroad ROW, and a greenfield ROW through Berks County. The first section of Corridor CO branches off from Corridor P in a greenfield route. This section between Zionsville and Barto has never had a railroad ROW and has no existing grade to follow. Construction of the ROW requires the taking of property currently held by private owners. The second section of Corridor CO is an abandoned railroad ROW between Barto and Boyertown. While the ROW is mostly intact, a few key locations have been developed. Most of the corridor between Barto and Bechtelsville is privately owned. The final section of Corridor CO is composed of the Colebrookdale Railroad. Berks County Redevelopment Authority owns the property itself, but Colebrookdale Railroad operates the line. Colebrookdale Railroad offers shortline freight services and excursion passenger services. Railroad operations here are confined to speeds of 10 mph.

Corridor CO offers a ROW with less impact on trails and existing properties than Corridor P but requires the acquisition of approximately 9 miles of greenfield property between Zionsville and Barto to make this route viable. Any passenger rail service using Corridor CO would also experience scheduling conflicts with freight traffic on the Norfolk Southern Reading Line and Harrisburg Line.

Reading Service Area

Corridor R

Corridor R largely consists of the Norfolk Southern Reading Line, which forms part of the core freight rail line between Norfolk Southern's network to the west and the Lehigh Valley and New York City areas to the east. The corridor is double-tracked, which provides operational flexibility but may also limit the ability to build a new dedicated passenger rail track. Freight movements through and around Reading are frequent and slow, potentially leading to greater conflicts for passenger rail movements than would be typical on a mainline track. The corridor extends to Franklin Street in Reading, where the Berks Area Regional Transportation Authority Transportation Center and the former Reading Railroad station are located, presenting a potential meeting point with the Schuylkill River Passenger Rail Authority with further connections to Philadelphia.

Connector Corridors

Corridor A

Connected Corridor A is a pair of segments that act as station leads between Corridors C and L to two potential station sites in Allentown. The selection of station and Connector Corridor A segment is immaterial to the planning of the overall Lehigh Valley passenger rail service. Both stations are close to downtown and Allentown's new Waterfront district and are located on a street with several bus routes. The stations differ in their topography, existing station infrastructure, and vacancy of surrounding parcels.

Corridor BC

Connector Corridor BC represents the collection of three possible ROWs between the northern end of Corridor B and connections to Corridor L and C in Bethlehem. Historically, Corridor B was connected to Corridor L at the former Bethlehem Union Station site along a ROW that is now the South Bethlehem Greenway. Traversing this corridor requires sharing significant sections of track that are heavily used for

assembling and maneuvering trains bound for a forge and an intermodal yard. This Lehigh Valley Rail Management area is also envisioned as an "inland port" that would become a major generator for freight rail traffic. Heavy freight rail traffic volumes as envisioned would impose constraints on passenger rail and freight rail operations passing through the area.

Corridor TC

Connector Corridor TC represents the collection of three possible approaches from the southern end of Corridor D to the Trenton Transit Center. The available options differ in their need for at-grade crossings of the Northeast Corridor and additional infrastructure required to cross existing highways.

Additional Considerations

The fundamental considerations in corridor selection for Lehigh Valley passenger rail services are minimizing conflict between freight and passenger rail operations and using corridors that require less construction capital.

Newark/New York Service Area

For corridors oriented toward Newark/New York, minimizing conflict between freight and passenger rail operations is the greatest challenge. All possible routes, no matter which corridors and segments they use, must share the rail ROW with the Norfolk Southern Lehigh Line at some point to reach Allentown from the east.

Three possible strategies exist for passenger rail service to share the rail ROW with mainline freight traffic on the Lehigh Line. Passenger and freight rail services can share the same existing tracks, passenger and freight rail services can share the same tracks but with additional capacity in the form of extra tracks added, or passenger and freight rail services can exist in the same rail ROW but with tracks dedicated to either passenger rail or freight rail services. The third option provides the greatest degree of flexibility in operations for both parties, given the differing nature of operations, but it limits the growth potential for both services.

An additional consideration is that any Bethlehem station located on Corridor L would likely be located on the south side of the corridor, requiring passengers to cross over the freight track to access the station. This area is further complicated by the fact that Lehigh Valley Rail Management, a heavily trafficked shortline industrial switching operation in Bethlehem, has its interchange yard with Norfolk Southern in south Bethlehem. Passenger rail service would need to cross over the dedicated Lehigh Line freight rail tracks and all interchange tracks from Lehigh Valley Rail Management. Depending on the location of crossovers and station site, passengers would need to cross from five to eight tracks. An additional consideration is that all approaches from Corridor B also approach Corridor L from the south, further suggesting the need to locate a station on the south side of the corridor if Corridor B were used for Philadelphia-bound services. Potential efforts to mitigate these conflicts prompt other conflicts between passenger and freight rail infrastructure or complications between station siting and the existing street grid.

If passenger rail service were to follow Corridor C in the Lehigh Valley instead of Corridor L, interacting with freight rail services is avoided until Bethlehem, where the rail ROW would be shared. To avoid

sharing tracks in Norfolk Southern's Allentown Yard requires a new elevated structure and the construction of a new bridge over the Lehigh River.

Because of the positioning of freight rail infrastructure, it is physically impossible for a completely dedicated passenger rail service track to exist between Newark/New York and Allentown that does not intersect freight main lines at-grade. Such dedicated tracks require flyovers, elevated tracks, and other capital-intensive infrastructure to separate the services completely. For full Newark/New York-Allentown service, dedicated passenger rail service tracks must either compromise on having conflicts with freight rail traffic or invest in capital-intensive infrastructure. Whether full-grade separation is preferable, it depends on local operational factors, including the frequency of freight and passenger rail services and the ability to schedule and dispatch around conflict points.

Philadelphia Service Area

Philadelphia-bound corridors are less affected by the interaction with freight rail services than Newark/New York-bound services. However, all Philadelphia-bound corridors require some degree of new construction or reconstruction to make routes viable.

Both Corridors B and P have critical stretches that are abandoned or inactive. However, the nature of these abandoned/inactive stretches on the two corridors is dramatically different. The inactive portion of Corridor B largely remains intact as a leased rail trail. Corridor B is a mix of rail trails, developed parcels, and abandoned ROWs that no longer form a continuous corridor. All three Philadelphia-bound corridors require some form of takings or adjustments to existing recreational trails, but the degree of impact varies between corridors.

Access to Allentown is more favorable for routes following Corridor P and Corridor CO compared to Corridor B, which has no viable connection to Corridor L. These two corridors merge into Corridor R and the Norfolk Southern Reading Line. While the ability to access a mainline freight track is unknown, it does not require the same amount of capital work or risk to passenger and freight rail operations that some of the Corridor BC branches do.

Corridors R, P, and CO all make use of existing freight rail mainlines, including the Norfolk Southern Reading Line and Harrisburg Line. The Reading Line is largely double-tracked, which mitigates some of the capacity concerns of Corridor L, but it may also preclude a dedicated passenger rail service track. On the Harrisburg Line, where Corridors CO and P connect, the Schuylkill River Passenger Rail Authority is examining concepts for service and ROW improvements to accommodate passenger rail service. The viability of Lehigh Valley passenger rail services using the Harrisburg Line partially depends on the solutions that the Schuylkill River Passenger Rail Authority identifies. Philadelphia-bound services via Corridor R rely entirely on mainline freight rail services.

One variable to consider with routes using Corridor B is whether the use of Corridor S or the SEPTA Doylestown Line is preferable for accessing Philadelphia. The Doylestown/Main Line, as currently configured, necessitates traversing the SEPTA Center City Tunnel to access 30th Street Station, which cannot accommodate diesel locomotives. A direct connection could be built from the SEPTA Main Line to the Northeast Corridor at North Philadelphia, but this likely requires an at-grade junction, which could foul the busy Main Line and Norristown Line.

Bethlehem

Only Corridor C and Corridor L are available for passenger rail services to travel through the Lehigh Valley. All services headed to Bethlehem at some point must interact with or be built over the freight tracks of the Lehigh Line to reach Allentown. However, if the passenger rail services were to terminate in Bethlehem instead of Allentown, it is possible to avoid crossing over or conflicting with the Lehigh Line.

A number of slow-moving trains pass through and are stored at the Lehigh Valley Rail Management yard, southeast of the Wind Creek Casino. The open area to the east of the casino offers an opportunity as a Bethlehem station site. Locating a terminal here has the advantage of having Philadelphia service via Corridor B avoid interacting with the Lehigh Line rail ROW.

4. Environmental Screening

Environmental constraints along the 12 identified rail corridors were reviewed as part of this analysis and are summarized below. Additional detail can be found in the *Environmental Documentation Technical Memorandum*. The technical memorandum briefly summarizes the location of each corridor, including connecting services. Constraint data were provided as maps and in an Excel spreadsheet.

Methodology

The project team conducted a desktop environmental screening that analyzed environmental constraints at both the corridor (12 corridors) and segment (99 segments) levels and created buffers for each environmental constraint. The indicators listed in *Table 3* were gathered and reviewed. Buffers were used for each variable to better understand the presence and potential for constraints.

Table 3. Environmental Documentation Data Sources

Indicator	Source		Buffer
	New Jersey	Pennsylvania	
Parks and Open Space	• New Jersey Geographic Information Network (NJGIN) state, local and nonprofit open space layer	• Pennsylvania Spatial Data Access (PASDA), federal, state, and local parks and open space	0.25 mile
Conservation and Preservation Areas	• NJ Highlands Council area boundary	• PASDA Highlands regional study area boundary	0.25 mile
Wetlands	• NJGIN priority wetlands • U.S. Fish & Wildlife Service wetlands data	• PASDA national wetlands inventory for Pennsylvania	500 feet
Coastal Environments	• NJGIN priority wetlands	• PASDA national wetlands inventory for Pennsylvania	500 feet
Agricultural Districts and Farmlands	• NJGIN preserved farmland • NJDEP Land Use/Land Cover	• PASDA conserved land and farmland preservation easements • PASDA croplands	0.25 mile
Historic Districts	• NJGIN historic districts	• PA-Share historic district data	0.25 mile
Federal Emergency Management Agency (FEMA) Flood Hazard Areas	• FEMA National Flood Hazard Layer Database		500 feet
Known Contaminated Sites	• NJGIN known contaminated site list • EPA Superfund site boundaries	• PASDA land recycling cleanup locations • EPA Superfund site boundaries	500 feet

Additionally, based on desktop research and knowledge of site conditions, the project team flagged the anticipated interference of the following variables along the respective rail corridors. This analysis

provides a more detailed review of constraints specifically affecting the rail corridor (without using a buffer) than the GIS-based analysis.

- Bridge – requires construction of new bridge at a high capital cost
- Contaminated Site – proximal to a contaminated site
- Operational Conflict – conflict between passenger and freight rail
- Park – conflict with parkland, including trails
- Parking – conflict with existing parking lot
- Property – conflict with existing building
- ROW – requires additional ROW
- Water – conflict with body of water

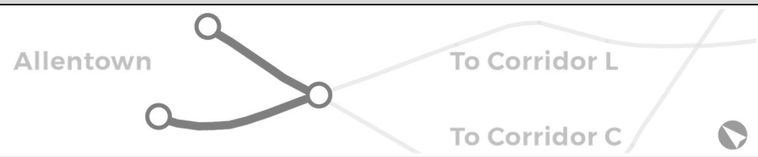
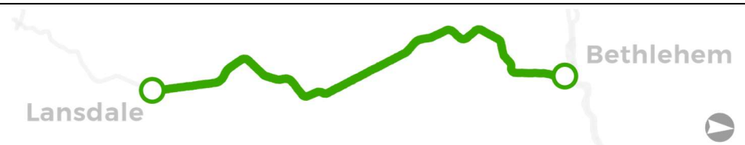
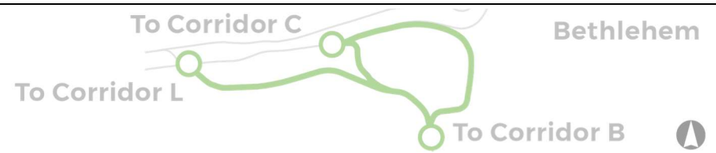
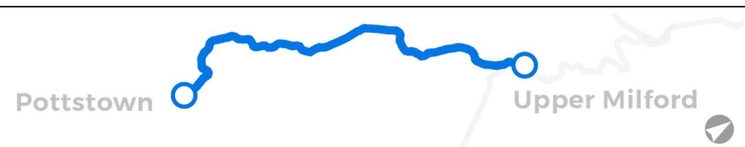
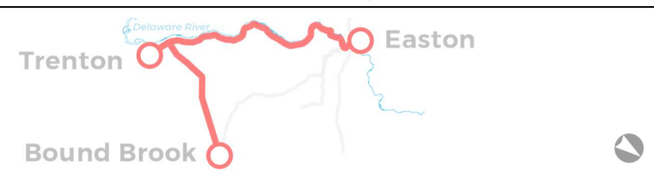
Results

In the *Environmental Screening Technical Memo*, 34 maps are provided, covering the entire 99 segments. These maps highlight the presence of the above-identified environmental constraint categories. As an example, one of these 34 maps is shown below in *Figure 4*.

Figure 4. Example of Zoomed-in Environmental Constraint Map

The presence of the constraints and flagged variables listed above are summarized in *Table 4* below. The green, orange, and red boxes indicate the extent of the constraint for each corridor. The precise presence of each constraint category differs between constraints, but green indicates a general absence of a constraint, orange indicates a notable presence of a constraint, and red indicates a significant presence of a constraint.

Table 4. Environmental Screening Summary by Corridor

Market Area Served	Corridor				Constraints						Flagged Environmental Constraints
	ID	Alignment	Water	Parks	Property	Contaminated Sites	Bridges	Parking	Rail ROW	Operational Conflicts	
Connector	A				●				●		• Property: Alignment for old CNJ Allentown station site (A1) • Rail ROW: Alignment for old LVRR Allentown station site (A2)
Philadelphia	B			●							• Parks: Site of Bethlehem Greenway rail trail (B1); site of Saucon Rail Trail and Upper Bucks Rail Trail (B3-B7)
Connector	BC			●	●					●	• Parks: Site of Bethlehem Greenway rail trail (BC3.2, BC3.3) • Property: Requires new steep ramp and potential Casino property impacts (BC1.3) • Operational Conflicts: Conflict with frequently used industrial switching operation (BC2.2)
Newark/ New York	C		●	●	●	●	●			●	• Water: Potential reconstruction of creek crossing required (C1) • Parks: In parkland and overlaps with Delaware & Lehigh Trail (C7, C8, C9) • Property: Requires new steep ramp and potential Casino property impacts; section used for private driveway (C6) • Contaminated Sites: Contaminated site in area (C6, C14) • Bridges: Requires new bridge over I-78 (C13) • Operational Conflicts: Shared use with main line freight rail; slow-speed yard-related traffic (C3, C4, C5b, C11, C12)
Philadelphia	CO				●						• Property: Requires takings of multiple residential, commercial, industrial, and farm properties (CO1, CO2, CO3); requires taking of Walmart parking lot and realignment of road CO3)
Newark/ New York & Philadelphia	D			●	●					●	• Parks: Requires use of parkland (D1); site of Delaware & Raritan Canal Trail and rail trail in Trenton (D3, D6, D7) • Property: Requires aerial structure to connect ramp to West Trenton Line; requires taking of residential property (D8b) • Operational Conflicts: Shared use with main line freight rail (D10)

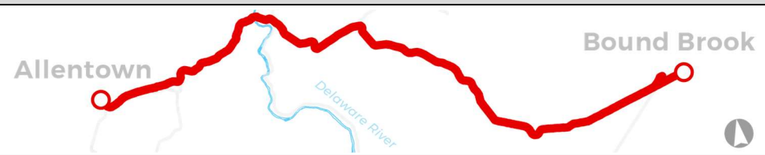
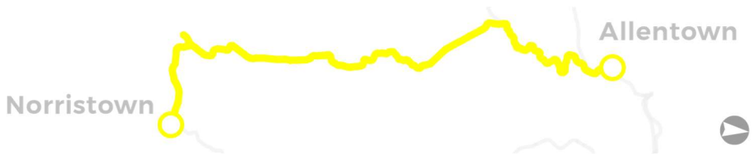
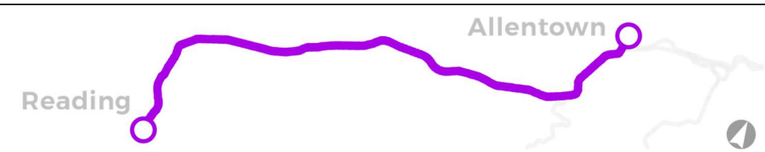
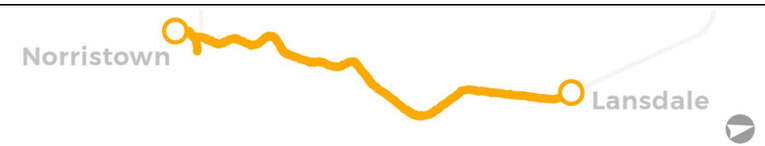
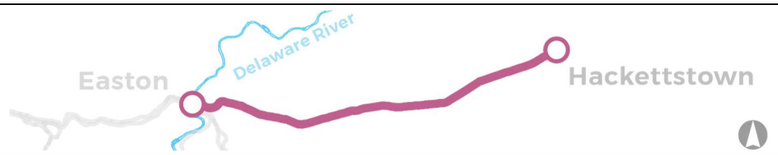
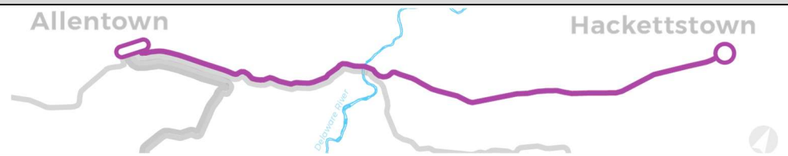
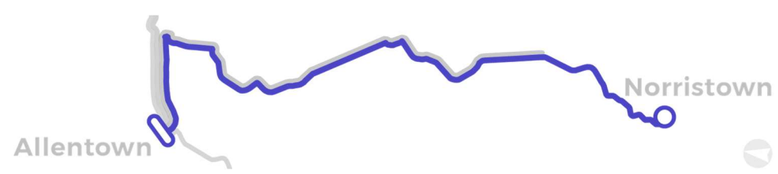
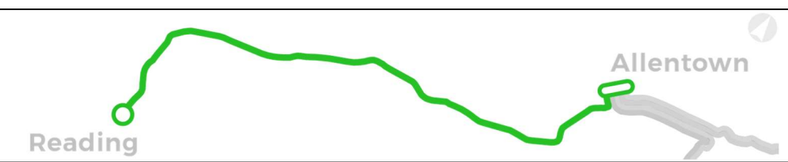
Market Area Served	Corridor				Constraints						Flagged Environmental Constraints
	ID	Alignment	Water	Parks	Property	Contaminated Sites	Bridges	Parking	Rail ROW	Operational Conflicts	
Philadelphia	L									●	• Operational Conflicts: Shared use with main line freight rail (L10-L13); used for storage of cars and heavy industrial operations (L12b)
Philadelphia	P			●	●			●			• Parks: Site of Perkiomen Trail (P3); site of Schuylkill River Trail (P7) • Property: Likely requires taking of major office development and residential properties, as well as new tunnel under freeway and relocation of local road (P4, P6) • Parking: Requires removal of SEPTA parking lot (P8)
Reading	R										
Philadelphia	S					●					• Contaminated Site: Contaminated site in area (S2)
Connector	TC			●	●	●					• Parks: Rail trail impacts (TC2.1, TC2.2) • Property: Requires significant reduction of parking; new bridge of Trenton Freeway required (TC1.1) • Contaminated Sites: Contaminated site in area (TC2.3)
Newark/ New York	W										

Table 5. Environmental Screening Summary by Service Alternative

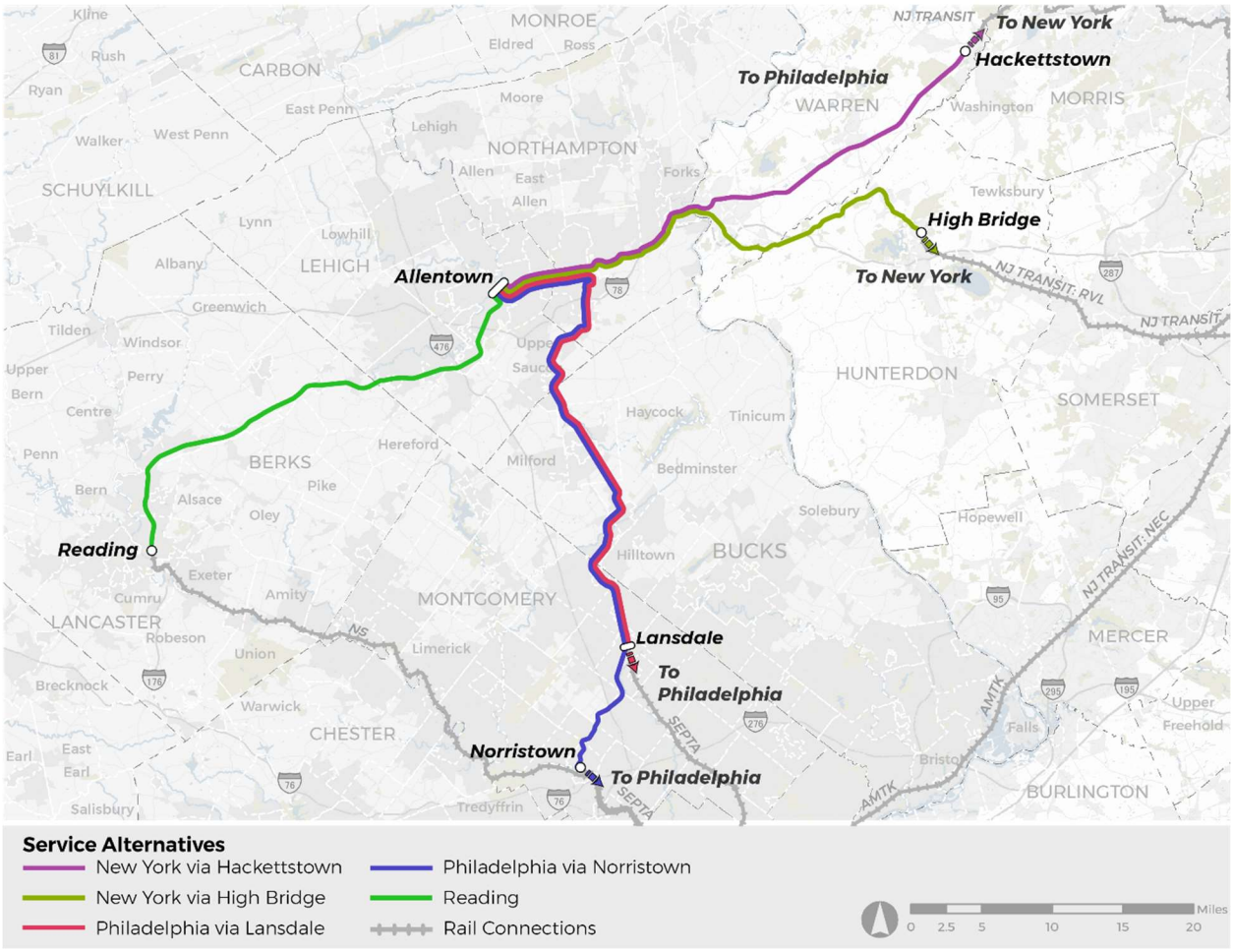
Market Area Served	Corridor			Constraints						Flagged Environmental Constraints
	Alignment	Water	Parks	Property	Contaminated Sites	Bridges	Parking	Rail ROW	Operational Conflicts	
To New York via Hackettstown								●	●	• Rail ROW: Alignment for old LVRR Allentown station site (A2) • Operational Conflicts: Shared use with main line freight rail (L10-L13, C11); used for storage of cars and heavy industrial operations (L12b)
To New York via High Bridge					●	●		●	●	• Contaminated Sites: Contaminated site in area (C14) • Bridges: Requires new bridge over I-78 (C13) • Rail ROW: Alignment for old LVRR Allentown station site (A2) • Operational Conflicts: Shared use with main line freight rail (L10-L13, C11-C12); used for storage of cars and heavy industrial operations (L12b)
To Philadelphia via Lansdale			●					●	●	• Parks: Site of Bethlehem Greenway rail trail (B1); site of Saucon Rail Trail and Upper Bucks Rail Trail (B3-B7) • Rail ROW: Alignment for old LVRR Allentown station site (A2) • Operational Conflicts: Shared use with main line freight rail (L10-L13); used for storage of cars and heavy industrial operations (L12b); conflict with frequently used industrial switching operation (BC2.2)
To Philadephia via Norristown			●		●			●	●	• Parks: Site of Bethlehem Greenway rail trail (B1); site of Saucon Rail Trail and Upper Bucks Rail Trail (B3-B7) • Contaminated Site: Contaminated site in area (S2) • Rail ROW: Alignment for old LVRR Allentown station site (A2) • Operational Conflicts: Shared use with main line freight rail (L10-L13); used for storage of cars and heavy industrial operations (L12b); conflict with frequently used industrial switching operation (BC2.2)
To Reading		●						●		• Water: Potential reconstruction of creek crossing required (C1) • Rail ROW: Alignment for old LVRR Allentown station site (A2)

5. Service Alternatives and Demand Analysis

Service Alternatives

Segments from the various corridors have been combined to form service alternatives between the Lehigh Valley and each of the market pairs. These service alternatives represent the actual route that a potential passenger rail service could follow between the Lehigh Valley and the three market areas. The project team identified five service alternatives from the network of evaluated corridors. Two of these service alternatives serve the Lehigh Valley to the Newark/New York market, two alternatives serve the Lehigh Valley to the Philadelphia market, and one alternative serves the Lehigh Valley to the Reading market. Figure 5 shows the five alternatives between the Lehigh Valley and the three market areas.

Figure 5. Service Alternatives



Lehigh Valley to Newark/New York

Within the Lehigh Valley, Corridor L is more feasible than Corridor C. Corridor C affects recreational land and nearby residential areas. Corridor L, while dominated by heavy freight rail traffic, is a pre-existing and active rail ROW and has space for additional tracks along the length of the corridor.

Hackettstown Alternative

Within the Lehigh Valley, the Hackettstown Alternative follows Corridor L to Easton, crosses the Delaware River on Segment C11, and stays on the Norfolk Southern Lehigh Line. At Phillipsburg, the alternative follows Corridor W to Hackettstown, where service then follows NJ TRANSIT's Morris & Essex Lines to Newark/New York. The Hackettstown Alternative has an expected travel time of 2 hours and 2 minutes from Allentown to New York Penn Station.

This alternative shares the ROW with the Norfolk Southern Reading Line and Lehigh Line between Allentown and Phillipsburg. This section sees heavy main line freight traffic with diverging tracks and yards that complicate the construction and operation of passenger rail infrastructure. However, the ROW generally has room for additional track infrastructure, and the use of an existing, active rail ROW avoids complications with acquiring private property or recreational lands. East of Phillipsburg, the rail ROW leverages underused freight rail corridors and existing NJ TRANSIT passenger rail corridors to access Newark/New York, which avoids using main line freight rail ROWs east of Phillipsburg.

High Bridge Alternative

Within the Lehigh Valley, the High Bridge Alternative follows Corridor L to Easton and stays on the Norfolk Southern Lehigh Line across the Delaware River and through to Bloomsbury on a mix of Corridor C and Corridor L segments. At Bloomsbury, the alternative follows Segment C14 to High Bridge, where it continues to Newark/New York via the NJ TRANSIT Raritan Valley Line. The High Bridge Alternative has an expected travel time of 1 hour and 49 minutes from Allentown to New York Penn Station.

The High Bridge Alternative shares the ROW with the Norfolk Southern Reading Line and Lehigh Line between Allentown and Bloomsbury. This section sees heavy main line freight traffic with diverging tracks and yards that complicate the construction and operation of passenger rail infrastructure. However, the ROW generally has room for additional track infrastructure, and the use of an existing, active ROW avoids complications with acquisition of private property or recreational lands. East of Bloomsbury, the ROW leverages underused freight rail corridors and existing NJ TRANSIT passenger rail corridors to access Newark/New York, which avoids using main line freight rail ROWs east of Bloomsbury. The High Bridge Alternative uses 7.4 miles more of Norfolk Southern's Lehigh Line than the Hackettstown Alternative but with the benefit of faster running times.

Lehigh Valley to Philadelphia

While Corridors B, S, P, and CO all provide potential routes for service alternatives to Philadelphia, Corridors P and CO pose substantial problems with acquiring privately owned land for rail ROW. Both alternatives use Corridor B to reach Philadelphia.

Lansdale Alternative

Between Allentown and Bethlehem, the Lansdale Alternative follows Corridor L. At Bethlehem, the alternative uses the existing Lehigh Valley Rail Management ROW (Segments BC2.2 and BC2.1) to reach the Saucon Creek crossing. The Lansdale Alternative then uses Corridor B to Lansdale, where passenger rail service joins the SEPTA Main Line to the Center City Philadelphia and 30th Street Station. The alternative has an expected travel time of 1 hour and 44 minutes from Allentown to Philadelphia's 30th Street Station.

The Lansdale Alternative shares the ROW with the Norfolk Southern Reading Line between Allentown and Bethlehem. The shared segments with Lehigh Valley Rail Management experience heavy freight rail traffic with trains moving in and out of the yards to the interchange point with Norfolk Southern. Operational or infrastructure strategies will need to be devised to avoid delays to freight and passenger rail services. On Corridor B north of Shelly, existing SEPTA-owned rail ROW is leased to local governments to maintain a mixed-use trail. Strategies for sharing or replacing the rail trails need to be carefully considered and sensitive to local communities. The alternative is predicated on using the SEPTA Main Line between Lansdale and Center City. The Center City Tunnel does not permit diesel operation, and it is unknown if SEPTA would permit dual-mode locomotives to operate. Therefore, the ability to use the Lansdale Alternative depends on trainsets used for this service to not be diesel-powered.

Norristown Alternative

Between Allentown and Bethlehem, the Norristown Alternative follows Corridor L. At Bethlehem, the Lansdale Alternative uses the existing Lehigh Valley Rail Management ROW (Segments BC2.2 and BC2.1) to reach the Saucon Creek crossing. The Norristown Alternative uses Corridor B to Lansdale. At Lansdale, this alternative follows Corridor S to SEPTA's Norristown Transportation Center, where passenger rail service joins the SEPTA Norristown Line to a connection to the Northeast Corridor near North Philadelphia Station and follows the Northeast Corridor to 30th Street Station. The Norristown Alternative has an expected travel time of 1 hour and 52 minutes from Allentown to Philadelphia's 30th Street Station.

Like the Lansdale Alternative, the Norristown Alternative shares ROW with the Norfolk Southern Reading Line between Allentown and Bethlehem. The shared segments with Lehigh Valley Rail Management experience heavy freight rail traffic with trains moving in and out of the yards to the interchange point with Norfolk Southern. Operational or infrastructure strategies will need to be devised to avoid delays to freight and passenger rail services. On Corridor B north of Shelly, existing SEPTA-owned rail ROW is leased to local governments to maintain a mixed-use trail. Strategies for sharing or replacing the rail trails need to be carefully considered and sensitive to local communities. Unlike the Lansdale Alternative, the Norristown Alternative uses Corridor S as far as Norristown, which necessitates greater capital investment and longer travel times. The Norristown Alternative, however, allows for the use of diesel-powered trainsets.

Lehigh Valley to Reading

Reading Alternative

Only one viable service alternative was created for Allentown to Reading service. The Reading Alternative uses Segment C1 to Auburn Street and Corridor R the rest of the way to downtown Reading.

This alternative has an expected travel time of 46 minutes. The Reading Alternative uses the Norfolk Southern Reading Line, the only direct rail ROW between Allentown and Reading. The Reading Line is mostly double-tracked, but freight rail volumes are high.

Demand Analysis

This section summarizes the demand analysis that used U.S. Census data to review existing demographics and commuting data between the Lehigh Valley and the three market areas along the five alternative routes. This analysis is not intended to provide ridership estimates, but it does show existing potential demand for renewed passenger rail service from the Lehigh Valley. Additional detail can be found in the *Service Alternatives Technical Memorandum*.

The demand analysis primarily used data from the U.S. Census 2019 OntheMap tool, which provides home and employment data for mapping and analysis. The data used was collected prior to the Covid-19 pandemic, at a time when typical weekday commutes involved daily round trips between home and work. It is unknown as of the writing of this report if and when commuting patterns will return to pre-Covid levels and frequencies or if they will remain more hybrid in nature, with many weekday employees continuing to work partially, primarily, or entirely from home.

The analysis focused on the five alternatives that connect the Lehigh Valley with existing or planned rail connections and the commuting characteristics along these existing and planned connections. Analyzing commuting along these connected corridors provides insights into the potential demand for transit service between the Lehigh Valley and the market areas, with the important caveat that proximity to a corridor alone does not mean an individual will choose to ride the train. Other factors like convenience of the rail service – and the cost, convenience, and reliability of the competing drive – influence modal decision-making.

Data were mainly gathered for the following two variables:

- Home location of people working within 1 mile of the corridor
- Work location of people living within 5 miles of the corridor

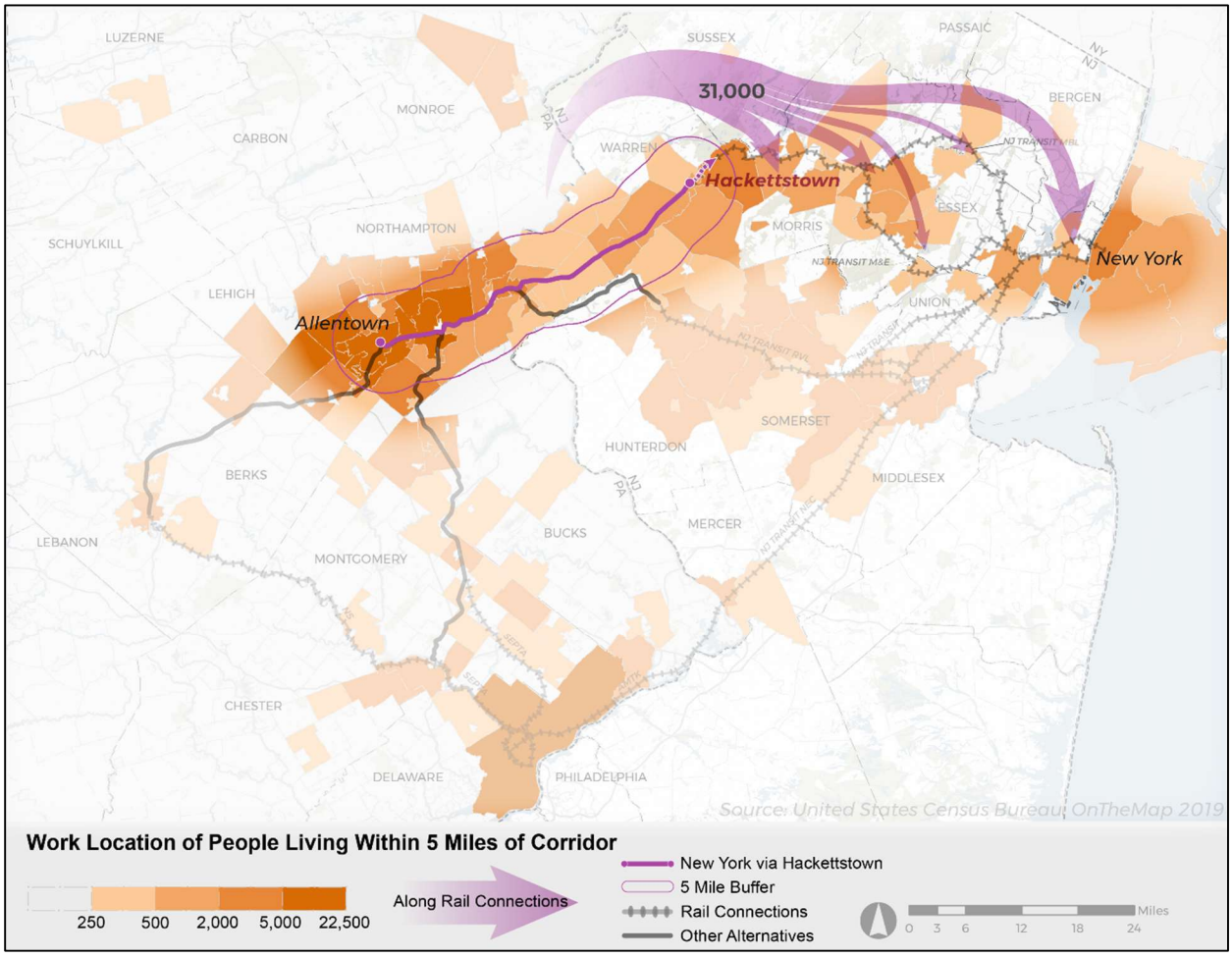
A distance of 1 mile was used for employment proximity because of the typically lower demand and ability for people to travel an additional distance from departing the train to their work destination. Five miles was used for home locations because people are typically more willing to drive a farther distance to start their trip by train.

The following maps (*Figures 7 through 11*) show the work location of Lehigh Valley residents living within 5 miles of the corridor for each alternative. Data are shown at the municipal geographic level. The large arrow and corresponding number on each map indicate the number of people commuting daily from within 5 miles of the planned corridor to municipalities within 1 mile of the connecting corridor (extending to New York, Philadelphia, or Reading, as applicable). Each map is followed by a brief description of the commuting patterns displayed on the map.

As further detailed in the *Service Alternatives Technical Memorandum*, far more people presently commute from the Lehigh Valley toward New York/Newark, Philadelphia, and Reading than commute from these areas to the Lehigh Valley. Renewed passenger rail service in the Lehigh Valley would

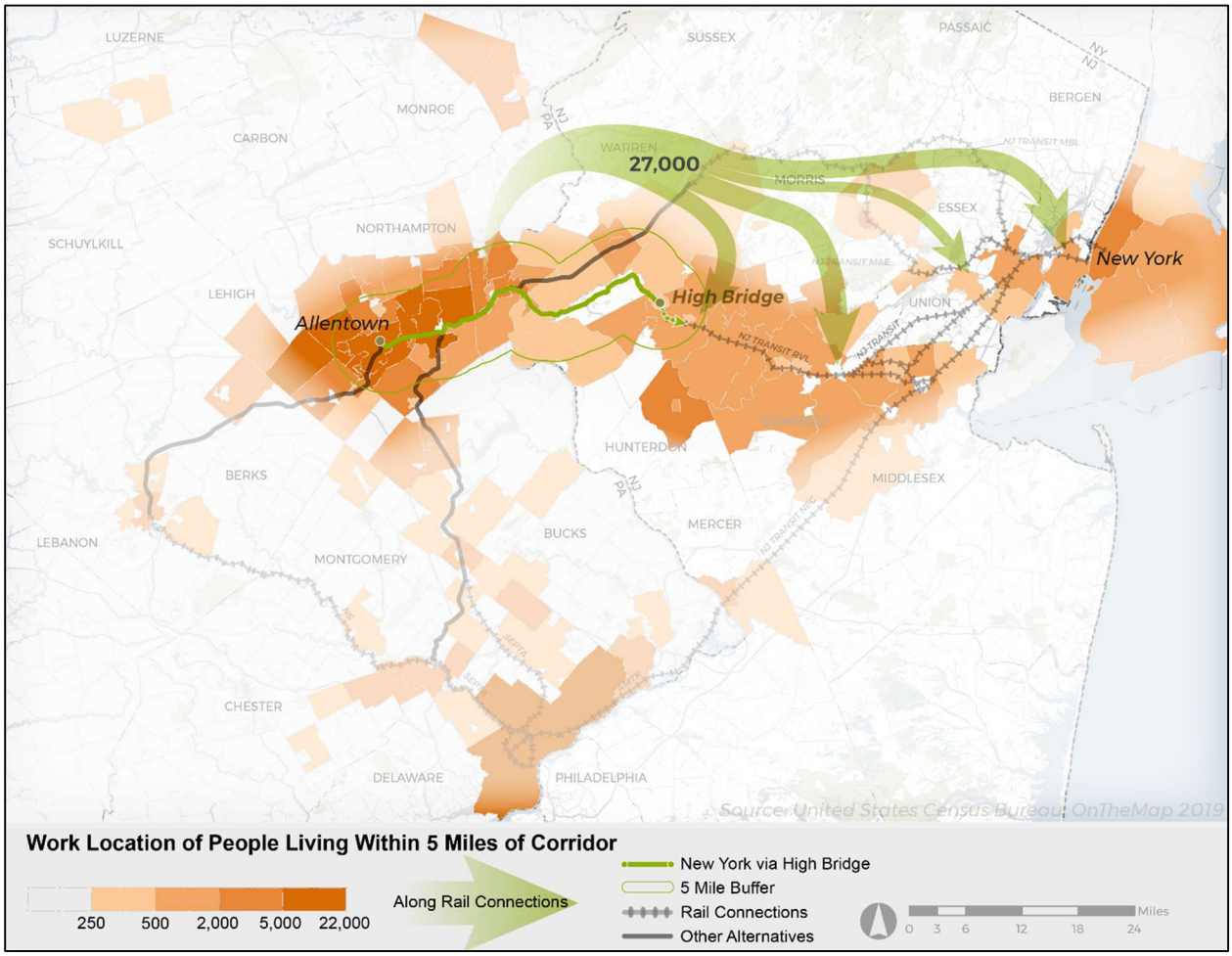
provide transit access for those already commuting toward these market areas and provide opportunities for commuting into the Lehigh Valley.

Figure 6. Hackettstown Alternative – Work Locations



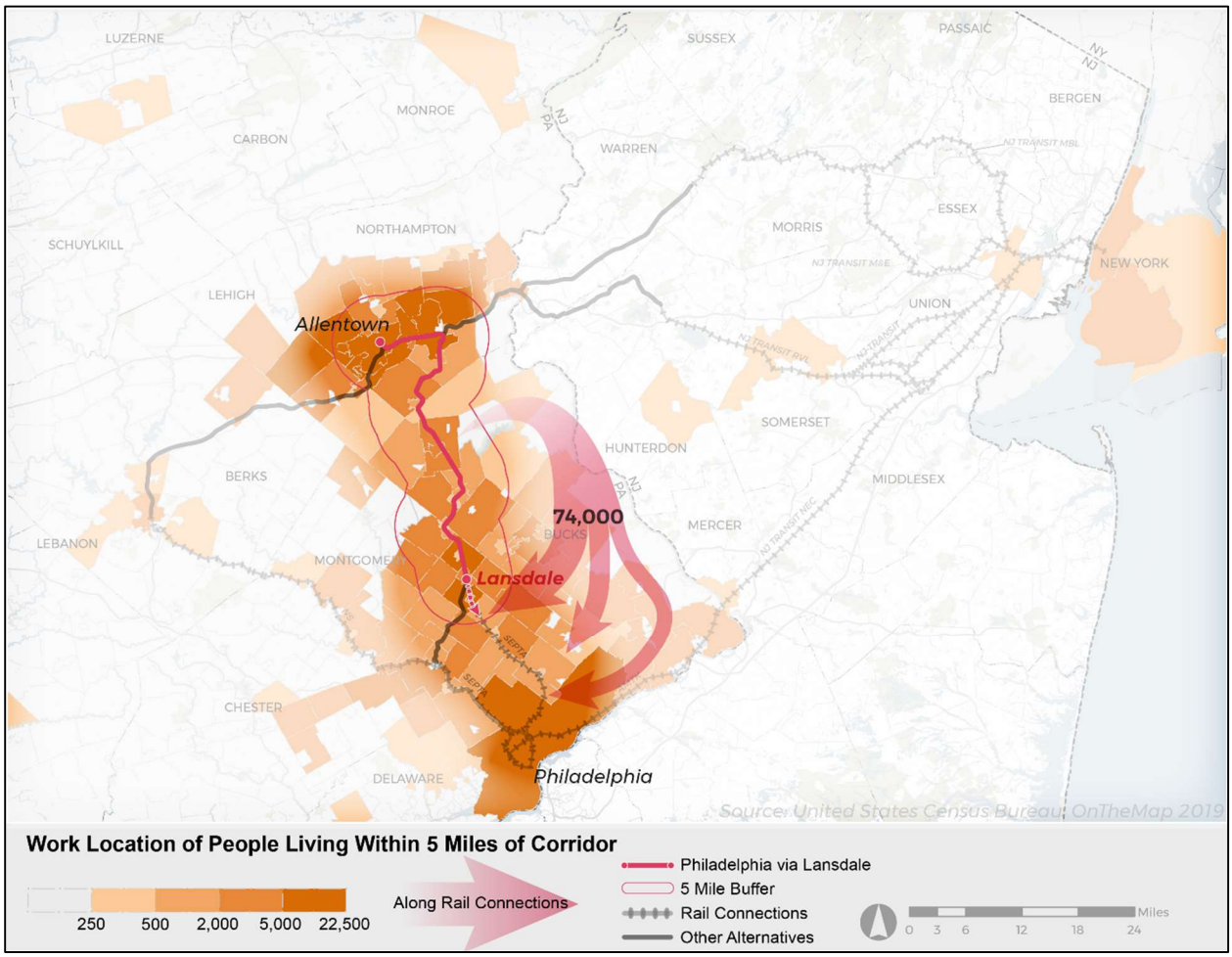
More than 30,000 people commute to work from the Lehigh Valley east to the New York/Newark area, including to communities along NJ TRANSIT's Morris & Essex Line and Montclair-Boonton Line. In addition to commuting from the Lehigh Valley to New York and Newark, many people also commute to Hackettstown.

Figure 7. High Bridge Alternative – Work Locations



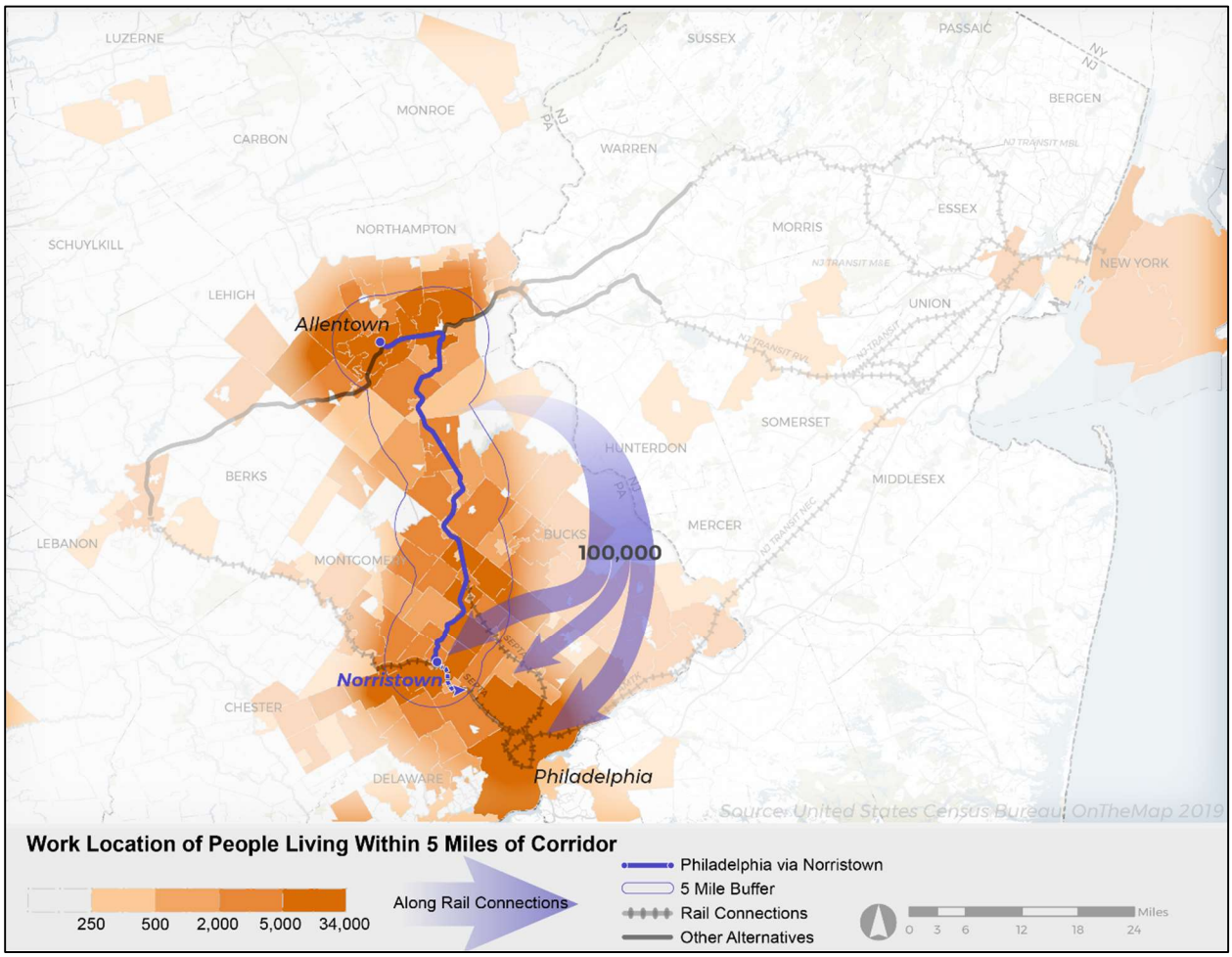
More than 35,000 people commute to work from the Lehigh Valley east to the New York/Newark area, including to communities along NJ TRANSIT's Raritan Valley Line. In addition to commuting from the Lehigh Valley to New York and Newark, many people also commute to Raritan Township in Hunterdon County.

Figure 8. Lansdale Alternative – Work Locations



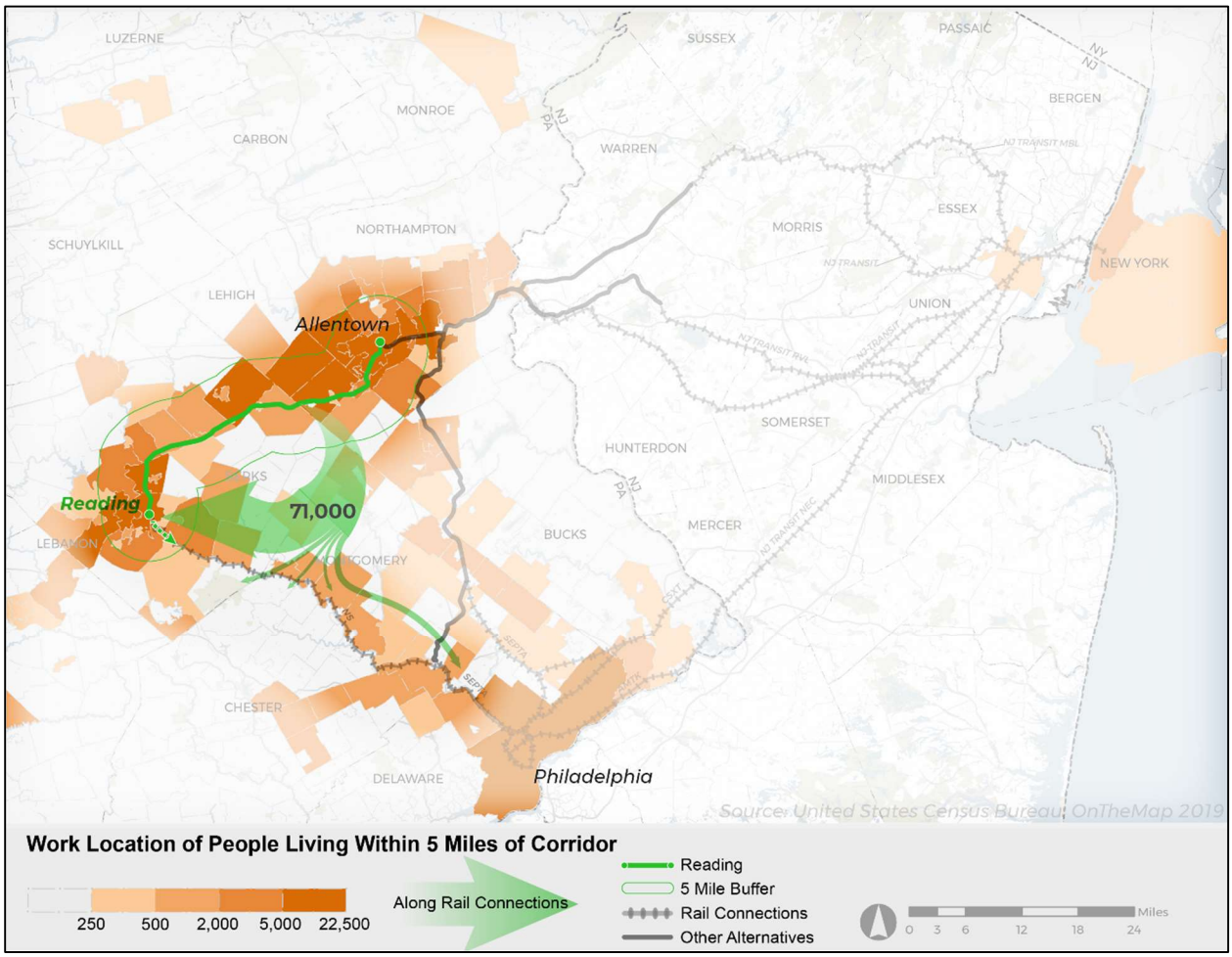
More than 74,000 people commute to work from the Lehigh Valley south to the Philadelphia area, including to communities along SEPTA's Lansdale/Doylestown Line. In addition to commuting from the Lehigh Valley to Philadelphia, many people also commute to Lansdale.

Figure 9. Norristown Alternative – Work Locations



More than 100,000 people commute to work from the Lehigh Valley south to the Philadelphia area, including to communities along SEPTA's Manayunk/Norristown Line and Norristown High Speed Line. In addition to commuting from the Lehigh Valley to New York and Newark, many people also commute to Norristown and King of Prussia.

Figure 10. Reading Alternative – Work Locations



More than 70,000 people commute to work from the Lehigh Valley southwest to the Reading and Philadelphia areas, including to communities along the planned rail route between Reading and Philadelphia. In addition to commuting from the Lehigh Valley to Reading and Philadelphia, many people also commute to the communities surrounding Reading.

6. Cost

Capital Cost

The project team developed planning-level capital cost estimates to compare the infrastructure needs and rolling stock procurement costs for the service alternatives. These order-of-magnitude capital costs are preliminary and were developed without detailed engineering analysis. These planning-level costs are being provided as a starting point for discussion of the service alternatives and will require more thorough study to serve as a guide for future investment.

The cost estimates considered the following variables:

- Constraints and limitations from freight activity, such as steep grades, sharp curves, and freight yard conflicts
- Necessary infrastructure upgrades or modifications to implement the potential service plans such as sidings, additional track, catenary, signals, and positive train control
- Constraints associated with reactivating or building tracks adjacent to existing rail trail facilities
- Station facilities (does not include any potential acquisition costs for station or parking needs)
- Identification of rolling stock
- Identification of maintenance and layover facilities

All infrastructure and rolling stocks are scaled to assume train service that operates three round trips per day. Capital costs were estimated based on the Passenger Rail Investment and Improvement Act (PRIIA) Section 209 cost methodology.

Methodology

This section presents capital costs for both the five potential service alternatives, as well as for each individual corridor segment that comprise those service alternatives. Costs for each line item were first calculated for each corridor. Then an estimated cost for each of the five service alternatives was derived from the corridor costs based on mileage of each corridor used as well as the locations of certain high-cost infrastructure pieces. These cost estimates all assume train service that operates three round trips per day.

Each of the candidate corridors was assumed to require 1 mile of new track construction for each mile of corridor. This assumption was made to account for single-track ROWs on passenger-only segments or freight branch lines and for an exclusive passenger rail track on segments that share the rail ROW with Class I freight railroad mainlines. A mile-long sample section was used for each corridor to estimate the quantity of structural items.

The following items were NOT included in the cost estimates:

- Financing
- Hazardous material handling
- Utility relocation

- Environmental mitigation
- Third-party mitigation
- Freight rail access fees

A unit price based on 2023 dollars was established for each of the items and multiplied by the quantity for each corridor. The sum of these figures resulted in the total direct cost for each corridor. The following additional contingency costs were added to this direct cost:

1. 30% of direct cost added for mobilization
2. 6.625% of direct cost added for taxes
3. 30% of direct cost added for general conditions
4. 20% of direct cost added for contractor's overhead and profit
5. 15% of direct cost added for subcontractor's overhead and profit
6. 10% of direct cost added for bond and insurance costs
7. 10% of direct cost added for environmental and permitting costs
8. 30% of direct costs added for an engineering contingency allowance, and includes:
    a. Design costs
    b. Construction management
    c. Program management
    d. Direct agency involvement

Because this study was conducted very early in the project development process prior to the identification of a potential project sponsor, the study did not involve discussions with freight rail roads or transit agencies about the potential for future Lehigh Valley passenger service or the costs associated with that service. Likewise, costs for freight rail access fees were not considered part of this effort since freight railroads or transit agencies involved may ultimately require different or additional capital improvements, which would impact the estimated capital costs.

After costs were established for each corridor segment using the methodology described above, the capital cost of each of the five service alternative alternatives was derived from the costs of the corridors comprising that alternative. For retaining walls, minor bridge structures, and minor culverts, service alternative line-item quantities were generally based on the percentage of mileage of a corridor that a service alternative used, multiplied by the quantity of that item from the corresponding corridor. The quantities calculated from each corridor were then summed up. Track alignment, earthwork, tunnels, flyovers, and stations were based on total service alternative mileage. Major bridge structures, tunnels, and flyovers were based on whether or not these items would be needed on the specific segments that each service alternative used. One rail maintenance facility was assumed to be part of each service alternative.

Service Alternative Capital Cost Summary

Table 6 provides an overview of the planning-level capital costs and track length for each of the service alternatives.

Table 6: Planning Level Capital Costs for the Service Alternatives

Service Alternative	Total Length (mi)	Estimated Capital Cost ($)	Rolling Stock Cost ($)
Newark/New Jersey Alt via Hackettstown	51.98	$474,909,110	$145,018,585
Newark/New Jersey Alt via High Bridge	47.19	$469,923,680	$145,018,585
Philadelphia Alt via Lansdale/Main Line	48.79	$635,811,084	$102,016,680
Philadelphia Alt via Norristown	63.21	$739,026,613	$102,016,680
Reading Alt	46.46	$450,325,639	$102,016,680

Note: Capital costs are assumed to be within ±20% of the estimated total capital costs. In addition to the capital costs shown in the table, approximately $0.5M-$1M in ROW costs is anticipated, depending on the service alternative.

Corridor Capital Cost Summary

Table 7 provides an overview of the planning-level capital costs and track length for each candidate corridor. Corridors C, D, L, P, and R are each estimated to exceed a capital cost of $1 billion because of the need for construction of new track. The table also presents the cost per mile.

Table 7. Planning-Level Capital Costs for the Candidate Corridors

Corridor	Total Length (mi)	Estimated Capital Cost ($)	Cost Per Mile ($)
Corridor A	0.40	$7,356,192	$18,390,479
Corridor B	38.82	$443,204,435	$11,416,910
Corridor BC	7.22	$49,279,230	$6,825,378
Corridor C	47.30	$665,252,290	$14,064,530
Corridor CO	25.01	$384,984,808	$15,393,235
Corridor D	98.35	$1,499,561,403	$15,247,193
Corridor L	80.09	$719,215,361	$8,980,089
Corridor P	59.71	$1,097,245,417	$18,376,242
Corridor R	46.00	$338,311,169	$7,354,591
Corridor S	15.07	$147,290,149	$9,773,733
Corridor TC	3.34	$198,509,269	$59,433,913
Corridor W	30.82	$219,990,035	$7,137,899

Note: Capital costs are assumed to be within ±20% of the estimated total capital costs.

Additional details for the estimated costs for the 12 candidate corridors are provided in the *Infrastructure and Capital Costs Technical Memorandum*, which is included as an appendix to this document.

Operating Plans and Cost Estimates

Operating Plan Methodology

The project team created draft service schedules for service from the Lehigh Valley to the target destinations to develop order-of-magnitude estimates of operating costs. These service plans assume the use of three equipment sets to provide service each day for each line. Each plan was developed using estimates of run time based on distance and average operating speeds for typical commuter rail operations. Average speeds were used to calculate run times because the study of these line segments is not at the level where engineering work has progressed to the point that would produce a speed profile for each route.

Along with the use of average operating speeds, allowances were added for a limited number of intermediate station stops. In scenarios where trains are expected to operate over existing NJ TRANSIT or SEPTA territory, trip times were estimated using existing service schedules, with the assumption that these trains would be something of a hybrid service—between a commuter rail and intercity rail service—with fewer stops than most express trips operating on the lines today. At this point, no effort has been made to determine if this assumption is acceptable to NJ TRANSIT or SEPTA. Also, at this level of planning, with no known start date for a potential start of service, no effort was made to integrate these service schedules into existing patterns of service.

The purpose of developing these draft service plans is simply to identify approximate run times and potential service levels (trains per day) to allow for a high-level order-of-magnitude estimate of annual operating costs for these service options.

New York/Newark Alternative via Hackettstown

A draft service plan was created for service to the Newark/New York area using the Lehigh Line, Short Line Railroad segment and the NJ TRANSIT Morristown Line via Hackettstown. For a trip from Allentown to Penn Station, New York, trip times were estimated at 2 hours 30 minutes. Three stops were assumed in Pennsylvania. In New Jersey, approximately five fewer intermediate stops then are typical for semi-express schedules on the Morristown Line were assumed. As noted earlier, it is not known if this number of stops would be acceptable to the various parties that would be involved with this service. The daily equipment cycles for the three trainsets allowed time for refueling between each round trip, based on the characteristics of existing, in-service, dual-mode (electric and diesel) locomotives. For cost-estimating purposes, the draft service plan assumed:

- 3 round trips or 6 trains per day
- A service pattern for the day with a morning round trip, midday round trip and evening round trip
- The same service level 7 days per week

New York/Newark Alternative via High Bridge

A draft service plan was created for service to the Newark/New York area using the Lehigh Line, portions of the currently inactive NJ TRANSIT Raritan Valley Line, and the NJ TRANSIT active section of the Raritan Valley Line. For a trip from Allentown to Penn Station, New York, trip times were estimated at 2 hours and 20 minutes. Three stops in Pennsylvania and up to five intermediate stops in New Jersey were included. As noted earlier, it is not known at this time if these stops would be acceptable to the various parties that would be involved with this service. The daily equipment cycles for the three trainsets allowed time for refueling between each round trip, based on the characteristics of existing, in-service, dual-mode (electric and diesel) locomotives. For cost-estimating purposes, the draft service plan assumed:

- 3 round trips or 6 trains per day
- A service pattern for the day with a morning round trip, midday round trip and evening round trip
- Allentown to the final daily arrival in Allentown)
- The same service level 7 days per week

Philadelphia Corridor Alternative via Lansdale

A draft service plan was created for service from Allentown to Philadelphia (30th Street Station) using the SEPTA Line between Lansdale, Pennsylvania, and Philadelphia with trip times of 1 hour and 46 minutes. Trip time on the Lansdale Line portion of the route was estimated by using current trip times for the Fort Washington Express trains that currently operate on the line, assuming these trains making three or four fewer stops between Lansdale and the Jefferson stop (formerly Market East Station). Again, there is no concurrence from SEPTA for this type of stopping pattern or assumed train slotting on the line. Like the New Jersey route, the equipment cycles allowed time for fueling in Allentown between each round trip. For cost-estimating purposes, the draft service plan assumed:

- 3 round trips or 6 trains per day
- A service pattern for the day with a morning round trip, midday round trip and evening round trip
- The same service level 7 days per week

Philadelphia Corridor Alternative via Norristown

A draft service plan was also created for service from Allentown to Philadelphia (30th Street Station) using the SEPTA Line between Norristown, Pennsylvania, and Philadelphia, with an estimated trip time of 1 hour and 52 minutes. Trip time on the Norristown Line portion of the route was estimated by using current trip times for trains that currently operate on the line, with those trains making three or four fewer stops between Norristown and the Jefferson Station (formerly Market East). Again, there is no concurrence from SEPTA for this type of stopping pattern or assumed train slotting on the line. Like the New Jersey route, the equipment cycles allowed time for fueling in Allentown between each round trip. For cost-estimating purposes, the draft service plan assumed:

- 3 round trips or 6 trains per day

- A service pattern for the day with a morning round trip, midday round trip and evening round trip
- The same service level 7 days per week

Reading Alternative

A draft service plan was also created for service from Allentown to Reading with trip times of 46 minutes between the two. These trip times assumed three intermediate station stops. Like the other routes, the equipment cycles allowed time for fueling in Allentown between each round trip. For cost-estimating purposes, the draft service plan assumed:

- 3 round trips or 6 trains per day
- A service pattern for the day with a morning round trip, midday round trip and evening round trip
- The same service level 7 days per week

Order-of-Magnitude Operating Cost Estimate Methodology

The study team used National Transit Database average cost per revenue vehicle hour data for diesel service as well as average cost per hour for the appropriate regional provider (NJ TRANSIT or SEPTA) to develop a range of cost estimates for the services studied. These estimates were developed to represent an "**order-of-magnitude**" estimate of operating costs. Operating cost estimates only include train-related expenses; they do not include the ongoing costs of operating and maintaining stations.

An existing operating railroad normally builds cost estimates from known data sources, such as labor rates, fuel costs, maintenance history, and other similar sources. The project team is familiar with these costs but not to the level of detail needed to generate operating cost estimates at this time. Because these data sources were not available for this level of study and this early in the process of study, the project team used available averages to estimate costs. Each average cost factor is result of the buildup of known costs for an operating railroad.

The basic formulas for the development of costs are:

- Rate per vehicle * number of vehicles per train * revenue hours per trip*trains per day = daily cost
- Daily cost * # of days of operation per year = annual cost

The cost factors or rate per vehicle revenue hour are shown in Table 8.

Table 8. Average Cost Factors or Rate Per Vehicle Revenue Hour

Average Cost per Vehicle Revenue Hour		
Operator	**Cost/Revenue Hour**	**Data Source**
National Diesel Services	$562	FTA National Transit Database (NTD)
NJ TRANSIT	$538	FTA NTD
SEPTA	$331	2019 Data

Average Cost per Vehicle Revenue Hour		
Operator	**Cost/Revenue Hour**	**Data Source**
Amtrak State-Supported Services	$657	FTA NTD

The cost estimates considered the ownership of line segments that could be used to provide the service, where applicable. The cost factors for SEPTA and NJ TRANSIT, where these service providers' rail lines might become part of the service route, were used for one of the estimates for that route. The project team also considered the average cost per revenue hour for Amtrak state-supported service to recognize the possibility that Amtrak could be the service provider.

Operating cost estimates were developed for the full length of proposed service. Where the potential for sharing those costs with a non-Pennsylvania entity exists, the project team used current examples for cost sharing as models to estimate a potential break-out of cost by the parties involved. An example of this situation might be the operation of a train from Pennsylvania to the New York City region, where part of the route operates over NJ TRANSIT territory and provides service to NJ TRANSIT rail stations. The potential exists for cost sharing with NJ TRANSIT over that NJ TRANSIT territory.

The cost-sharing approach was based, to a degree, on the current operating agreement between NJ TRANSIT and Metro North for the operation of trains from Orange County, New York, and Rockland County, New York, to and from Hoboken Terminal in New Jersey. In this arrangment, Metro North is 100% responsible for the cost of operation in New York State and shares the cost of operation for those specific trains over NJ TRANSIT territory. The costs are split based on the percentage of New York State riders and percentage of New Jersey riders on the service, while operating through New Jersey.

Where SEPTA and/or NJ TRANSIT own a line segment, that railroad's cost averages per revenue service hour per car were used for the estimate of operating costs along with a separate estimate using the national diesel cost factor developed from NTD reporting. Nationally, many service providers operate service over rail lines owned by other entities, so use of the national rate helps cover the cost structure for operations over the freight and commuter lines in question.

It should be noted that the SEPTA average cost per revenue hour is signifcantly lower than other rates. While pay scales differ by operator and given the fact that SEPTA's current operation does not involve the use of diesel trains (which may affect the cost structure), it is also possible that the SEPTA average cost factor is related to direct operating costs and does not include some overhead costs that would be expected with the operation of these services.

These estimates are for annual operating costs and do not include capital costs or access fees that might be required above and beyond the annual operating fees or costs.

The cost factors were applied as follows.

NJ TRANSIT/New York Options

New York/Newark Alternatives via Hackettstown and High Bridge

To develop a range of costs:

- The first estimate used the national diesel rate per revenue hour using the general formulas shown above for the entire route.
- The second estimate used the NJ TRANSIT rate per revenue hour using the general formulas above for the entire route.
- The project team developed an estimated sharing of cost split over NJ TRANSIT's existing active lines. Note that the project team cannot state with any assurance that NJ TRANSIT or the State of New Jersey will participate in funding the service, if a decision is made to move forward with this option.
- The final result is an estimate of the potential range of costs for the operation of the service over the NJ TRANSIT lines used in Alternatives 1 and 2.

Note: The number of vehicles assumed matched the six-car trainsets that NJ TRANSIT operates on the Raritan Valley Line and eight-car trainsets that NJ TRANSIT operates on the Morristown Line.

A separate estimate was developed using the Amtrak state-supported rate per revenue hour, with the costs split by mileage and by state, using the general formulas above and the Amtrak average rate per vehicle revenue hour.

SEPTA Options

Philadelphia via Lansdale and Norristown Corridors

To develop a range of costs:

- The first estimate was developed using the national diesel rate per revenue hour using the general formulas noted above for the entire route.
- The second estimate was developed using the SEPTA rate per revenue hour using the general formulas noted above, for the entire route.

Note: The number of vehicles used in the calculation matched the four-car trainsets often operated by SEPTA on the Lansdale Doylestown and Norristown Lines.

An estimate assuming Amtrak as the operator was also developed for each scenario using the average cost per revenue hour for state-supported services.

This combination of estimates provides a range of potential order-of-magnitude costs based on recent experience in the region and across the country for the various options under consideration.

Method Validation

The project team evaluated this cost-estimating concept based on a recent study for NJ TRANSIT. In that study, NJ TRANSIT budgeting staff provided feedback on operating costs for the various scenarios studied. The use of the proposed approach resulted in similar order-of-magnitude results when compared to the cost estimates from NJ TRANSIT. NJ TRANSIT did not provide the details behind those estimates, so the project team cannot state with certainty the various cost factors that NJ TRANSIT used; however, this information is sufficient for this level of planning.

Order-of-Magnitude Operating Cost Estimates

The project team created order-of-magnitude cost estimates for five route/service options: two Lehigh Valley to New York area routes, two Lehigh Valley to Philadelphia options, and the Allentown to Reading service option. The draft service plans for these options are described in the previous section of this document. As a reminder, the service plans used to develop these estimates have not yet been coordinated with existing service on the rail lines assumed for operation of the service and have not been discussed with the operators of those lines.

New York/Newark Corridor Alternative via Hackettstown - Lehigh Line, Raritan Valley Line and NEC - Allentown to New York, Penn Station

Key factors for this set of estimates are described below. Table 9 provides the estimates.

- 6 trains per day
- 8 cars per train
- 2 hours and 30-minute service time per train
- The same service level assumed 7 days per week

Table 9. Estimates for the New York/Newark Corridor Alternative via Hackettstown

Cost Factor Used	Per Day Cost Estimate (Dollars in Thousands)	Annual Operating Cost Estimate (Dollars in Thousands)
NJ TRANSIT	$64.6	$23,564.4
National Diesel	$67.4	$24,615.6
Amtrak State-Supported	$78.8	$28,776.6

Because this route would operate in New Jersey, New York, and Pennsylvania and because NJ TRANSIT is a potential operator of the service, the project team developed potential cost-sharing estimates for the portion of the route where NJ TRANSIT service currently operates. The cost sharing was modeled on the current operating agreement between NJ TRANSIT and Metro North for the operation of trains to and from New York State communities in New Jersey and operated by NJ TRANSIT. Because the split of ridership between states for the line segment within New Jersey is a critical factor in determining the potential cost-sharing split, the project team assumed an equal (50/50) share for this exercise (Table 10).

Table 10. Potential for Cost Share Based on 50%/50% Ridership Split with NJ TRANSIT

Cost Factor Used	Potential NJ TRANSIT Share Based on 50/50 Split of Ridership on NJ TRANSIT Territory (Dollars in Thousands)	Potential Pennsylvania Share Based on 50/50 Split of Ridership on NJ TRANSIT Territory (Dollars in Thousands)
NJ TRANSIT	$6,833.7	$16,730.7
National Diesel	$7,138.5	$17,477.1
Amtrak State-Supported	$8,345.2	$20,431.4

New York/Newark Corridor Alternative via High Bridge - Lehigh Line, Raritan Valley Line and NEC - Allentown to New York, Penn Station

The key factors for this set of estimates are provided below. Table 11 provides the estimates.

- 6 trains per day
- 6 cars per train
- 2 hours and 20 minutes of service time per train
- The same service level assumed 7 days per week

Table 11. Estimates for the New York/Newark Corridor Alternative via High Bridge

Cost Factor Used	Per Day Cost Estimate (Dollars in Thousands)	Annual Operating Cost Estimate (Dollars in Thousands)
NJ TRANSIT	$45.1	$16,471.5
National Diesel	$47.1	$17,206.3
Amtrak State-Supported	$55.1	$20,114.8

Because this route would operate in New Jersey and New York as well as Pennsylvania and because NJ TRANSIT is a potential operator of the service, the project team developed potential cost-sharing estimates for the portion of the route where NJ TRANSIT service currently operates. The cost-sharing was modeled on the current operating agreement between NJ TRANSIT and Metro North for the operation of trains to and from New York State communities that operate through New Jersey by NJ TRANSIT. The split of ridership between states for the line segment within New Jersey is a critical factor in determining the potential cost-sharing split; the project team assumed an equal 50/50 share for this exercise, as shown in Table 12.

Table 12. Potential for Cost Share Based on 50%/50% Ridership Split with NJ TRANSIT

Cost Factor Used	Potential NJ TRANSIT Share Based on 50/50 Split of Ridership on NJ TRANSIT Territory (Dollars in Thousands)	Potential Pennsylvania Share Based on 50/50 Split of Ridership on NJ TRANSIT Territory (Dollars in Thousands)
NJ TRANSIT	$4,964.4	$11,777.1
National Diesel	$4,903.8	$12,302.5
Amtrak State-Supported	$5,732.7	$14,382.1

Philadelphia Alternative 1 Corridor - Allentown to Philadelphia – Via the SEPTA Lansdale Line

Key factors for this set of estimates are described below. Table 13 provides the estimates.

- 6 trains per day
- 4 cars per train
- 1 hour and 46 minutes of service time per train
- The same service level assumed 7 days per week

Table 13. Estimates for the Philadelphia Alternative via Lansdale

Cost Factor Used	Per Day Cost Estimate (Dollars in Thousands)	Annual Operating Cost Estimate (Dollars in Thousands)
SEPTA	$14.1	$5,132.2
National Diesel	$23.9	$8,713.9
Amtrak State-Supported	$27.9	$10,186.9

The estimates above provide a range of potential service costs for this option. There is some concern regarding the comparability of the SEPTA figures with the other two calculations. Both the national diesel rate and the Amtrak state-supported rate come from NTD statistics. The SEPTA rate comes from SEPTA data and may not include the same overhead information or other costs that are factored into the NTD data. It should also be noted that SEPTA service is completely electrified, while the other rates are predominately based on diesel operations, which could also account for some of the differences in the rates.

Philadelphia Alternative via Norristown Corridor

Key factors for this set of estimates are described below. Table 14 provides the estimates.

- 6 trains per day
- 4 cars per train
- 1 hour and 52 minutes of service time per train
- The same service level assumed 7 days per week

Table 14. Estimates for the Philadelphia Alternative via the Norristown Corridor

Cost Factor Used	Per Day Cost Estimate (Dollars in Thousands)	Annual Operating Cost Estimate (Dollars in Thousands)
SEPTA	$14.9	$5,451.2
National Diesel	$25.4	$9,255.5
Amtrak State-Supported	$29.6	$10,820.0

Reading Alternative

Key factors for this set of estimates are described below. Table 15provides the estimates.

- 6 trains per day
- 4 cars per train
- 46 minutes of service time per train
- The same service level assumed 7 days per week

Table 15. Estimates for the Reading Alternative

Cost Factor Used	Per Day Cost Estimate (Dollars in Thousands)	Annual Operating Cost Estimate (Dollars in Thousands)
SEPTA	$6.0	$2,174.7
National Diesel	$10.1	$3,692.3
Amtrak State-Supported	$11.8	$4,316.5

7. Operations, Approvals, and Funding

The review of operations, approvals, and funding covers the key requirements necessary to begin passenger rail operations between the Lehigh Valley and the three partner market areas of Newark/New York, Philadelphia, and Reading. Detailed analysis is provided in the *Operations, Approvals, and Funding Technical Memorandum*.

This section also describes the conditions under which services could be provided, including a general legal framework governing agreement between freight railroads and a passenger service sponsor, the studies required by the various railroads prior to service initiation, potential financial mechanisms to allow for the service, as well as a general discussion of the process of allocated or shared costs. Additionally, potential federal, state, and local funding sources that could support restoring passenger rail service are identified.

Rail service between the Lehigh Valley and the partner markets is predicated on two key determinations:

- Concurrence is required between the owner/controller of a corridor to permit passenger rail service within its ROW. This concurrence must be legally formalized.
- A project sponsor must be identified that has developed a model for operations. A project sponsor would serve as the contracting entity to any rail segment owner(s) and would ultimately oversee the planning, design, construction, and operations of the proposed service.

The project sponsor would be responsible for acquiring new ROW on corridors where active rail ROW is not currently in use or available for new or additional passenger rail operations. The project sponsor also would need to acquire property on the rail ROW, lease it from public or private owners, establish any easements, or otherwise initiate an agreement for the use of the rail ROW.

The restoration of passenger rail service originating in the Lehigh Valley assumes the following activities:

1. Agreement with freight rail operators to permit passenger rail service or acquisition of the rail ROW.
2. Acquisition or agreement to use ROW not currently used for rail services.
3. The identification of an operator to plan, operate, maintain, and financially support the service.
4. Infrastructure program to ensure the development of the support facilities necessary to enable service, such as stations, platforms, and parking; track, turnouts, switches, and other necessary rail work; grade crossing upgrades and signal systems, including Positive Train Control systems; and maintenance and storage facilities.
5. Operations funding program to address labor, insurance, staffing, and internal and external coordination.

For any potential service alternative between the Lehigh Valley and the New York City region, restoration of passenger service would also require an agreement or working partnership with NJ TRANSIT or the State of New Jersey.

Agreement with Freight Railroads and Corridor Owners

As part of the Class I freight railroad's consideration of passenger rail services along its ROW, Class I freight railroads typically undertake evaluations to determine the impact of the proposed passenger rail services on system capacity, network infrastructure, dispatching, liability and indemnification, compensation, and consistency with business plans, among other topics. While each railroad's due diligence varies, studies often focus on four areas:

1. **Capacity and Service Planning** – evaluating the impact of proposed passenger rail service on capacity of freight rail network and consistency with growth and business plans.
2. **Infrastructure Needs and Integration with Existing Rail Facilities** – identifying the infrastructure necessary to support passenger rail service.
3. **Environmental Reviews** – evaluating the current environmental conditions along the freight railroad ROW in advance of a public environmental process that would be undertaken by the proposed operator in coordination with the FRA.
4. **Access, Operations, Indemnification/Liability, and Compensation Agreements** – developing multiple contractual agreements between the freight railroads and the operator of the Lehigh Valley passenger rail service.

Additional agreements with shortline freight railroad operators may be necessary; however, entering into any operating arrangement with a shortline operator may be easier than equivalent arrangements with a Class I freight railroad, as the shortline railroads typically would directly benefit from improvements made to enable passenger rail service with little impact to their own scheduling. Shortline railroads' lower traffic volumes mean they are not incentivized to invest track and capacity improvements based on their traffic alone, but they would benefit from improvements made by others nonetheless and may therefore be more eager to enter into these agreements.

Some segments make use of rail ROW already owned or operated on by existing passenger rail operators such as SEPTA or NJ TRANSIT. In some cases, these agencies may own the tracks but have agreements with another agency to run passenger rail services on them. Arrangements for using these tracks will depend on negotiation and planning between the agencies and may include scheduling arrangements to permit both rail operators to maintain service on the shared track.

Some segments of corridors are owned by either private owners or public agencies for purposes other than rail transportation. For acquiring ROW from private owners, the most common means of acquisition are through a negotiated purpose or eminent domain by agencies and authorities with the ability to do so. Public agencies have repurposed many of the former rail ROWs included as candidate segments in the study for recreational purposes, either in the form of multi-use trails or as part of parks. Making shared use of these segments for recreational purposes will require careful negotiation and planning with the agencies operating these facilities.

Mechanisms

Commuter rail systems have started or continued operations on current and former ROW and/or tracks under agreements with freight railroads throughout the United States. Each Class I freight railroad

entered such agreements with commuter rail system owners and/or operators. These agreements generally take one of the following forms:

- Buy – the commuter rail operator acquires the ROW from the freight railroad. Such agreements may encompass a clause by which the freight railroad pays access fees to continue operating slots on the ROW.
- Lease – the commuter rail operator leases the ROW from a freight railroad. The lease can consist of an annual fee, which can be considered an operating expense.
- Pay access fees – similar to a lease, the commuter rail operator pays access fees to a freight railroad for use of the ROW. Access fees can be based on specific metrics.

Example metrics and examples of transportation providers making financial contributions to freight operators to gain access to freight-owned ROW are provided in the *Operations, Approvals, and Funding Technical Memorandum*.

Capital Funding and Financing Sources

Federal

The Bipartisan Infrastructure Law, passed by Congress in November 2021, provides $102 billion in funding directed to passenger and freight rail between fiscal year 2022 and fiscal year 2026. For most programs, the federal share may not exceed 80% of total project costs. Restoring passenger rail funding to the Lehigh Valley may be eligible for the following funding programs:

- Corridor Identification and Development Program – provides discretionary funding to project sponsors for the planning and development of intercity passenger rail service. Has broad eligibility of project sponsors and is particularly applicable to any potential Lehigh Valley-originating project.
- New Starts – supports projects with costs greater than $300 million or projects seeking more than $100 million in federal grants. Projects must either be new fixed-guideway investments or an extension of an existing fixed-guideway system. Eligible activities include design and construction of new fixed guideways or extensions to fixed guideways.
- Small Starts – supports projects with capital costs less than $300 million and seeking less than $100 million in Section 5309 Capital Investment Grant program funds. Projects must be new fixed-guideway projects, extensions to existing fixed-guideway systems, or corridor-based bus rapid transit projects. Eligible activities include design and construction.
- Federal-State Partnership for Intercity Passenger Rail Grant Program – provides discretionary funding for projects that expand or establish new intercity rail service, including privately operated intercity passenger rail service.
- National Infrastructure Project Assistance (Mega) Program – provides discretionary federal funding for large, complex projects that create regional or national economic benefits. Intercity passenger rail is an eligible category.

- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) – provides discretionary federal funding for multimodal, multijurisdictional projects with a broader list of potentially eligible applicants compared to most federal programs. Rail projects are identified as an eligible funding category.
- Interstate Rail Compacts Grant Program – includes promotion of intercity passenger rail services as an identified category, though only existing entities established by member states are eligible.
- Consolidated Rail Infrastructure and Safety Improvements Program (CRISI) – provides discretionary capital funding for intercity rail or commuter rail projects that typically seek to reduce congestion, deploy new technologies, and link rail transit to other modes.

State and Regional

State and regional funds are available to support the planning and design of passenger rail service terminating in the Lehigh Valley, although the funding they provide is relatively small compared to the federal funding programs described above. The project sponsor would almost assuredly need to attain funding from multiple sources to plan, design, permit, and construct a passenger rail project into the Lehigh Valley. The following state and regional funding sources are available:

- PennDOT Multimodal Transportation Fund – reimburses up to $3 million to project sponsors for eligible activities and requires a local match of at least 30% of the award.
- Department of Community and Economic Development Multimodal Transportation Fund – provides grant funding to projects and sponsors similar to the PennDOT Multimodal Transportation Fund, including intercity bus and rail programs.
- Transportation and Community Development Initiative (TCDI) – provides funding, within Philadelphia, and Bucks, Montgomery, Delaware, and Chester Counties in Pennsylvania and Mercer County in New Jersey; the program is managed by the Delaware Valley Regional Planning Commission.

Operations and Maintenance Funding and Financing Sources

Federal funding options are more limited for operations and maintenance support than for capital support.

- Section 5307 (Urbanized Area Formula Funding program) – makes federal resources available to urbanized areas and to governors for transit capital and operating assistance.
- Section 5337 (Good Repair Grants Program) – provides capital assistance for maintenance, replacement, and rehabilitation projects of high-intensity fixed-guideway and bus systems to help transit agencies maintain assets in a state of good repair.

Recent initiatives to permit selected counties the authority to levy and collect taxes through a county or municipal ordinance were introduced in the Pennsylvania House of Representatives in June 2023 as HB1307. Should this legislation pass, another potential source of regional funding for transit services will be available. As written, this legislation would apply to Bucks, Chester, Delaware, Lancaster, Montgomery, and Philadelphia counties; it would not apply to Berks, Lehigh, or Northampton counties.

Local taxes and fees could be used to cover a share of the project's recurring operations and maintenance costs. Potential sources of local funding used to fund similar rail projects throughout the country include property taxes, income taxes, utility taxes, license fees, and others. Across the United States, there are numerous examples of local taxes and fees used to defray the operations and maintenance costs of transit service beyond fares, including municipal contributions, student activity fees, advertising, and station concessions. The project sponsor would need to work with local municipalities and other organizations that would benefit from the restoration of rail services between the Lehigh Valley and partner markets to determine whether local funding sources could be available. It must be noted that local funding sources at the scale envisioned for the passenger rail project originating in the Lehigh Valley likely represent a small portion of the transportation funding needed to operate the proposed system.

As noted in Chapter 6, there is also the potential for operating cost sharing with NJ TRANSIT if a route were to operate over NJ TRANSIT territory and provide service to NJ TRANSIT rail stations. A similar arrangement currently exists between NJ TRANSIT and Metro North for the operation of trains between Orange and Rockland counties in New York and Hoboken Terminal in New Jersey. In this arrangement, Metro North is 100% responsible for the cost of operation in New York State and shares the cost of operation for those specific trains over NJ TRANSIT territory. The costs are split based on the percentage of New York State riders and percentage of New Jersey riders on the service while operating through New Jersey. Note that the project team cannot state with any assurance that NJ TRANSIT or the State of New Jersey would participate in funding the service, if a decision were to be made to move forward with an option that operates in NJ TRANSIT territory.

Additionally, partnerships or agreements with private stakeholders could provide limited funding to support rail operations along the candidate corridors.

8. Conclusion

Together, this final report and its appendices lay the foundation for future study phases aimed at restoring passenger rail service to the Lehigh Valley. Should the region decide to pursue reestablishing Lehigh Valley passenger rail service, a critical next step is identifying a project sponsor (*Figure 11*). This entity will be the organization responsible for developing a framework for planning, designing, funding, constructing, and operating the new passenger rail service. Figure 11 provides a high-level timeline for the project lifecycle, including planning-level cost estimates for each phase.

The analysis conducted as part of the *Lehigh Valley Passenger Rail Feasibility Analysis* will be essential to informing potential project sponsors of the opportunities and challenges associated with this effort. Once a project sponsor is identified, subsequent steps include conducting a feasibility study, developing an alternatives analysis, and assessing the operational feasibility of partner railroads. This analysis is occurring early in the process, and the operation of passenger rail service in the Lehigh Valley is dependent on a complex series of next steps. However, this study and subsequent elements will help guide the direction of the project and support the desired outcome for the Lehigh Valley.

Figure 11. Project Development Process