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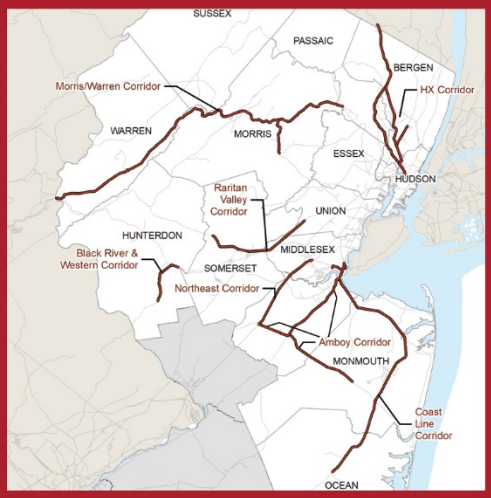

Freight Rail Industrial Opportunities Corridors Program

Final Report

June 10, 2019

Prepared by:

HDR

NJTPA Freight Rail Industrial Opportunity Corridors Program

Disclaimers

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Due to rounding, numbers presented throughout this report may not add up precisely to the totals indicated.

About NJTPA

The North Jersey Transportation Planning Authority (NJTPA) is the federally authorized Metropolitan Planning Organization (MPO) for the 13-county northern New Jersey region, home to 6.7 million people. It evaluates and approves transportation improvement projects, provides a forum for cooperative transportation planning, sponsors and conducts studies, assists county and city planning agencies and monitors compliance with air quality goals.

The NJTPA Board includes 15 local elected officials representing 13 counties—Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union and Warren—and the cities of Newark and Jersey City. The Board also includes a Governor's Representative, the Commissioner of the New Jersey Department of Transportation (NJDOT), the Executive Director of NJ TRANSIT, the Chairman of the Port Authority of New York & New Jersey and a Citizen's Representative appointed by the Governor.

Cover images: Wagaraw Road, Hawthorne, and New York Susquehanna & Western Railway, and New Jersey TRANSIT Main Line (top); Study Area Map (middle); and Norfolk Southern Freight Train on HX Corridor.

Executive Summary

Background

The ability to move large amounts of goods and people efficiently is critical to sustaining the economic output and quality of life in the thirteen-county planning region overseen by the North Jersey Transportation Planning Authority (NJTPA), where 6.7 million people live, 3 million people work, and 473 million tons of domestic freight per year are shipped and received.[1] Among the 313,000 businesses located in Northern and Central New Jersey, one third are engaged in activities that are highly dependent on freight transportation, such as construction, manufacturing, mining and extraction, wholesale trade and distribution, retail distribution, and logistics. Several key business sectors rely especially on freight rail transportation, both to move the large quantities of material required for their operations, as well as to maintain their economic competitiveness in regional and national markets by keeping their shipping costs low.

Figure ES-1. Norfolk Southern Freight Train on the Passaic Spur

The NJTPA created the Freight Rail Industrial Opportunity (FRIO) Corridors Program to foster collaboration among public and private entities to address physical barriers to freight access to industrial properties that exist along some of New Jersey's railroad lines. The FRIO program is the first

[1] https://www.njtpa.org/archive/completed-regional-studies-archive/2040-freight-industry-level-forecasts/2040-freight-forecasts/freight-profile-njtpa-region.aspx

comprehensive assessment of the physical restrictions that preclude national standard freight rail service to many of the NJTPA's industrial areas and the associated value with addressing these impediments.

Industry and modern freight movement rely on heavier and taller rail cars than used in preceding decades. Current standards permit rail cars weighing 286,000 pounds fully loaded (286k), and measuring 17 feet high above the top of the rail with a maximum width of 10 feet, 8 inches, a dimension known as a Plate "F" rail car (see Figure ES-2).

The legacy rail lines serving New Jersey's industrial areas cannot handle many modern Plate "F"/286k rail freight cars, placing industries and sites along these lines at a competitive disadvantage. Railroad customers that do not have national standard rail freight access typically have higher transportation costs, potentially longer shipping times, and potential equipment shortages — conditions that may influence, or prompt, decisions regarding whether or not to remain or locate in Northern and Central New Jersey.

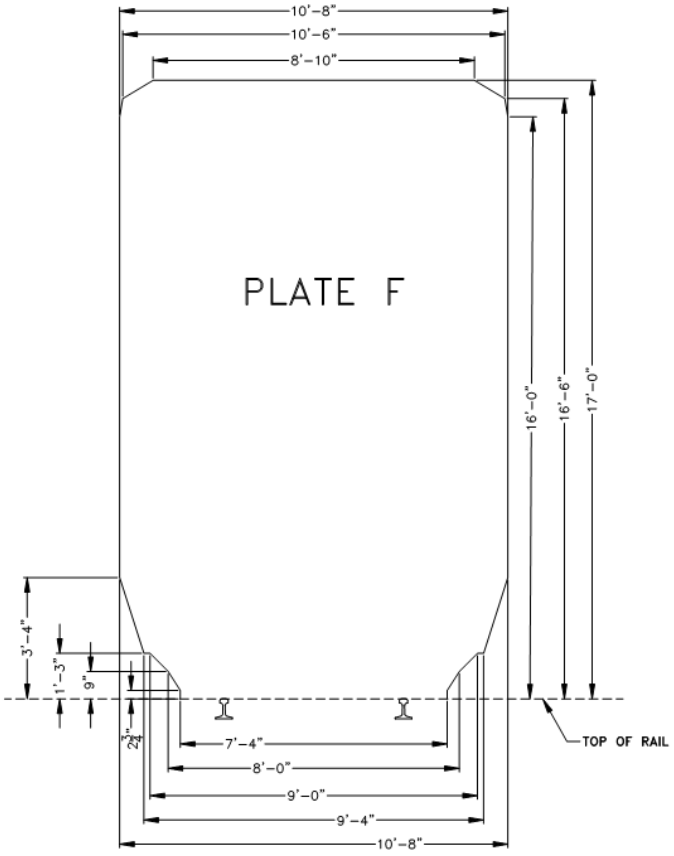


Figure ES-2. Plate "F" Rail Car Dimensions

FRIO evaluates the improvements needed to address the identified physical impediments to moving modern rail cars and the resulting economic potential for seven rail corridors in Northern and Central New Jersey.

Corridors

The FRIO Corridors Program identified and evaluated seven railroad corridors in Northern and Central New Jersey to determine the locations and types of physical barriers preventing access by modern freight rail cars. The rail lines analyzed under the program were selected because they have physical restrictions that prevent the use of modern freight rail cars, and requests to eliminate those restrictions had been made by businesses along the lines or the freight railroads serving them. After studying the physical connections between the rail lines selected for the program, as well as how freight cars traveled over the lines to reach rail customers, the NJTPA established seven FRIO “corridors”. Each corridor is a grouping of physically connected rail lines that share a common point of access to the unrestricted freight rail network (where physical barriers no longer exist). The seven FRIO corridors are shown in Figure ES-3:

- HX Corridor
- Raritan Valley Corridor
- Amboy Corridor
- Coast Line Corridor
- Morris/Warren Corridor
- Black River & Western Corridor
- Northeast Corridor

Two of the FRIO corridors, the Amboy and Coast Line, have the same access point to the unrestricted freight rail network at Perth Amboy, and share a common segment of trackage approximately 7.9 miles in length between Perth Amboy and a railroad yard in Old Bridge that serves as the base of freight rail operations for both corridors.

Two databases have also been developed to advance decision-making and investments:

- **Industrial opportunity database**: Identifies potential properties along the affected rail lines that could benefit through improved access
- **Restriction location database**: Inventory of physical height and weight restrictions on the rail lines

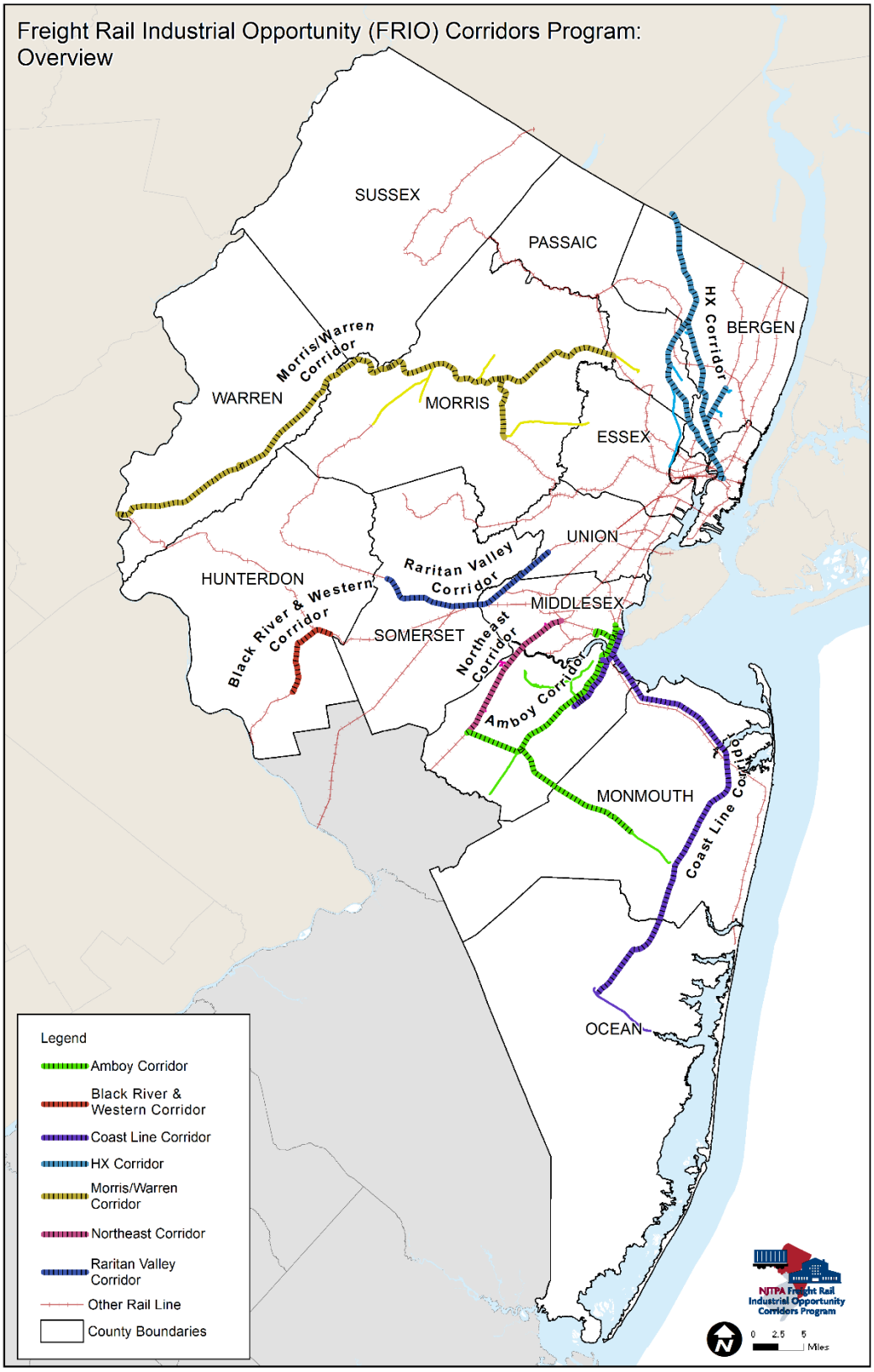


Figure ES-3. FRIO Corridor Overview

Restrictions

Two types of physical restrictions impede the use of national standard rail freight cars on the FRIO corridors:

- Weight restrictions that prevent the use of modern freight cars weighing 286,000 pounds fully loaded (286k)
- Height restrictions that prevent the use of freight cars measuring 17 feet above the top of the running rails (a height dimension for freight rail cars defined as Plate “F”)

Restrictions can include bridges, catenary clearances, culverts, and other physical elements on the right-of-way. Railroad lines with these types of restrictions require the use of rail freight cars that have smaller dimensions or cannot carry as much cargo.

Figure ES-4. Geometric Restriction Pedestrian Overpass on Coast Line Corridor

As part of the FRIO study, a detailed analysis was performed that documented the type and location of all physical restrictions on the seven corridors, as well as potential, suitable solutions and associated order of magnitude cost ranges to alleviate each restriction.

The seven FRIO corridors have a combined total of 54 weight restrictions and 24 geometric restrictions, all of which are vertical clearance (height) restrictions. There are no horizontal clearance (width) restrictions preventing the use of industry-standard Plate "F" rail freight cars on these corridors (Table ES-1).

Table ES-1. Overview of Corridors, Restriction Locations, and Estimated Investments Required

Corridor	Length (miles)	Restriction Locations		Range of Estimated Improvement Costs ($2019 millions)
		Weight	Geometric	
HX	61.5	24	3	10.0-454.6
Raritan Valley	20.8	6	0	1.3-23.5
Amboy*	54.6	0	10	9.6-64.9
Coast Line*	58.7	3	19	16.4-139.3
Coast Line w/o shared section with Amboy*	50.8	3	9	6.8-74.4
Morris/Warren	95.0	6	2	14.6-27.4
Black River & Western	9.0	11	0	0.4-67.3
Northeast**	18.7	4	0	0.4-162.3
Total*	**310.4**	**54**	**24**	

* Amboy and Coast Line Corridors share a segment of 7.9 miles. Improvements made to provide modern freight rail access for one corridor will also benefit the other corridor in that segment of shared trackage.

** Only the two center tracks of the four track Northeast Corridor are clear for Plate "F". (Source: Amtrak)

Common solutions to eliminate weight restrictions that were recommended as potential improvements at specific locations in the study area include:

- Instrumentation of structure to measure actual live loads under train traffic. The data generated by these measurements can be used to perform more refined load rating analysis, which will yield more precise information to determine the need for additional measures
- Rehabilitation of individual structural members to raise controlling rating of bridge
- Replacement of the superstructure

Figure ES-5. Example of a Superstructure Replacement

Common solutions to eliminate vertical restrictions that were recommended as potential improvements at specific locations in the study area include:

- Installation of steel ties embedded in the ballast, allowing a lower track profile compared to traditional ties using the same amount of ballast
- Undercutting by using equipment to vacuum out excess ballast or sub-ballast from under the ties, lower the track profile, and replace with fresh ballast
- Raising of the superstructure
- Replacement of the superstructure

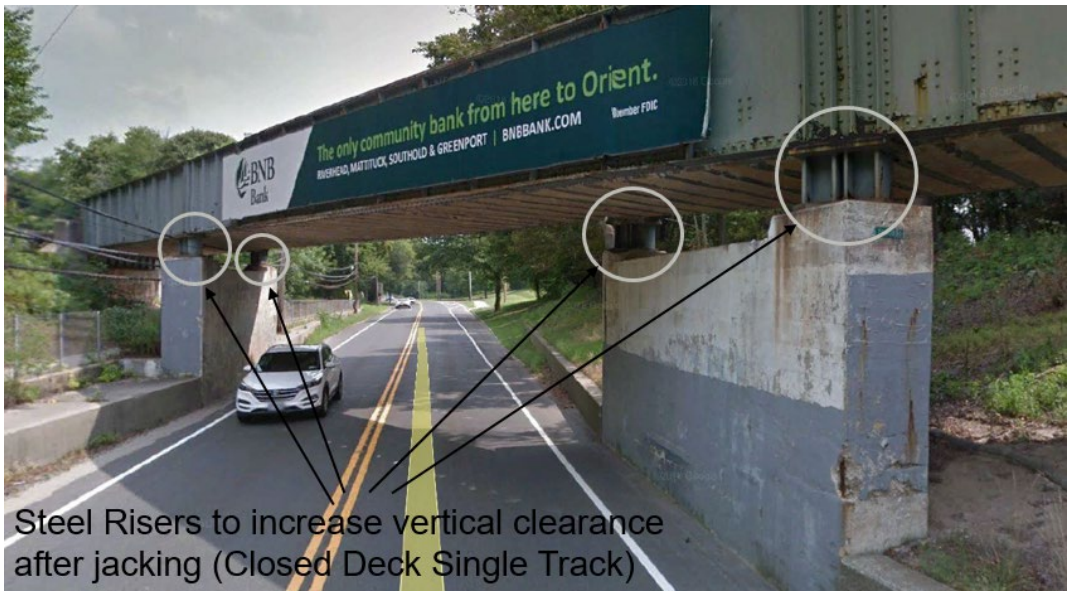


Figure ES-6. Raised Superstructure

The suitable solutions identified for each restriction location have been assessed to generate individual conceptual order of magnitude cost-estimates to execute them. Individual solutions range from as little as $25,000 to $130 million. Table ES-1 summarizes the type and number of restrictions in each FRIO corridor, and the cumulative range of estimated costs to alleviate them.

Industrial Opportunities

Both existing freight rail customers and potential rail shippers could benefit from the ability to support their operations through the use of national standard rail freight cars. As part of the FRIO study, a detailed analysis was performed of real estate parcels adjacent to the corridors where existing or future occupants would have the opportunity to take advantage of rail improvements that were made, should the need arise for their operations. This analysis included properties currently served by rail.

Figure ES-7. Conrail Freight Train on Northeast Corridor

The existing freight rail customers identified by the FRIO study are involved in manufacturing and distribution activities that contribute to the economic vitality of Northern and Central New Jersey. They make and distribute products used by New Jersey residents and other customers throughout the US and the world every day, including food and beverages, aggregates,

home-building supplies, plasticware and household products, recyclable materials, shipping cartons and pizza boxes, and more.

Additional properties also were identified that offer the potential for future development or redevelopment as rail-served industrial sites along the corridor. These sites include properties previously served by rail, industrial redevelopment areas, and properties that were already of interest to counties, municipal officials, or developers as favorable locations for industrial activity.

Based on the analysis conducted, the NJTPA estimates that approximately 21,600 acres of land in Northern and Central New Jersey could benefit from modern rail freight car access. This includes land occupied by existing freight rail customers, as well as land with the potential for development or redevelopment after rail improvements were made. Table ES-2 summarizes the industrial opportunity including current rail customers, as measured in acres of real estate, by corridor.

Table ES-2. Acres of Industrial Opportunity by Corridor

Corridors	Length (miles)	Total Industrial Opportunity Including Current Rail Customers (acres)
HX	61.5	1,665
Raritan Valley	20.8	2,084
Amboy*	54.6	4,849
Coast Line*	58.7	8,362
Coast Line w/o shared section with Amboy*	50.8	8,084
Morris/Warren	95.0	2,917
Black River & Western	9.0	242
Northeast	18.7	1,752

* Amboy and Coast Line Corridors share a segment. Improvements made to provide modern freight rail access for one corridor will also benefit the other corridor in that segment of shared trackage.

Economic Impacts

Economic value associated with addressing the identified impediments result from:

- Existing customers that benefit by having their facilities become more cost effective through the use of national standard freight rail cars; and
- New freight rail customers that locate to New Jersey to the industrial opportunity sites identified in the analysis.

The NJTPA used a Multi-Regional Input-Output model and the calculations of land occupied by both existing and potential rail customers to develop an estimate of the potential gross economic impact benefits to municipalities, counties, and the State if the sites were fully developed for freight rail served businesses and all of the existing freight rail users were retained and benefited from the removal of the impediments.

These economic measurements include employment effects, business output and revenue, personal income effects, and the effect of taxes, based on a mix of known industrial activities that occur in the corridor. The impact analysis is considered a gross estimate of economic value; the analysis does not consider the loss of any non-freight rail businesses on existing parcels.

The maximum potential economic value attributable to alleviating the barriers to modern rail freight car access in the FRIO corridors is estimated to be more than 224,000 direct jobs and more than $16.8 billion in annual federal, state and local tax revenues.

The vast majority of the gross potential economic value associated with addressing the impediments comes from the potential development of the hundreds of acres of industrial opportunity sites.

The estimated economic value of the existing freight rail customers is important and could be at risk if the impediments are not addressed. The existing freight rail customers are estimated to employ over 15,700 workers and generate nearly $1.2 billion in annual federal, state and local tax revenues.[2]

Table ES-3 summarizes the potential gross economic benefits that could be realized, if rail improvements were made to provide modern rail freight car access.

[2] Note: The impact analysis is a gross estimate of economic value. It does not consider the loss of any non-freight rail businesses on existing parcels.

Table ES-3. Gross Potential Economic Impacts of Retaining Existing Freight Rail Businesses and Attracting New Freight Rail Businesses to New Jersey

Corridor	Direct Employment (jobs)	Total Employment (jobs)	Personal Income ($2019 millions)	Business Activity ($2019 millions)	State and Local Taxes ($2019 millions)	Federal Tax Revenue ($2019 millions)	Total Tax Revenues ($2019 millions)
Amboy	50,000	117,685	8,621.9	38,164.7	1,629.1	2,221.7	3,850.8
BR&W	2,240	5,050	362.5	1,544.8	66.4	93.2	159.6
Coastline[3]	86,140	199,995	14,558.6	63,657.6	2,741.2	3,748.2	6,489.4
HX	18,145	41,325	2,977.5	12,985.9	553.7	766.2	1,319.9
Morris/ Warren	31,340	71,750	5,191.9	22,496.9	963.3	1,335.6	2,298.8
Northeast	18,350	41,590	2,999	12,862	549	771	1,319.7
Raritan	17,855	43,115	3,188	14,459	615	824	1,439.6
Total Economic Impact	**224,070**	**520,510**	**37,900.2**	**166,171.7**	**7,118.0**	**9,759.8**	**16,877.8**

Outreach

The NJTPA and the team worked with multiple stakeholder groups as information for the FRIO study was gathered and analyzed. Cooperation from the railroads that own and operate track in the study area was crucial to the success of the project. Each of the railroads (Conrail, NJ TRANSIT, Amtrak, and the Black River and Western) provided data and input during the development of the restriction location database, and arranged for study participants to conduct on-site surveys and analysis of potential restrictions as needed.

A Technical Advisory Committee (TAC) was established to provide guidance throughout the duration of the study. The project team met with the TAC four times while the study was being performed at key moments to present preliminary results and obtain feedback and guidance on how to proceed. Representatives from Passaic, Morris, Somerset, and Middlesex Counties, NJ TRANSIT and the New Jersey Department of Transportation participated in

[3] Excluding shared segments with Amboy Corridor

the TAC. These representatives also functioned as project ambassadors to their organizations.

Figure ES-8. Weight Restriction Hackensack River (HX Draw) on HX Corridor

During summer and fall 2018, the NJTPA held 11 WebEx presentations with representatives from different counties served by FRIO railroad lines to present the study team's initial findings on restriction locations and potential industrial opportunities within each county. Representatives from Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, and Union counties provided guidance and information on land use, economic development, and recent industrial development efforts that enabled the project team to refine their analysis of potential industrial opportunities along the FRIO rail lines.

At the April 15, 2019 Freight Initiatives Committee (FIC) meeting, the project team presented on the FRIO Corridors Program's findings to inform the FIC members, private sector freight companies and the general public about the initial findings emerging from this effort.

Figure ES-9. Norfolk Southern Freight Train on HX Corridor near Suffern, NY

Next Steps

FRIO advances the NJTPA's mission by linking transportation planning with economic growth, environmental protection and quality of life goals for the region.

Table ES-4 compares the estimated potential range of costs to alleviate the barriers to modern freight rail access in each corridor, and the resulting benefits in direct employment and annual tax revenues (federal, state, and local) that are estimated to accrue. In each corridor, the estimated economic benefits greatly exceed the costs, even at the high range of infrastructure solutions.

Table ES-4. Estimated One-Time Improvement Costs and On-Going Economic Benefits per Corridor

Corridors	Length (miles)	Range of Estimated Improvement Costs ($2019 millions)	On-Going Jobs Supported (direct employment)	Annual Federal, State and Local Tax Revenues (in $2019 millions)
HX	61.5	10.0-454.6	18,145	1,319.9
Raritan Valley	20.8	1.3-23.5	17,855	1,439.6
Amboy*	54.6	9.6-64.9	50,000	3,850.8
Coast Line*	58.7	16.4-139.3	89,100	6,711.2
Coast Line w/o shared section with Amboy*	50.8	6.8-74.4	86,140	6,489.4
Morris/Warren	95.0	14.6-27.4	31,340	2,298.8
Black River & Western	9.0	0.4-67.3	2,240	159.6
Northeast	18.7	0.4-162.3	18,350	1,319.7

Addressing the restrictions to this standard is critical to the region's economy as potential new businesses often make their location decisions based on having national standard rail access if they need freight rail service. In addition, existing businesses dependent on freight rail transportation for their operations may be forced to relocate in order to be able to receive cost-competitive modern rail freight access. Further, a looming shortage of non-standard rail freight equipment, often the older cars in a fleet and candidates for retirement, will soon make Plate "F" access an absolute necessity for rail customers.

Figure ES-10. Weight Restriction Raritan River/Red Rock Lake on BR&W Corridor

The NJTPA Region and the State recognize the importance of this issue. As such, the restriction locations identified in this study may be considered for inclusion in the NJTPA Freight Concept Development Program which can lead to eventual funding and implementation of solutions. The restriction locations first will be evaluated and prioritized through this program's intake process criteria. Those selected for advancement would go through a variety of tasks including, but are not limited to: data collection, community outreach, development of the purpose and need statement, development of alternatives, NEPA (National Environmental Policy Act) classification and selection of a preliminary preferred alternative. The NJTPA also will work with railroads, county and municipal agencies, and existing and potential freight rail customers to identify funding sources for the capital improvements that will eliminate identified physical restrictions.

As a result, this study serves as an important roadmap in planning and funding improvements to enhance freight rail transportation and further economic development opportunities in the region.

Table of Contents

Table of Tables

Table of Figures

List of Appendices

Acronyms and Abbreviations

286k	Description of rail track load-bearing capacity, i.e. 286,000 pounds
AAR	Association of American Railroads
AREMA	American Railway Engineering and Maintenance-of-Way Association
BR&W	Black River & Western
CFR	Code of Federal Regulations
Conrail	Conrail Shared Assets Operations
CSAO	Conrail Shared Assets Operations
CSX	CSX Transportation
FRIO	Freight Rail Industrial Opportunity
GIS	Geographic Information System
MRIO	Multi-Region Input-Output
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NJT	New Jersey TRANSIT
NJTPA	North Jersey Transportation Planning Authority
NS	Norfolk Southern Railway
NYS&W	New York, Susquehanna, and Western Railway
OCS	Overhead Contact System
Plate	Description of geometric profile of rail cars, e.g. Plate “F”
ROW	Right-Of-Way
sqft	Square feet
TAC	Technical Advisory Committee

1 Introduction

1.1 Background

The ability to move large amounts of goods and people efficiently is critical to sustaining the economic output and quality of life in the thirteen-county planning region overseen by the North Jersey Transportation Planning Authority (NJTPA), where 6.7 million people live, 3 million people work, and 473 million tons of domestic freight per year are shipped and received.[4] This portion of New Jersey, part of a metropolitan statistical area with 20 million people, is one of the most densely populated areas of the United States. Among the 313,000 businesses located in Northern New Jersey, one third are engaged in activities that are highly dependent on freight transportation, such as construction, manufacturing, mining and extraction, wholesale trade and distribution, retail distribution, and logistics. Several key business sectors rely especially on freight rail transportation, both to move the large quantities of material required for their operations, as well as to maintain their economic competitiveness in regional and national markets by keeping their shipping costs low.

New Jersey was the birthplace of railroading for the US. As a result of our State's long history with the mode, New Jersey must now adapt its "legacy" rail infrastructure for 21st century shipper needs. While many of the major main lines have been upgraded to meet current national freight standards for both carload and double-stack trains, many rights of way that provide freight rail access to industrial properties throughout the NJTPA region do not meet current national standards. Railroad customers located along lines that cannot accommodate today's modern freight rail cars are placed at a competitive disadvantage, faced with higher shipping costs, potentially longer shipping times, and potential equipment shortages — conditions that may influence, or prompt, decisions regarding whether or not to remain or locate in Northern and Central New Jersey.

1.2 Goals and Objectives

To help address the disparity in freight rail car-handling capabilities of railroad infrastructure in the region, and improve the conditions that will sustain and expand Northern New Jersey's industrial and manufacturing base, the NJTPA created the Freight Rail Industrial Opportunity (FRIO) Corridors Program. The Program is intended to foster collaboration among public and private entities

[4] https://www.njtpa.org/archive/completed-regional-studies-archive/2040-freight-industry-level-forecasts/2040-freight-forecasts/freight-profile-njtpa-region.aspx

to address the barriers to rail freight access to industrial properties and guide infrastructure investments.

This study results are designed to be an important roadmap in planning and funding improvements to enhance freight rail transportation and further economic development opportunities in the region. The FRIO Corridors Program advances the mission of the NJTPA by linking transportation planning with economic growth, environmental protection, and quality of life goals for the region.

Upgrading regional rail corridors to accommodate rail industry national standard rail cars with 286,000 pounds (286k) loaded weight on rails and heights up to 17 feet (Plate "F") is consistent with the goals and priorities established in NJTPA's current regional transportation plan, "Plan 2045: Connecting North Jersey."[5] Among the plan's identified transportation needs and strategies for North Jersey is the removal of operational and physical constraints on the region's freight rail system. Eliminating the barriers to national standard freight rail cars is also one of the five critical issues identified by the New Jersey Department of Transportation in the "New Jersey Statewide Freight Rail Strategic Plan"[6] and the most recent "New Jersey State Rail Plan."[7] In addition, the Port Authority of New York and New Jersey's "Goods Movement Action Program (G-MAP)"[8], along with the NJTPA's "Rail Freight Capacity and Needs Assessment to Year 2040"[9] and the New Jersey Statewide Freight Plan[10] all have identified the need to address physical restrictions on freight rail lines to retain and attract industrial businesses to the State of New Jersey.

In support and advancement of these overarching goals, the NJTPA initiated the "Morris/Warren County Rail Corridor Study"[11] in 2013, which analyzed the primary freight rail corridor serving Morris and Warren Counties to determine infrastructure and operational improvements necessary to accommodate taller and heavier rail cars, the potential for improved freight rail access to stimulate industrial development along the Corridor, and the economic impacts of that development. The FRIO Program enhances the methodology

[5] https://apps.njtpa.org/plan2045/docs/11699_plan2045_v5_Low%20Res.pdf

[6] https://www.state.nj.us/transportation/freight/rail/pdf/NewJerseyStatewideFreightRailStrategicPlanJune2014.pdf

[7] https://www.njtransit.com/pdf/NJStateRailPlan.pdf

[8] https://www.panynj.gov/gmap/

[9] https://www.njtpa.org/getattachment/5c080db3-56a3-4f1f-8e2e-27e7041e35f4/Rail-Freight-Capacity-and-Needs-Assessment-to-Year.aspx

[10] https://www.state.nj.us/transportation/freight/plan/stateplan17.shtm

[11] https://www.njtpa.org/getattachment/Archive/Completed-Regional-Studies-Archive/Morris-Warren-County-Rail-Corridor-Study/Morris-Warren-County-Rail-Corridor-Study/Morris-Warren-Rail-Corridor-Study-(final)-compressed.pdf.aspx

and geographical scope of the Morris/Warren study to provide a forward-thinking comprehensive framework for addressing freight rail service impediments throughout the entire NJTPA region. Assistance in conducting the study was provided by the consulting firm HDR.

1.2.1 How Larger Freight Cars Boost Economic Competitiveness

Today's "national standard freight car" is defined by its maximum allowable loaded weight on rails, which is 286,000 pounds (286k), and its dimensions, which is Plate "F", indicating a rail car maximum height of 17 feet above top of rail and a maximum width of 10 feet, 8 inches (see Figure 1-1). The Association of American Railroads issued a standard (S-259) in November 1994 that increased the maximum allowable gross weight on rail (which is the empty weight of the rail freight car plus the total weight of product being carried by the car) per car from 263,000 pounds to 286,000 pounds, effective January 1, 1995. The new weight allowance encouraged the development of larger freight cars (Plate "F" cars) that have become the industry standard.

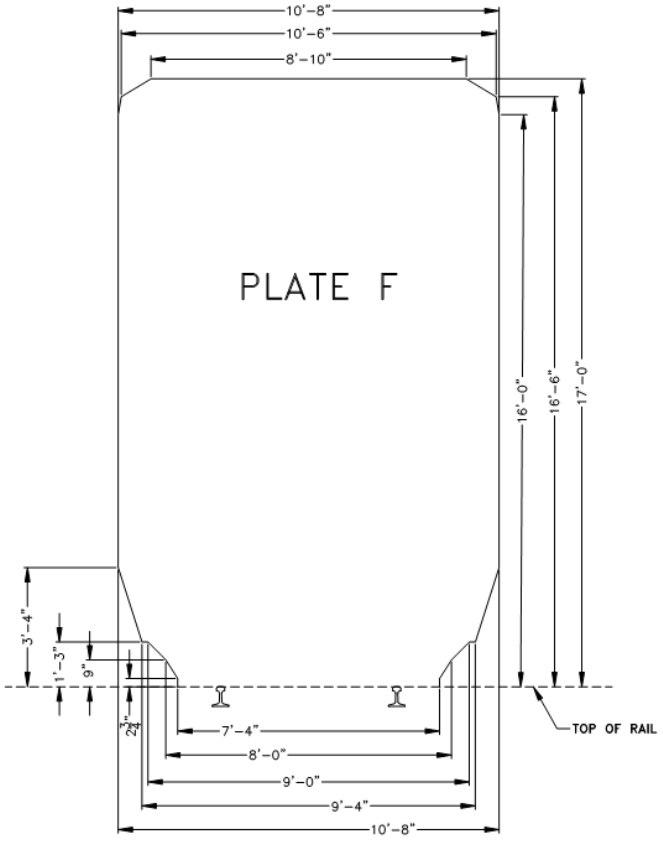


Figure 1-1. Plate "F" Rail Car Dimensions

Cars with heavier carrying capacity and larger dimensions have allowed rail customers to ship the same amount of freight with fewer cars and fewer shipments, improving operational efficiency and reducing shipping and handling costs for railroads and their customers. Businesses located along railroad lines that are restricted from handling national standard 286k, Plate "F" freight cars are at a competitive disadvantage. With operating margins shrinking and an increasingly competitive national and global marketplace, rail-dependent industries seeking to increase, or at least maintain, operating margins may make a corporate decision to relocate to areas served by rail lines already capable of handling modern freight cars. As more time has passed since the adoption of the new freight car standards, rail-dependent industrial operations and jobs have begun to leave the NJTPA region, often relocating to other states. Businesses looking to establish rail-served operations in Northern New Jersey place a high priority on national standard freight car access. The FRIO Corridors Program seeks to extend the economic advantages of national standard freight rail access to businesses in Northern and Central New Jersey by moving to address the barriers to modern freight car use on seven rail corridors.

1.2.2 Rail Lines in the FRIO Corridors Program

The FRIO Corridors Program evaluated seven rail corridors in Northern and Central New Jersey to determine the locations and types of physical barriers preventing access by modern freight rail cars. The rail lines analyzed under the program were selected by the NJTPA because they have physical restrictions that prevent the use of modern freight rail cars, and in response to requests to eliminate those restrictions by businesses along the lines or the freight railroads serving them.

After studying the physical connections between the rail lines selected for the program, as well as how freight cars traveled over the lines to reach rail customers, the NJTPA established seven FRIO "corridors". Each corridor is a grouping of physically connected rail lines that share a common point of access to the unrestricted freight rail network (where physical barriers no longer exist).

The rail lines are in use by the following passenger and freight railroads:

- NJ TRANSIT (NJT)
- Conrail, North Jersey's primary local freight railroad, which is jointly owned by the two large Eastern U.S. freight railroad companies, Norfolk Southern and CSX Transportation
- Norfolk Southern Railway (NS)
- CSX Transportation (CSX)

- Black River and Western Railroad (BR&W RR)
- Dover & Delaware River Railroad
- Morristown & Erie Railway

The FRIO corridors include the following rail lines:

- HX Corridor
  - NJT's Pascack Valley Line between East Rutherford and Hackensack
  - NJT's Bergen County Line between Secaucus and Ridgewood
  - NJT's Main Line between Jersey City and Suffern
- Raritan Valley Corridor
  - NJT's Raritan Valley Line between Plainfield and North Branch
- Amboy Corridor
  - Conrail's Perth Amboy Industrial Track between Perth Amboy and Woodbridge Township
  - Conrail's Amboy Secondary between South Amboy and Monmouth Junction,
  - Conrail's Freehold Industrial Track between Jamesburg and Freehold
  - NJT's North Jersey Coast Line between Perth Amboy and South Amboy
- Coast Line Corridor
  - NJT's North Jersey Coast Line between Perth Amboy and South Amboy
  - NJT's freight-only Church Running Track in South Amboy
  - NJT's North Jersey Coast Line between South Amboy and Red Bank
  - Conrail's Amboy Secondary between South Amboy and Old Bridge
  - Conrail's Southern Secondary between Red Bank and Lakehurst
- Morris/Warren Corridor
  - NJT's Morristown Line from Hackettstown to Morristown
  - NJT's Montclair Line from Denville to Wayne
  - Dover & Delaware River Railroad's Washington Secondary from Phillipsburg to Hackettstown
  - Dover & Delaware River Railroad's Totowa Spur from Wayne to Totowa
  - Morristown & Erie Railway's Whippany Line from Morristown to Roseland
- Black River & Western Corridor
  - BR&W RR, between Ringoes and Three Bridges
- Northeast Corridor
  - Amtrak's Northeast Corridor between Metuchen and South Brunswick

Figure 1-2 shows the FRIO Corridors Program's seven corridors.

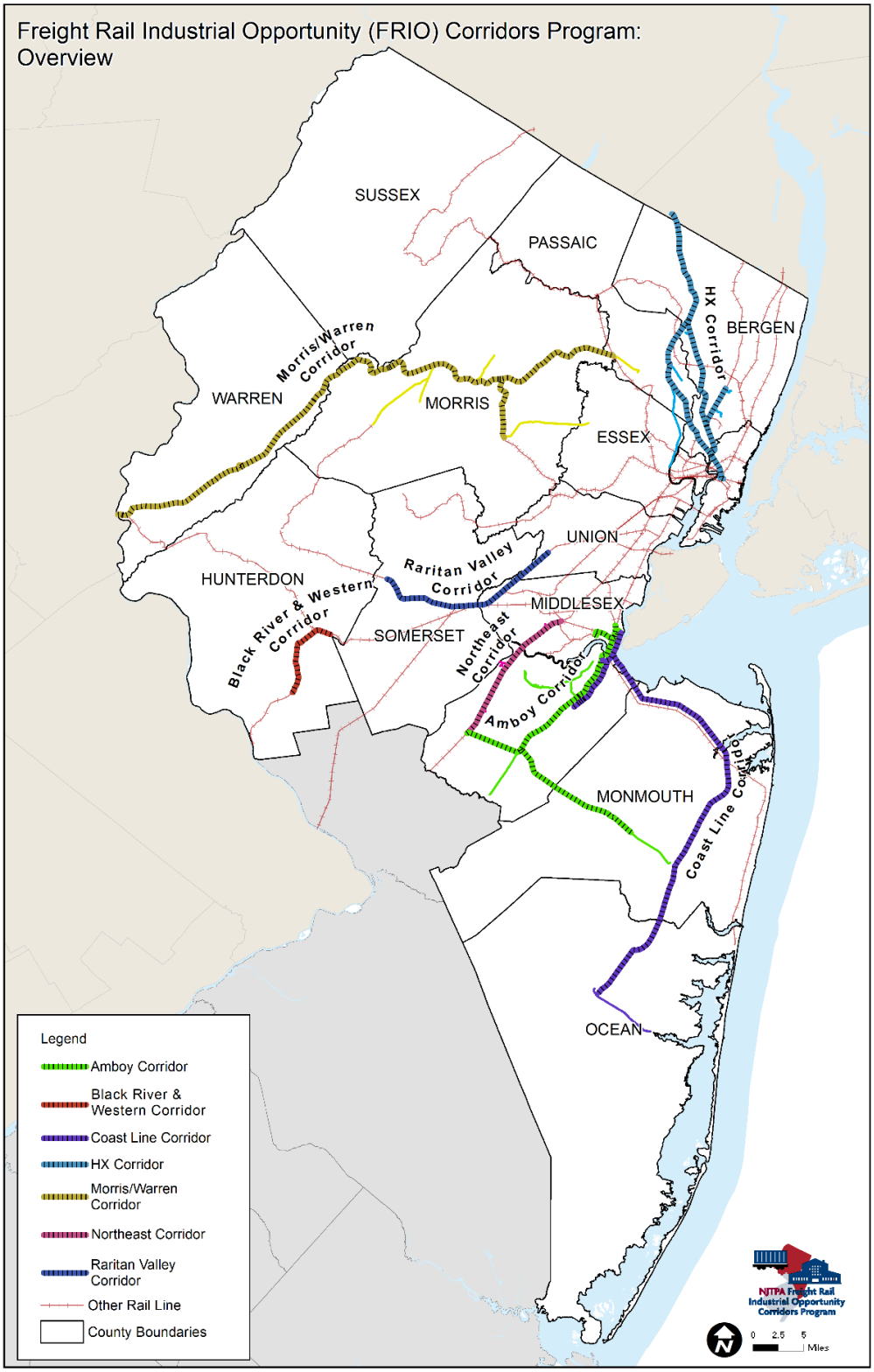


Figure 1-2. FRIO Corridors Overview

1.3 Methodology

1.3.1 Data Collection

NJTPA

The NJTPA began the FRIO effort by creating two databases that formed the basis for further development and refinement during this effort:

- Restriction locations database
- Industrial opportunities database

The restriction locations database is a gathering of all relevant data on locations along the FRIO rail lines where physical interruptions to the safe passage of Plate “F” and/or 286k rail cars occur. Because the FRIO lines are defined by their limitations to national standard freight rail car access, it is essential to have an accurate and complete picture of the restrictions. The database describes 406 structures that have been analyzed by up to 40 different attributes. Some of these attributes are descriptive, such as ‘rail line’, ‘number of tracks’, ‘primary rail user’, and ‘load rating’.

Other attributes relate to the potential solutions and preliminary cost estimates to alleviate the restrictions. The safe operating weight limits of all railroad bridges must be documented and inspections performed annually as per the Department of Transportation Federal Railroad Administration 49 Code of Federal Regulations Parts 213 and 237 effective September 13, 2010. Railroads are expected to be in compliance with this mandate as follows, thus making the data readily available for the FRIO project:

- Class I Railroads – March 14, 2011
- Class II Railroads – September 13, 2011
- All Other Railroads – September 13, 2012

Most rail corridors in the Northeast were originally designed with clearances lower than the Plate “F” and weight limits lower than 286k. Railroad clearances are typically subject to each state’s regulations and rail operator’s special instructions.

The industrial opportunities database is a collection of parcels that would be suitable for potential industrial development. These parcels of land with potential industrial opportunities are also essential to the FRIO lines, as they offer the potential economic pay-off for the investments that need to be made in alleviating the restrictions.

The database inventories 2,813 parcels by up to 45 different attributes. These attributes describe characteristics, such as the location and zoning of a

parcel, whether it is feasible to install a rail link, and whether there is an active rail freight customer present already.

Appendix A Database Descriptions illustrates the process the NJTPA and the team went through designing, enhancing, and populating the two databases.

During this project, the team:

- Refined the industrial opportunities database with additional information related to suitability of the parcels for freight rail service and drawing upon the informed opinions of the staff from 11 counties in the NJTPA region who participated in individual WebEx discussions on this database.
- Expanded and fully populated the restriction location database with information obtained from partner railroads and field inspections.

1.3.2 Database Development

Restriction Locations Database

The consultant effort primarily focused on populating the restriction location database through a three-step process consisting of:

- Obtain and review available information for the railroads owning the rights of way identified as in the FRIO Corridor System.
- Undertake targeted field work to gather additional information on specific restrictions based on the data obtained.
- Develop estimates of the potential types of improvements and associated costs for addressing the identified impediments.

Close collaboration and support of the railroads was needed to enable this work to be successful. All of the railroads participated and provided significant data, insights and help throughout the FRIO project.

The Restriction Locations Database was initially populated by HDR using aerial photography and track charts to determine potential restriction locations along each corridor, generally including all overhead and undergrade[12] structures along a given corridor. As clearance and load rating information was received from the railroads, the database was refined to a point where a targeted field plan could be implemented to identify and record any potential restrictions that had not yet been verified.

[12] Undergrade structures support the track

As of September 13, 2012, every railroad is required to have bridge rating information as prescribed by federal regulations[13]. In addition, it was expected that each railroad would already have a substantial amount of geometric clearance data available for use.

As such, requests for information were made to the railroads for the following items:

- Track Charts listing all types of physical elements along the operating railroads right of way (Mile Post ID)
- Undergrade Bridge Ratings for bridges which are not permitted to accept 286k rail cars, or carry restrictions from normal timetable freight speeds
- Overhead Clearances or Line Clearance records

Each rail operator was assured that company sensitive information provided would be protected as per the operator's request.

Each of the operating railroads, NJ TRANSIT, Conrail, Amtrak, and the Black River and Western, were contacted and asked to provide track charts, bridge ratings, and clearances for their railroads. It was anticipated that any bridge rating information would be available due to the requirements mandated by CFR 49 Parts 237 Bridge Safety Standards which must be complied with by September 13, 2012 by all railroads. Clearance information, although not mandated by any CRF's are subject to each operating railroads discretion, and dissemination of such information set by their operating rules.

Requests were made by e-mail and followed up with phone calls as necessary. NJ TRANSIT hosted a meeting at their Newark headquarters to discuss the information available and the extent to which it could be used. All track charts, bridge ratings, and clearances were readily produced. Conrail hosted a meeting at their Mt. Laurel headquarters and shortly after produced track charts, clearance information and written confirmation that their structures all meet the 286 rating. The Black River and Western produced ratings and escorted the project team onto the right-of-way via high rail vehicle and assisted in taking clearance measurements and photographs of various structures.

Field Inspections

Field inspections were conducted as part of the data collection effort in order to fill in any missing or incomplete data fields.

There were two types of potential restriction locations that required field inspections:

[13] 49 CFR Parts 213 & 237 Bridge Safety Standards Subparts B Railroad Bridge Safety Assurance 237.31

- Locations that are known restrictions based on data received from public agencies and railroads in the previous phase of data collection described above. These sites were visited to verify and document the restriction.
- Locations where the restriction status was unknown due to insufficient data received during the previous phase of data collection. These sites were visited to take survey measurements to measure clearance and collect other data that may be necessary to make a determination on the status of the potential restriction.

The field effort required access to the railroad right of way, which was coordinated directly with the appropriate railroads. All team members who accessed the right of way received Roadway Worker Protection training from each railroad in accordance with federal regulations.[14]

Thirty-one locations were surveyed on NJT, Conrail, and Black River & Western (BR&W) right-of-way. GTS conducted all field inspection and survey of Conrail and BR&W structures. HDR conducted all field inspection of NJT structures. Inspections were completed over the span of October 9, 2018 and January 12, 2019. An inventory of these locations is available in Appendix C Restriction Locations and Engineering Cost Estimates.

Industrial Opportunities Database

NJTPA staff undertook considerable work on this database prior to the inception of the FRIO consultant effort. NJTPA used New Jersey's statewide parcel data as the foundation for recording the investigation and classification of properties within reach of the FRIO corridors for suitability as rail-served industrial sites. The NJTPA's staff conducted the first stage of the development of the Industrial Opportunity Database. Staff compiled parcel data (including several data fields from New Jersey's MOD-IV assessment system) on a county level, united it into a single database structure and added fields detailing land use, used Python scripting to select parcels that meet a series of criteria including: distance no greater than 2,000 feet from the rail line, a distance determined from input by industry and rail owners; excluding parcels with their centers within a critical New Jersey Highlands preservation area or within a conservation easement. A manual review process further narrowed the selection to exclude parcels with, or adjacent to, incompatible land uses (primarily residential), isolated parcels separated from the rail track or subject to zoning or wetland or other environmental restrictions that could prevent their development as industrial sites. A full description of the initial stage of database development is contained in the "Freight Rail Industrial Opportunity (FRIO) Corridors Program GIS Data

[14] 49 CFR part 214

Documentation" (November 16, 2017) and can be found in Appendix A Database Descriptions.

At the inception of HDR's participation in the FRIO project, a number of fields were added based on discussions between the NJTPA and HDR to accommodate analysis. The suggested modifications include adding new fields to capture or clarify information such as existing rail customers occupying the site and their level of rail usage and the results of analysis of the practicability of new rail links such as sidings.

This laid the groundwork for a further refinement of the analysis, resulting in a comprehensive classification of the Industrial Opportunities database into properties judged suitable or not for industrial development under present conditions. HDR in cooperation with the NJTPA made further additions to the database employing aerial photos, detailed site analysis of specific locations that appeared to have active freight rail use, historic rail customer volume information provided to the NJTPA by some of the railroads participating in the study, and comments and contributions from the economic development offices of Bergen, Passaic, Essex, Hudson, Hunterdon, Morris, Somerset, Union, Middlesex, Monmouth, and Ocean Counties. The outreach and involvement of the counties is documented in the next section.

1.3.3 Stakeholder Involvement

To help advance the FRIO Corridors Program, and provide opportunities for understanding and input from those potentially affected, many different stakeholders were regularly informed on the progress of the project, including through the use of slide presentations, online video conferencing, and walkthroughs in an interactive map. The interactive map is a highly accessible visualization of the Geographic Information System (GIS) databases, displaying the gathered data at the click of a mouse. Additionally, the consultant team developed four-page brochures on each corridor to assist in stakeholder outreach, presenting profiles identifying the many different characteristics of each of the FRIO corridors.

Technical Advisory Committee

A Technical Advisory Committee (TAC) supported the FRIO Corridors Program throughout the process with their technical knowledge and stakeholder perspective. The project team met with the TAC four times over the period of the project at key moments to present to them preliminary study results and receive their feedback and guidance on how to proceed. Representatives from Passaic, Morris, Somerset, and Middlesex Counties, NJ TRANSIT and the New Jersey Department of Transportation participated in

the TAC. These representatives also functioned as project ambassadors to their employers.

On **December 19, 2017**, the first TAC meeting emphasized on presenting the project goals and objectives of the FRIO Corridors Program and introduced the different tasks and the timeline of the project. The consultant team presented the current status of the databases and their plan to further data collection. TAC members suggested additional fields to add to the databases to more fully describe the restriction locations. They also provided insight in freight rail concerns specific for their counties.

The **April 10, 2018**, TAC meeting focused on how to shape the project's outreach efforts and update the TAC members on work completed to date. The TAC members were taken on a walkthrough of the interactive map. Using one rail line as an example, they were made familiar with the inventory of restriction locations and potential industrial opportunities. TAC members then provided insights on how to shape the outreach process, who to invite and the best way to translate the team's findings to the counties' planning and economic development staff.

Upon completion of data gathering and analyses in regards to identifying the restriction locations and potential industrial opportunities, the consultant team presented the FRIO corridors during the TAC meeting of **January 23, 2019**. To reflect differences among local freight operations, the team divided the rail lines in the study area, and their associated restrictions and industrial opportunities, into seven distinct corridors to help frame future decision-making, stakeholder engagement, and investment opportunities. The seven corridors were presented to the TAC one-by-one allowing for questions and dialogue resulting in some suggestions from the TAC members on how to proceed with finalizing the project.

The fourth and last TAC meeting was held on **March 5, 2019**, and focused on the costs and benefits of alleviating the impediments to national standard freight rail access. Firstly, common engineering solutions to alleviate weight and geometric restrictions were covered. The techniques and approximate costs were discussed. Next, the methodology of NJTPA's economic impact assessment was presented. The consultant team then went through the total restrictions, estimated engineering costs, and preliminary economic impact as it pertained to each corridor. In addition to the databases and a report, the consultant team was also creating a four-page brochure on each corridor to assist in future outreach. A draft brochure was presented for feedback. The TAC then discussed on the best way to disseminate all the information that the project had generated and how to move from corridor initiatives into concept development.

Outreach to Counties

During summer and fall 2018 the project team arranged discussions with each of the 11 counties served by FRIO railroad lines to present the study team's initial findings on restriction locations and potential industrial opportunities within each county. These presentations were conducted by interactive online video conferences. During their respective county meetings, representatives from Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, and Union Counties provided guidance and information on land use, economic development, and recent industrial development efforts, which enabled the project team to refine their analysis of potential industrial opportunities along the FRIO rail lines.

Every county outreach meeting started off with an introduction on the origin and importance of the FRIO Corridors Program. Then the county was presented with an overview of the FRIO rail lines within their boundaries, the locations of the identified restrictions and an overview of the passenger and freight operations on those lines. The consultant team then discussed the county's economic development priorities as found in public strategic documents. Next the county's representatives were made familiar with the screening criteria that the consultant team had used to determine potential industrial opportunities in their county. During this process there was room for engagement and dialogue between the county, the NJTPA and the consultant team to allow for the county's representatives to elaborate on their economic development priorities and what industries that saw fit for which areas. They also indicated whether the identified potential industrial opportunity parcels were consistent with the county's current and long term development plans and their knowledge of these sites and others along the FRIO Corridors. This discussion included taking the county on a walkthrough of the interactive map. The dialogue was concluded by sending the county the industrial opportunity data in maps and written form for them to comment on. The industrial opportunities database was updated with the information that emerged from these discussions and reviews.

General Public

At the April 15, 2019 Freight Initiatives Committee (FIC) meeting, the project team presented the FRIO Corridors Program's initial findings to FIC members, representatives of private sector freight companies and members of the general public in attendance.

2 Overview of the Restrictions Found

The FRIO program is the first comprehensive assessment of the physical restrictions that preclude national standard freight rail service to large portions of the NJTPA's industrial properties. This section summarizes the types of restrictions found. As previously noted, New Jersey's long history of railroading means that the region generally has older rail infrastructure which may not meet current shipper needs and/or may be reaching the end of its useful service life, requiring additional maintenance and potential replacement.

2.1 Restriction Types

FRIO corridors are generally characterized as having multiple restrictions, preventing freight trains utilizing Plate "F", 286k rail cars to move through them. These restrictions can cause constraints to a rail car's weight, horizontal, or vertical dimensions, limiting the efficiency of a rail operator serving its rail-customers, in turn limiting the efficiency of their operations. On the FRIO corridors there are 54 weight restrictions, and 24 geometric restrictions, all vertical clearance restrictions. There are no horizontal clearance restrictions.

Table 2-1. Restriction Locations per Corridor

Corridor	Length (miles)	Weight	Clearance	Total
HX	61.5	24	3	27
Coast Line*	58.7	3	19	22
BR&W	9.0	11	0	11
Amboy*	54.6	0	10	10
Morris/Warren	79.0	6	2	8
Raritan Valley	20.8	6	0	6
Northeast**	18.7	4	0	4
Total	**294.4**	**54**	**24**	**78**

*10 Shared restriction locations and 7.9 shared miles

** Only the two center tracks of the four track Northeast Corridor are clear for Plate "F". (Source: Amtrak)

All restrictions were assessed by the team in accordance with the American Railway Engineering & Maintenance-of-Way Association (AREMA) guidelines. AREMA is an industry organization which advances the development of both technical and practical knowledge and recommended practices pertaining to the design, construction and maintenance of railway infrastructure. It consists of six railroad practicing discipline groups totaling 30

technical committees. From the workings of these committees the “Manual for Railway Engineering” was developed and promulgated as “Recommended Practices and Guidelines” that are used throughout the rail industry involving all aspects of rail infrastructure. The Manual consists of more than 5,000 pages of railway engineering reference material, the recommended practices for the industry. It contains principles, data, specifications, plans and economics pertaining to the engineering, design and construction of the fixed railway infrastructure (except signals and communications), and allied services and facilities. The material is developed by AREMA technical committees and is published as a guide to railways in establishing policies and practices relative to the subjects, activities and facilities covered in the Manual, with the aim of assisting them to engineer and construct a railway infrastructure, which will have inherent qualities of a safe and economical operation as well as low maintenance cost.

Each type of restriction is discussed below.

2.1.1 Weight Restrictions

Weight restrictions, or load-bearing capacity restrictions, as identified in this study are bridges or culverts that structurally do not permit the safe passage of 286k rail cars, which has become the industry standard for shipping rail freight. A 286k rail car has a gross weight of 286,000 pounds or a lading weight of approximately 110 tons. The freight lines typical to the FRIO project were constructed to 263k, which has a gross weight of 263,000 pounds or a lading weight of approximately 100 tons.

Industry standard solutions to eliminate weight restrictions that were recommended as potential improvements at specific locations in the study area included:

- Instrumentation of structure to measure actual live loads under train traffic. The data generated by these measurements can be used to perform more refined load rating analysis, which will yield more precise information to determine the need for additional measures
- Rehabilitation of individual structural members to raise controlling rating of bridge
- Replacement of the superstructure

Figure 2-1 shows an example of what the replacement of a superstructure could look like. Paragraph 5.2 elaborately covers all mitigation strategies considered.

Figure 2-1. Example of a Superstructure Replacement

The study identified 54 weight restrictions within in the FRIO project area, which are listed in Appendix C Restriction Locations and Engineering Cost Estimates and, include a description, potential mitigation strategies and their costs.

Consider the example of HX Draw: This double track bridge over the Hackensack River carries the NJT Bergen County Line between Secaucus, NJ and Rutherford, NJ. The bridge is approximately 1,100 feet long and consist of 17 total spans. Certain components of the superstructure have insufficient capacity to carry 286k rail cars.

Figure 2-2. Weight Restriction Hackensack River (HX Draw) on HX Corridor

Three mitigations have been proposed for this restriction location ranging from performing a refined load rating analysis at approximately $400,000 to replacing deficient bridge components at approximately $130 million.

Another example, is a concrete box culvert and a concrete pipe culvert that routes the Benagut Brook under the NJT Raritan Valley Line. The structure is located ½ mile west of the Dunellen Station platforms. The top slab of the box culvert does not have sufficient capacity to allow passage of 286k rail cars.

Figure 2-3. Weight Restriction Benagut Creek on Raritan Valley Corridor

Two mitigations have been proposed for this restriction location ranging from performing a refined load rating analysis at approximately $30,000 to replacing the box culvert at approximately $3.5 million.

2.1.2 Speed Restrictions

Speed restrictions refer to structures that permit the passage of 286k rail cars, but trains must proceed at a restricted speed in order to stay within the structural integrity of the infrastructure. While these are not explicit restrictions, and are not identified in the study documentation as such, it is important to note that these operational constraints do exist throughout the rail network. In addition, structures that were rated as being able to operate 286k freight at a speed restriction are at the lower end of the allowable load bearing capacity and may become a restriction at a future time as the structure ages. See Appendix C Restriction Locations and Engineering Cost Estimates for a complete overview of speed restrictions on FRIO corridors.

2.1.3 Geometric Restrictions

Geometric restrictions as identified in this study are locations that do not permit the passage of Plate “F” rail cars. The Plate “F” designation denotes

rail cars that are generally 17’-0” in height and 10’-8” in width. The freight lines typical to the FRIO Corridors Program were constructed to accommodate Plate “C” rail cars, which are generally 15’-6” in height and 10’-8” in width. As the width between Plate “F” and Plate “C” is the same and since the FRIO corridors currently run Plate “C” traffic, Plate “F” in the context of this study denotes a vertical clearance.

A six-inch buffer was added to the Plate “F” clearance in order to accommodate the movement of the train and future track maintenance which could raise the position of the rail, such as surfacing cycles or rail upgrades. Along electrified corridors, a buffer of 12.5 inches was used for energized contact wires and a buffer of 29.5 inches was used for overhead structures above energized contact wires in accordance with AREMA guidelines.

Table 2-2. Vertical Restriction Clearances

Type of Overhead Structure	Vertical Buffer	Total Required Vertical Clearance
Overhead Structure (Non-Electrified Territory)	Plate “F” +6”	17’-6”
Energized Contact Wire	Plate “F” +12.5”	18’-0 1/2”
Overhead Structure above Energized Contact Wire	Plate “F” + 29.5”	19’-5 1/2”

Common solutions to eliminate vertical restrictions that were recommended as potential improvements at specific locations in the study area include:

- Installation of steel ties embedded in the ballast, allowing a lower track profile compared to traditional ties using the same amount of ballast
- Undercutting by using equipment to vacuum out excess ballast or sub-ballast from under the ties, lower the track profile, and replace with fresh ballast
- Raising of the superstructure
- Replacement of the superstructure

Figure 2-4 shows an example of construction workers using hydraulic jacks to raise an existing superstructure. Figure 2-5 illustrates what the track looks like after undercutting and implementation of steel ties. Paragraph 5.2 elaborately covers all mitigation strategies considered.

Figure 2-4. Superstructure Being Jacked with Hydraulic Jacks

Figure 2-5. Example of Implementation of Steel Ties and Undercutting

A total of 24 vertical restrictions were identified within the FRIO project area and are listed in Appendix C Restriction Locations and Engineering Cost Estimates.

Consider the example of a pedestrian overpass just south of the South Amboy station platforms allowing passengers to cross between the Track 1 and Track 2 platforms. The bridge is a steel TPG bridge with concrete deck. The reported vertical clearances are 17’-7” to the contact wire and 19’-0” to the low chord of the overhead bridge. This requires an increase in vertical clearance to the contact wire and overhead structure of 5½” to allow passage of Plate “F” rail cars. The overpass is partially demolished and out of service.

Figure 2-6. Geometric Restriction Pedestrian Overpass on Coast Line Corridor

Three mitigations have been proposed for this restriction location ranging from undercutting at approximately $180,000 to removal of the structure at approximately $500,000.

Another example, this structure is an overhead bridge carrying Tinton Avenue (County Road 537) over the Conrail South Secondary right-of-way in Eatontown, NJ. The bridge is a steel TPG bridge with concrete/asphalt deck supporting two lanes of Tinton Avenue. There is a sidewalk on the south side of the bridge outside of the south girder. The railroad has no overhead contact system (OCS) and is not electrified. The reported vertical clearance is 16’-5½“, requiring an increase of 11½“ to allow passage of Plate “F” rail cars.

Figure 2-7. Geometric Restriction Tinton Avenue on Coast Line Corridor

Three mitigations have been proposed for this restriction location ranging from installation of steel ties at approximately $300,000 to jacking and raising of the existing structure at approximately $1.75 million.

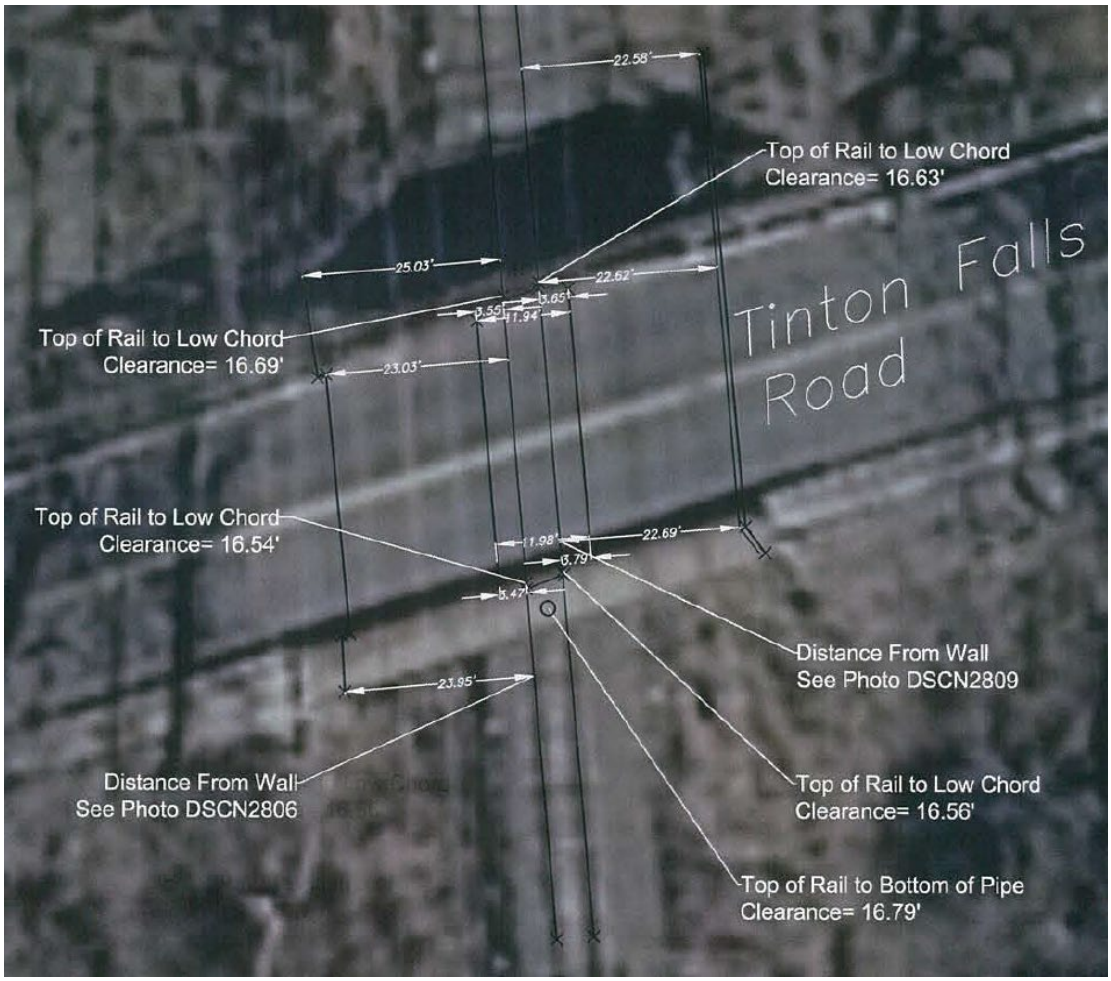


Figure 2-8. Clearance Survey of Tinton Avenue crossing the Coast Line Corridor

3 Rail Served Industrial Opportunities

3.1 Methodology

The Industrial Opportunities Database was created by the NJTPA "starting with parcel level data from the 11 counties in the NJTPA region that contain rail lines identified as Rail Infrastructure Opportunities. The counties included are: Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, and Union"[15]. This database contained approximately started with 2,200,000 parcels before criteria were applied by NJTPA. Examples of criteria applied to select potential freight rail served parcels included:

- Further than 2,000 feet from the rail line
- Within Preserved Highlands, according to the NJ Highland Water Protection and Planning Act
- Within Preserved Farmlands, according to the NJ State Farmland Preservation Program
- In a Conservation Easement, according to The National Conservation Easement Database
- With incompatible land uses, e.g. residential

The Industrial Opportunities Database developed by the NJTPA initially consisted of approximately 2,800 parcels.

3.2 Industrial Opportunities

3.2.1 Rail Access Criteria

In order to determine the feasibility of a rail link into the parcel, the following aspects were analyzed:

- Minimum 350 feet ROW frontage length
- Proximity to rail line
- Obstacles between parcel and rail line
- Parcel dimensions
- Parcel shape

[15] NJTPA: FRIO GIS Data Documentation, November 16, 2017

3.2.2 Other Considerations

In order to determine the overall feasibility of rail-served industrial opportunity, the following aspects were taken into account:

- Elevation difference between parcel and rail line
- Environmental compatibility
- Existing land-use
- Adjacent land-use
- Road access

3.3 Rail Freight Customers

Rail-freight customers are defined as rail-served companies that have been identified as currently using their existing rail-link for receiving raw materials, distribution of products, or both. All known properties with rail freight customers identified along FRIO corridors are included in the Industrial Opportunities Database.

Parcels with active shippers were given a separate designation in the database in order to differentiate these parcels from potential industrial opportunity sites.

3.4 Suitable Parcel Sizes per Industry

As discussed in Appendix A Database Descriptions, the NJTPA had determined based on research and discussions with the Class I railroads' industrial development staff, that the minimum size of a rail-served industrial opportunity parcel is three acres. HDR assessed what a common range of parcel sizes is per industry. The objective of this analysis is to assist in identifying which industries may be suitable for industrial opportunity parcels along the FRIO rail lines.

HDR conducted an assessment of 84 randomly selected existing rail-served industrial facilities to identify the size of parcels and facilities used by 10 different rail-served industries that are common in Northern and Central New Jersey. The existing businesses that have been reviewed are mainly located within the NJTPA territory, but also extend across the U.S. Northeast. Businesses in the following industries have been assessed:

- Transloading, Warehousing, and Distribution
- Waste and Recycling
- Paper and Printing

- Plastics
- Chemicals
- Pharmaceuticals
- Food and Beverage
- Steel and Metal
- Bricks, Tiles, Aggregates, and Cement
- Lumberyard

Figure 3-1 summarizes HDR's analysis and identifies the range of common rail-served parcel sizes by industry sector. Most industries have a bandwidth fitting in the majority of businesses and one or two outliers. To illustrate, most rail-served customers in the paper and printing business were situated on parcels ranging from three to 13 acres. However, there were two outliers, the multinational companies International Paper and Schweitzer-Mauduit International. Another example, if a 65-acre rail-served site would become vacant along one of the FRIO corridors, it might be a suitable location to attract a chemical company, as it fits within the common 44 to 86 acre bandwidth for the chemical industry. The site might also be able to accommodate a large pharmaceutical or food and beverage company, similar to Thermo Fischer Scientific or Mars Chocolate, but these would be less common.

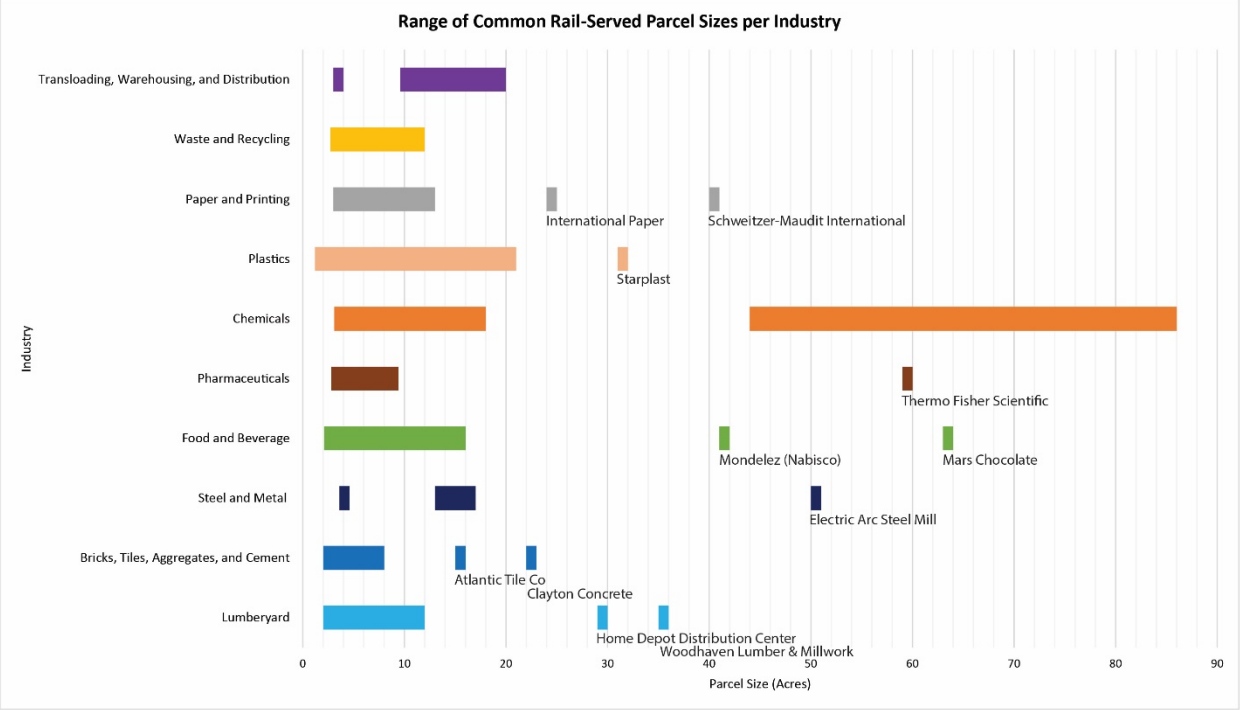


Figure 3-1. Range of Common Rail-Served Parcel Sizes per Industry

4 Economic Impact Assessment

This chapter summarizes the economic impact assessment that was conducted by the NJTPA Central Staff for the FRIO Corridors Program. The information used, translation mechanisms, assumptions and economic impact methodology are summarized.

The economic impact assessment is an essential part of the FRIO Corridors Program leading to economic benefits. After determining the estimated costs for the required engineering solutions to alleviate the restrictions, the economic benefits make it possible to juxtapose costs and benefits, allowing the NJTPA and their member counties to make an informed decision on where to invest and determine their investment priorities.

4.1 Data Input

At the base of the economic impact assessment are surface area calculations based on properties of land that have been identified as potential industrial opportunity or in use by an existing rail-freight customer.

4.2 Translation from Square Feet to Employment Estimates

The industrial sectors used and the associated on-site direct employees per thousand square feet for this analysis are shown in Table 4-1.

Table 4-1. Employees per 1,000 sqft per Industry

Industry	Number of employees per 1,000 sqft of enclosed space
Food Product Manufacturing	1.15
Wood Product Manufacturing	0.65
Paperboard Production	0.55
Plastic Products Manufacturing	0.87
Metal Products Manufacturing	0.96
Chemical Production	0.78
Building Materials Retail	1.24
Warehousing/Transload	0.3

The industrial sectors were selected based on the range of operations that tend to use freight rail services particularly in New Jersey. The sectors also reflect the range of existing direct rail served customers in the NJTPA region.

The employee per square foot information is based on several sources:

- The US Energy Information Administration (EIA) data released in 2018.
- Information on warehousing and transload facility employment based on field work conducted by Anne Strauss-Wieder for more than a decade.
- Institute of Transportation Engineers Building Area Per Employee by Business Type

NJTPA Central Staff also conducted additional research on employee per square foot information and trends to review this data. This research indicated a continuing productivity improvement that decreased employees per thousand square feet over time. Because the employment data was based on "enclosed space," a conservative estimate of 30 percent site coverage was generally used in this analysis. The economic impact work undertaken for the predecessor Morris/Warren study was also compared to the current analysis and found to be consistent.

4.3 Methodology

The NJTPA acquired the most recent version of the IMPLAN input-output software and data in 2018. A multi-region input-output model (MRIO) of the NJTPA and the State of New Jersey was created by the NJTPA with the IMPLAN software for this analysis, with all data reported in 2019 dollars. Eight runs – one each for the industrial sectors discussed previously – were undertaken with the MRIO model to create an impact calculator spreadsheet with separate abilities to assess existing customers and potential future freight rail customers.

The existing and potential employment associated with freight rail served businesses was assessed for each segment that HDR had designated within each FRIO corridor:

- Existing Customers: The square footage information for identified existing customers from HDR was used to generate estimated on-site direct employment in that specific industrial sector (which coincided with one of the eight designations previously discussed). The direct employment estimate was the basis to assess the impacts. Information on actual employment at each existing customer was not collected during this project.
- Potential Future Freight Rail customers: The square footage information for the parcels identified as having potential freight rail customers was evenly divided among the eight industrial sectors and then analyzed. The assumption is that the potential customers could be a mix of these types of uses.

Economic value associated with addressing the identified impediments come from sources:

- Existing customers that benefit by having their facilities become more cost effective through the use of national standard freight rail cars; and
- New freight rail customers that locate to New Jersey to the industrial opportunity sites identified in the analysis.

The NJTPA used a Multi-Regional Input-Output model and the calculations of land occupied by both existing and potential rail customers to develop an estimate of the potential gross economic impact benefits to municipalities, counties, and the State if the sites were fully developed for freight rail served businesses and all of the existing freight rail users were retained and benefited from the removal of the impediments.

These economic measurements include employment effects, business output and revenue, personal income effects, and the effect of taxes, based on a mix of known industrial activities that occur in the corridor. The impact analysis is considered a gross estimate of economic value; the analysis does not consider the loss of any non-freight rail businesses on existing parcels.

The maximum potential economic value attributable to alleviating the barriers to modern rail freight car access in the FRIO corridors is estimated to be more than 223,700 direct jobs and more than $16.8 billion in annual federal, state and local tax revenues.

The vast majority of the gross potential economic value associated with addressing the impediments comes from the potential development of the hundreds of acres of industrial opportunity sites.

The estimated economic value of the existing freight rail customers is important and could be at risk if the impediments are not addressed. The existing freight rail customers are estimated to employ over 14,700 workers and generate nearly $1.2 billion in annual federal, state and local tax revenues.

As capital investments and concept development proceeds to address specific impediments, a more detailed analysis that considers the net impacts can be undertaken. Nevertheless, the assumptions used for the square footage estimates are conservative in terms of site coverage; the actual economic value could be higher.

MRIO analyses require several considerations and reviews beyond single region economic impact models:

Each region within a MRIO model is separate and does not overlap. Without the creation of separate regions, a duplication of impacts would occur.

- The MRIO model has separate regions for:
  - The NJTPA region of 13 counties
  - The rest of New Jersey
- In general, the economic characteristics within each region in a MRIO model will vary, which reflects the differences in costs and other considerations in each area. These differences (such as in employee/output ratios) are considered in developing the inputs for the model. The starting point impacts for the FRIO analysis all occurred within the NJTPA region.

4.3.1 Definitions

The economic impact assessment estimates the total impacts, which are defined to include:

- **Direct** – the spending at the site of the economic activity. Direct effects are the focal point of an impact analysis.
- **Indirect** – the purchases of goods and services by suppliers. By definition, the first round of indirect impacts includes the purchase of supplies and services that are required to produce the direct effects. Subsequent purchases of supplies and services generate other rounds of indirect impacts. Such purchases continue to ripple through the economies of each of the regions in the MRIO model.
- **Induced** – the purchases (of such items as food, clothing, personal services, vehicles, etc.) that arise, in turn, from the increase in the aggregate labor income of households.

The **total economic impact** consists of the direct, indirect and induced effects as shown above.

The economic measurements included in this analysis are:

- **Employment Effects** –Jobs generated or supported, including:
- Direct employment: onsite full- and part-time equivalent jobs or jobs in the initial Industry/business development.
- Total employment: The total number of full-time equivalent jobs (direct, indirect and induced) generated in each of the geographically defined regions.
- **Business Output/Revenue** – Output represents the value of industry production. In IMPLAN, these are annual production estimates for the year of the data set and are in producer prices. For manufacturers this would be sales plus/minus change in inventory. For service sectors production = sales. For Retail and wholesale trade, output = gross margin and not gross sales.
- **Personal Income Effects** – Includes all forms of employment income, including Employee Compensation (wages and benefits) and Proprietor Income.

- **State and Local Tax Effects** – defined as revenues collected by state and sub-state governments. The taxes include employee, personal, proprietor, business, household and corporate taxes.
- **Federal Tax Effects** – defined as revenues collected by the federal government from corporate income, personal income, social security, and excise taxes.

More information on the background and history of Input-Output analysis can be found in Appendix B Economic Impact Analysis.

4.4 Economic Impact

This section presents the economic benefits calculated by the NJTPA, reporting on the following quantities:

- Direct Employment
- Total Employment
- Personal Income
- Business Activity
- State and Local Taxes
- Federal Tax Revenue
- Total Tax Revenues

Employment is shown in number of jobs, Personal Income, Business Activity, Taxes, and Revenues are shown in millions of 2019 dollars.

Table 4-2. Total Economic Impacts

Corridor	Direct Employment (jobs)	Total Employment (jobs)	Personal Income ($2019 millions)	Business Activity ($2019 millions)	State and Local Taxes ($2019 millions)	Federal Tax Revenue ($2019 millions)	Total Tax Revenues ($2019 millions)
Amboy	50,000	117,685	8,621.9	38,164.7	1,629.1	2,221.7	3,850.8
BR&W	2,240	5,050	362.5	1,544.8	66.4	93.2	159.6
Coastline[16]	86,140	199,995	14,558.6	63,657.6	2,741.2	3,748.2	6,489.4
HX	18,145	41,325	2,977.5	12,985.9	553.7	766.2	1,319.9
Morris Warren	31,340	71,750	5,191.9	22,496.9	963.3	1,335.6	2,298.8
Northeast	18,350	41,590	2,999.0	12,862.0	549.0	771.0	1,319.7
Raritan	17,855	43,115	3,188.0	14,459.0	615.0	824.0	1,439.6
Total Economic Impact	**224,070**	**520,510**	**37,900.2**	**166,171.7**	**7,118.0**	**9,759.8**	**16,877.8**

[16] Excluding shared segments with Amboy Corridor

5 Restriction Location Solutions and Cost Estimates

5.1 Introduction

A total of 102 restrictions were identified: 54 weight or 'load carrying capacity' restrictions, 24 vertical clearance restrictions, and 24 speed restrictions. Mitigation strategies and order-of-magnitude cost estimates were not developed for the speed restrictions. It should be noted that speed restrictions can, under further bridge deterioration advance to a full 286k restrictions.

In non-electrified territory (without OCS), vertical clearance restrictions were identified as overhead structures less than 17'-6" from top of rail elevation. This ensures that any overhead structure cleared for Plate "F" rail cars will have a 6" buffer over the Plate "F" rail car height of 17'-0" to account for future track surfacing, rail upgrades, or equipment aberrations which may occur. In electrified territory, vertical clearance restrictions were identified as those below the clearances recommended in AREMA Chapter 33 and the National Electrical Safety Code (NESC), which take into account OCS uplift, tolerances, and future track surfacing or rail upgrades. These recommendations call for 12½" clearance between the top of the rail car and the energized contact wire, and 29½" clearance between the top of rail car and overhead obstructions above the OCS. Weight restrictions were identified using load rating information provided by the railroads that are responsible for these structures. The railroads at a minimum provided a summary of which undergrade structures on the study corridors do not have sufficient capacity to carry 286k rail cars.

5.2 Mitigation Strategies

The restriction information obtained from the railroads and targeted field investigations of the structures were used to propose a number of mitigation strategies that could eliminate the restriction at each location. Construction cost data on projects similar to the proposed mitigations were used to generate order-of-magnitude cost estimates for incorporating each mitigation strategy. Results of this exercise were incorporated into the FRIO restrictions database.

5.2.1 Vertical Clearance Mitigations

The following are the main strategies investigated to eliminate vertical clearance restrictions. These are strategies that have a proven track record in the railroad industry and are commonly used to increase vertical clearance.

Steel Ties

Concrete or wood ties can be replaced with steel ties, which have a hollow "U" cross section which is embedded in the ballast layer. This allows a lower track profile compared to traditional crossties using the same ballast depth. Vertical clearance can be increased by seven inches when replacing timber ties and approximately nine inches when replacing concrete ties.

Steel tie installation costs approximately $1,200 per track foot.

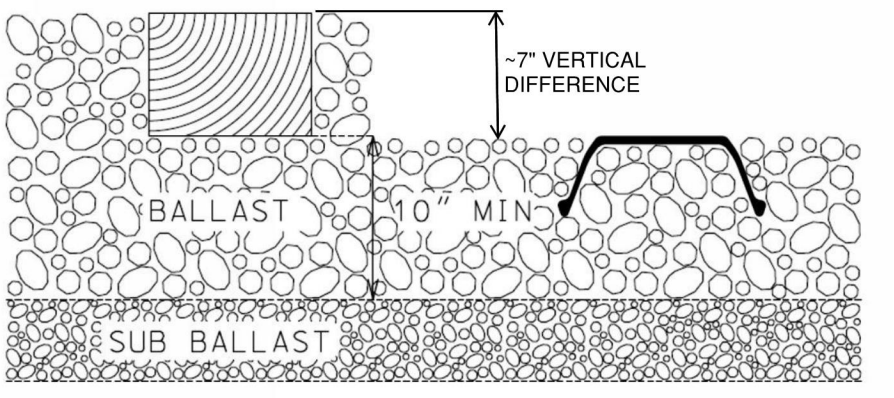


Figure 5-1. Steel/Timber Ties Comparison

Undercutting

Specialized equipment is used to vacuum out, or remove by scraping directly under each tie, ballast and sub-ballast from under the ties. This procedure is typically employed to replace fouled ballast with clean ballast, leaving the track profile at the same elevation. However, the track profile can also be lowered during undercutting.

Undercutting costs approximately $1,000 per track foot per 9" depth.

Catenary Elevation Adjustment

Some overhead bridge locations are restrictions because the OCS wire elevation under the bridges provides less than the AREMA recommended clearance to the top of rail car. In such cases, the catenary wire elevation can be raised. This solution would affect several OCS supports either side of the restriction location.

Jack and Raise Superstructure

Hydraulic jacks can be used to raise the superstructure of overhead bridges with low clearance. The superstructure can be placed on rise blocks or steel grillages. This solution may require rework of roadway or railroad approach grades, and relocation of some utilities, depending on the required height of

the bridge raise. In electrified territory, this solution is often coupled with a catenary elevation adjustment.

Superstructure jacking costs approximately between $60,000 and $1.2 million.

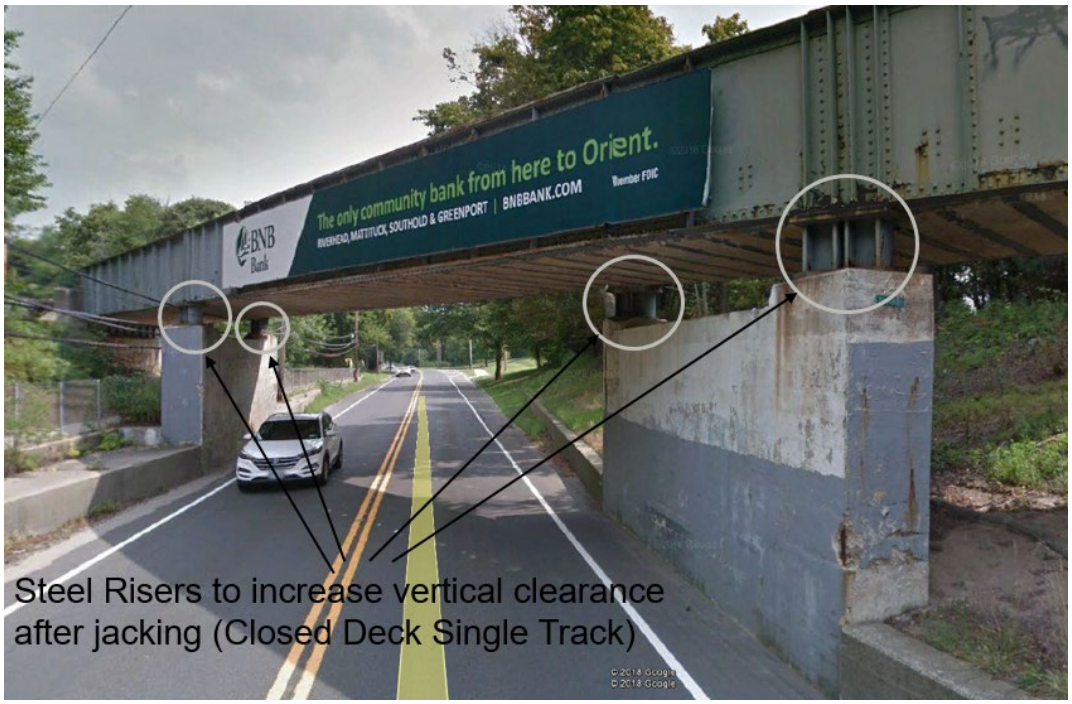


Figure 5-2. Raised Superstructure

Replace Superstructure

In restriction locations where the age or type of overhead structure will not allow one of the solutions described above, superstructure replacement at a higher elevation may be required. In electrified territory, this solution may be coupled with a catenary elevation adjustment.

Replacement of a superstructure costs between approximately $1.75 million and $15.0 million.

Figure 5-3, Overhead Bridge Replacement with Increased Vertical Clearance on Long Island Rail Road Mainline

5.2.2 Load Carrying Capacity Mitigations

Measurements of load carrying capacity, or bridge ratings, depend heavily on the level of conservatism and analysis methods employed by the engineers conducting the ratings. It can be useful to perform more refined load rating calculations or take field measurements before using funds for a construction solution. In the event that analysis cannot reasonably raise the bridge rating to the required level, rehabilitation or replacement of the deficient bridge members may be required.

Instrumentation/Analysis

Strain gauges can be installed on the structure to measure actual live load strains under train traffic. The measured strains are used to determine live load distribution to the different bridge members and perform a more refined analysis determining the stresses in the bridge components. Often this type of analysis will show the structure has more load carrying capacity than is reported in bridge ratings using more approximate methods of analysis. In addition to instrumentation, analysis can be performed to investigate removal of dead load from the superstructures such as abandoned station platforms or excess ballast. Removal of excess dead load frees up bridge capacity to support live loads and therefore raises the bridge rating.

The cost estimates for this solution range from $25,000 to $500,000.

Rehabilitate Structure

When the structure rating cannot be sufficiently raised through analysis, rehabilitation or replacement of limited components can be performed. Most of the structures that are load carrying restrictions have riveted, built-up steel members. This means that cover plates can be added or replaced on these members without replacing the entire member or structure. In addition to replacing flange cover plates, web reinforcing or stiffeners can be added to increase shear capacity where required. Individual deficit members such as floor beams or stringers can also be replaced without significant disruption. In the FRIO database, distinctions are made between minor and major rehabilitations.

Cost estimates to rehab a structure vary from $350,000 to $40 million.

Figure 5-4. Example of Built-up Steel Girder Section Showing Flange Cover Plates

Replace Superstructure

When bridge rating cannot be sufficiently raised through refined analysis or rehabilitation, replacement of certain superstructure spans may be required. It is assumed that bridge replacement would require accelerated bridge construction techniques in order to minimize rail service disruptions.

This is the most expensive of the solutions with cost estimates ranging from $1.2 million to $130 million and is utilized if the rating cannot be raised sufficiently through refined analysis or rehabilitation.

Figure 5-5. Triple Track Superstructure Replacement using SPMT in Weekend Rail Outage

5.3 Cost Estimates

Depending on the mitigation strategy and the affected track length, the engineering solutions range widely in cost. The individual restriction locations, their most suitable engineering solutions, and related cost estimates are discussed in Appendix C Restriction Locations and Engineering Cost Estimates.

Table 5-1. Estimated Costs of Engineering Solutions per Corridor

Corridor	Range of Estimated Improvement Costs ($2019 millions)
HX	10.0-454.6
Raritan Valley	1.3-23.5
Amboy*	9.6-64.9
Coast Line*	16.4-139.3
Coast Line w/o shared section with Amboy*	6.8-74.4
Morris/Warren	14.6-27.4
Black River & Western	0.4-67.3
Northeast	0.4-162.3

* Amboy and Coast Line Corridors share a segment. Improvements made to provide modern freight rail access for one corridor will also benefit the other corridor in that segment of shared trackage.

Table 5-2 identifies the weight restrictions, their locations, and the lowest and highest engineering cost estimates.

Table 5-2. Cost Estimates Range of Weight Restrictions

	Site Name	Site ID	Rail Line	Corridor	Minimum Cost Estimate ($2019 million)	Maximum Cost Estimate ($2019 million)
1	Hackensack River (HX Draw)	BC UG 5.48	NJT Bergen County Line	HX Corridor	0.4	130.0
2	River Drive	BC UG 11.16	NJT Bergen County Line	HX Corridor	0.2	7.2
3	Passaic Street	BC UG 11.43	NJT Bergen County Line	HX Corridor	0.05	7.2
4	John Ringo Rd.	BR UG 6.89	Black River & Western	Black River & Western Corridor	0.03	1.54
5	Drainage	BR UG 8.12	Black River & Western	Black River & Western Corridor	0.03	1.2
6	Cattle Pass	BR UG 8.39	Black River & Western	Black River & Western Corridor	0.025	1.5
7	Cattle Pass	BR UG 10.46	Black River & Western	Black River & Western Corridor	0.025	2.0
8	1st Neshanic River	BR UG 10.90	Black River & Western	Black River & Western Corridor	0.03	1.56
9	Walnut Brook	BR UG 11.05	Black River & Western	Black River & Western Corridor	0.03	3.75
10	Dayton Rd	BR UG 11.10	Black River & Western	Black River & Western Corridor	0.03	1.375
11	Rt. 31	BR UG 12.68	Black River & Western	Black River & Western Corridor	0.045	4.534
12	Bushkill Brook Tributary	BR UG 13.80	Black River & Western	Black River & Western Corridor	0.03	1.7
13	Raritan River/Red Rock Lake	BR UG 14.01	Black River & Western	Black River & Western Corridor	0.125	46.646
14	S Branch Raritan River Tributary	BR UG 15.05	Black River & Western	Black River & Western Corridor	0.03	1.5
15	Meadow Road	MB UG 21.32	NJT Montclair-Boonton Line	Morris/Warren Corridor	0.96	0.96
16	Rockaway River	MB UG 29.54	NJT Montclair-Boonton Line	Morris/Warren Corridor	0.06	1.5
17	Midvale Road	MB UG 31.20	NJT Montclair-Boonton Line	Morris/Warren Corridor	0.055	3.4
18	Conrail	ML UG 2.19	NJT Main Line	HX Corridor	0.045	0.3
19	Conrail	ML UG 2.67	NJT Main Line	HX Corridor	0.06	32.3

	Site Name	Site ID	Rail Line	Corridor	Minimum Cost Estimate ($2019 million)	Maximum Cost Estimate ($2019 million)
20	Hackensack River (Upper Hack Lift)	ML UG 4.95	NJT Main Line	HX Corridor	0.25	33.0
21	Stuyvesant Ave	ML UG 8.23	NJT Main Line	HX Corridor	0.09	12.5
22	Passaic River (Lyndhurst Draw)	ML UG 8.52	NJT Main Line	HX Corridor	0.175	75.0
23	River Road	ML UG 8.94	NJT Main Line	HX Corridor	0.085	11.22
24	Delawanna Avenue	ML UG 9.34	NJT Main Line	HX Corridor	0.085	8.424
25	Main Avenue	ML UG 9.99	NJT Main Line	HX Corridor	0.095	14.0
26	Howard Avenue	ML UG 10.37	NJT Main Line	HX Corridor	0.07	7.1
27	Pedestrian Tunnel at Passaic Station	ML UG 10.56	NJT Main Line	HX Corridor	0.03	2.5
28	Clifton Blvd	ML UG 12.13	NJT Main Line	HX Corridor	0.06	14.688
29	Clifton Avenue	ML UG 12.36	NJT Main Line	HX Corridor	0.06	13.6
30	Getty Avenue	ML UG 14.84	NJT Main Line	HX Corridor	0.065	1.9
31	Straight Street and 21st Avenue	ML UG 15.14	NJT Main Line	HX Corridor	0.04	0.35
32	20th Avenue	ML UG 15.26	NJT Main Line	HX Corridor	0.06	4.0
33	Essex Street	ML UG 15.53	NJT Main Line	HX Corridor	0.105	3.5
34	Market Street	ML UG 15.71	NJT Main Line	HX Corridor	0.08	40.0
35	Fulton Street	ML UG 16.30	NJT Main Line	HX Corridor	0.045	0.5
36	Mahwah Creek	ML UG 30.01	NJT Main Line	HX Corridor	3.3	8.64
37	Route 202	ML UG 30.11	NJT Main Line	HX Corridor	2.2	8.64
38	Chestnut Street	ML UG 30.66	NJT Main Line	HX Corridor	0.05	5.6
39	Franklin Road	MO UG 35.28	NJT Morristown Line	Morris/Warren Corridor	8.0	12.0
40	Mill Brook	MO UG 36.41	NJT Morristown Line	Morris/Warren Corridor	2.5	4.0
41	Drain	MO UG 57.25	NJT Morristown Line	Morris/Warren Corridor	1.5	2.0
42	George Street	NEC UG 31.22	ATK Northeast Corridor	Northeast Corridor	0.1	38.0

	Site Name	Site ID	Rail Line	Corridor	Minimum Cost Estimate ($2019 million)	Maximum Cost Estimate ($2019 million)
43	French Street	NEC UG 31.43	ATK Northeast Corridor	Northeast Corridor	0.16	80.52
44	Joyce Kilmer Avenue	NEC 31.49	ATK Northeast Corridor	Northeast Corridor	0.085	27.36
45	Paterson Street	NEC 31.55	ATK Northeast Corridor	Northeast Corridor	0.09	16.4
46	Morgan Drawbridge	NJC UG 3.22	NJT North Jersey Coast Line	Coast Line Corridor	0.075	1.9
47	Navesink River	NJC UG 16.08	NJT North Jersey Coast Line	Coast Line Corridor	0.5	40.0
48	Front Street	NJC UG 16.22	NJT North Jersey Coast Line	Coast Line Corridor	0.15	12.0
49	Berkman Street	RV UG 22.35	NJT Raritan Valley Line	Raritan Valley Corridor	0.05	7.84
50	Roosevelt Avenue	RV UG 22.85	NJT Raritan Valley Line	Raritan Valley Corridor	0.035	5.32
51	Benagut Brook	RV UG 26.56	NJT Raritan Valley Line	Raritan Valley Corridor	0.03	3.5
52	River Road	RV UG 29.83	NJT Raritan Valley Line	Raritan Valley Corridor	0.035	1.25
53	Main Street	RV UG 30.08	NJT Raritan Valley Line	Raritan Valley Corridor	0.05	4.06
54	Milltown Road	RV UG 38.67	NJT Raritan Valley Line	Raritan Valley Corridor	1.1	4.06

Table 5-3 identifies the geometric restrictions, their locations, and the lowest and highest engineering cost estimates.

Table 5-3. Cost Estimates Range of Geometric Restrictions

	Site Name	Site ID	Rail Line	Corridor	Minimum Cost Estimate ($2019 million)	Maximum Cost Estimate ($2019 million)
1	Signal Bridge	ML OH 3.72	NJT Main Line	HX Corridor	0.06	0.06
2	Kingsland Tunnel	ML Tunnel 7.23	NJT Main Line	HX Corridor	2.25	30.0
3	NYS&W Hudson Secondary Line	ML OH 17.66	NJT Main Line	HX Corridor	0.0	0.35
4	Hall Avenue	NJC OH E5.32	NJT North Jersey Coast Line	Amboy Corridor	0.216	0.3

	Site Name	Site ID	Rail Line	Corridor	Minimum Cost Estimate ($2019 million)	Maximum Cost Estimate ($2019 million)
5	Signal Bridge	NJC OH E5.33	NJT North Jersey Coast Line	Amboy Corridor	0.24	0.3
6	Washington Street	NJC OH E5.68	NJT North Jersey Coast Line	Amboy Corridor	0.252	2.1
7	CONRAIL	NJC OH E5.69	NJT North Jersey Coast Line	Amboy Corridor	0.346	1.2
8	New Brunswick Avenue	NJC OH E5.84	NJT North Jersey Coast Line	Amboy Corridor	1.148	14.75
9	Fayette Street	NJC OH E5.92	NJT North Jersey Coast Line	Amboy Corridor	1.064	12.5
10	Signal Bridge	NJC OH E5.96	NJT North Jersey Coast Line	Amboy Corridor	0.225	0.99
11	Smith Street	NJC OH E6.05	NJT North Jersey Coast Line	Amboy Corridor	1.435	12.25
12	Pedestrian Overpass	NJC OH E6.10	NJT North Jersey Coast Line	Amboy Corridor	3.82	5.75
13	Market Street	NJC OH E6.16	NJT North Jersey Coast Line	Amboy Corridor	0.825	14.75
14	Private Road	NJC OH 0.94	NJT North Jersey Coast Line	Coast Line Corridor	0	0.125
15	Access Road	NJC OH 0.97	NJT North Jersey Coast Line	Coast Line Corridor	1.15	2.25
16	Conrail	NJC OH 0.98	NJT North Jersey Coast Line	Coast Line Corridor	1.15	1.75
17	Pedestrian Overpass	NJC OH 1.40	NJT North Jersey Coast Line	Coast Line Corridor	0.18	0.5
18	Bordentown Avenue	NJC OH 1.56	NJT North Jersey Coast Line	Coast Line Corridor	2.88	9.25
*	Morgan Drawbridge	NJC UG 3.22	NJT North Jersey Coast Line	Coast Line Corridor	-	-
19	Lloyd Road	NJC OH 7.25	NJT North Jersey Coast Line	Coast Line Corridor	0.16	0.192
20	Red Hill Road	NJC OH 12.37	NJT North Jersey Coast Line	Coast Line Corridor	0.16	4.5
21	Bowmans Road	NJC OH 12.47	NJT North Jersey Coast Line	Coast Line Corridor	0.16	0.2
22	Tinton Avenue	SOSE OH 41.13	Conrail Southern Secondary	Coast Line Corridor	0.03	1.75
23	Hanover Avenue Bridge Catenary	MO OH 31.48	NJT Morristown Line	Morris/Warren Corridor	0.5	1.5
24	South Main Street Bridge	WS OH 80.23	NS Washington Secondary	Morris/Warren Corridor	1.0	3.0

* This is technically a clearance restriction, but should not be treated as such (see Appendix C Restriction Locations and Engineering Cost Estimates for a detailed description).

6 Corridors

6.1 Introduction

6.1.1 Freight Operations

In order to get a clear image of which freight operators and rail-freight customers would benefit from investments in the FRIO rail lines, the rail lines and their adjoining parcels have been grouped to form corridors. The Corridor approach has been widely and successfully used throughout the US to advance key freight projects, particularly freight rail initiatives.

The Corridor approach recognizes that more than a single impediment may need to be addressed in order to achieve national standard freight rail access to clusters of customers and/or potential industrial opportunity locations. The approach thus provides a framework for action to address the impediments.

There are seven FRIO corridors:

- HX Corridor
- Raritan Valley Corridor
- Amboy Corridor
- Coast Line Corridor
- Morris/Warren Corridor
- Black River & Western Corridor
- Northeast Corridor

6.1.2 Corridor Segments

Segments were chosen through a process of linking similar or clustered restrictions impeding access to an area of industrial opportunity. The beginning point of a segment is typically a restriction or set of restrictions that must be cleared in order to access the parcels that lie on the other side. For example, the 10 vertical restrictions along the North Jersey Coast Line between Wood Interlocking and River Draw represent a segment where all 10 of the identified restrictions must be mitigated in order to unlock the industrial opportunities along the Conrail Amboy Secondary. Restrictions on an additional segment would need to be mitigated in order to access industrial opportunities along the Conrail Southern Secondary.

The FRIO corridors are divided into segments ranging from two segments on the BR&W and Northeast corridors to eight segments on the HX corridor.

As part of the FRIO project, standalone profiles of each Corridor were developed.

6.2 HX Corridor

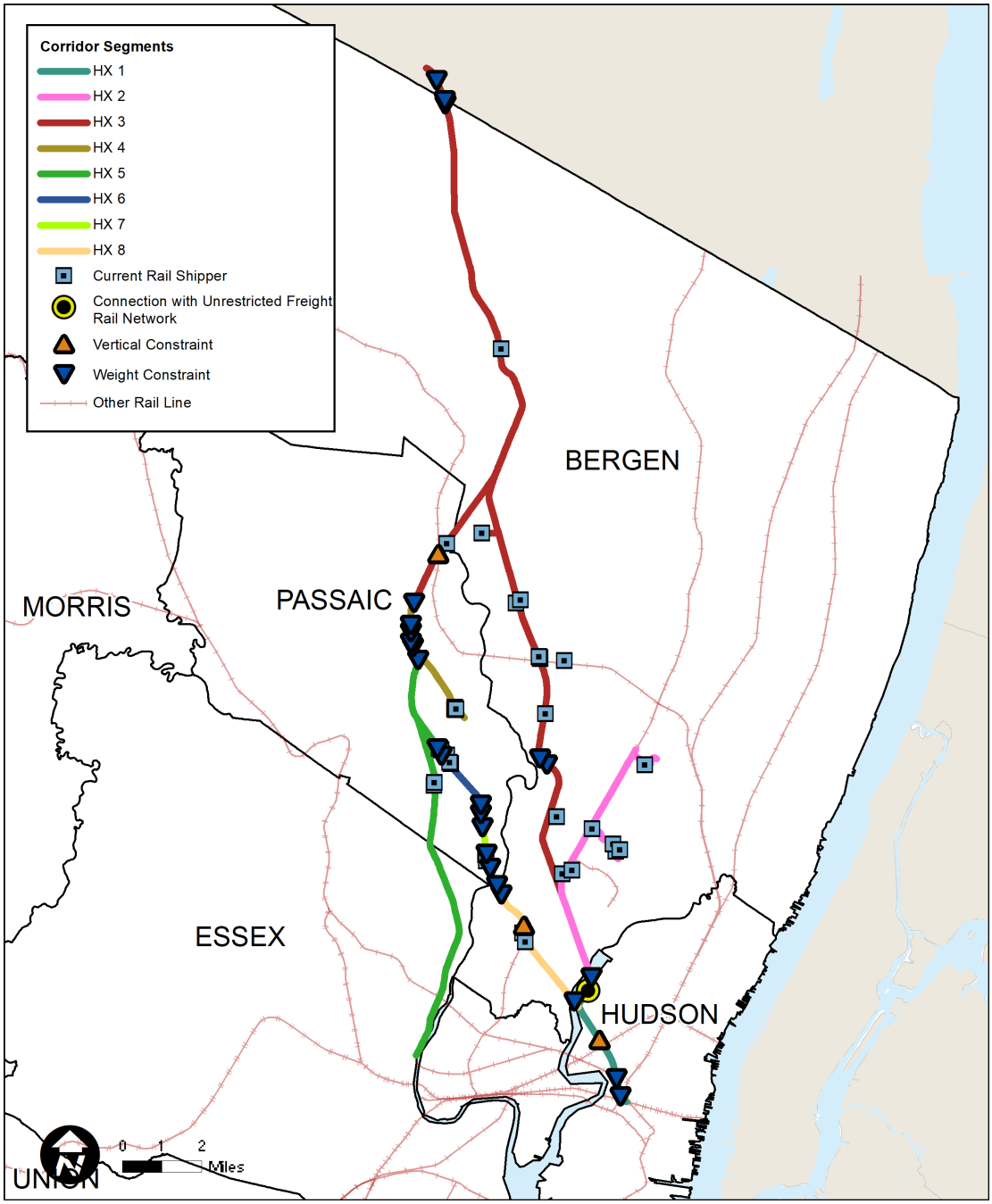


Figure 6-1. HX Corridor

6.2.1 Description

The HX Corridor is made up of 62 miles of railroad lines in Northern New Jersey. The corridor includes three NJT commuter lines that also host local rail freight service:

- NJT's Pascack Valley Line between East Rutherford and Hackensack, 4.3 miles

- NJT's Bergen County Line between Secaucus and Ridgewood, 14.4 miles
- NJT's Main Line between Jersey City and Suffern, 29.4 miles

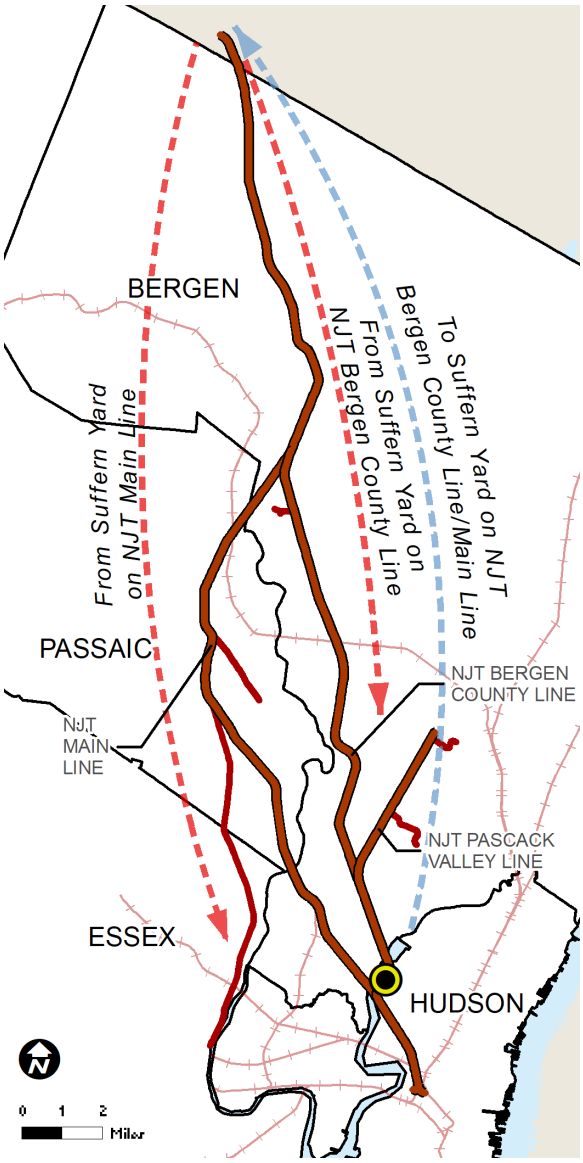


Figure 6-2. Freight Operations on HX Corridor

The HX Corridor also includes several connecting freight-only tracks that depend on the NJT lines for access to the national rail network. Local freight service on the HX Corridor is provided by NS. The HX Corridor is located in Bergen County, Hudson County, and Passaic County, but has one connecting freight track that reaches into Essex County. The corridor has a high-density passenger rail operation with more than 150 NJT trains per day.

The HX Corridor's connection to the unrestricted rail network (where physical barriers no longer exist) is located at the HX interlocking in Secaucus on NJT's Bergen County Line. From that location, local freight trains operate directly north and east to serve rail freight customers along the Pascack Valley Line. Other freight trains operate north from the HX interlocking nonstop along the Bergen County Line and Main Line until they reach a railroad yard at Suffern, New York, just across the New Jersey state line. This is the base of operations for the local freight trains that will then make the final delivery of freight cars to rail customers along the Bergen County Line, Main Line, and connecting freight tracks.

Figure 6-3. NS Freight Train on HX Corridor near Suffern, NY

6.2.2 Restriction Locations

There are 27 restriction locations on the HX Corridor. They are both vertical constraints and weight constraints. The estimated costs to alleviate these restrictions range from $10.0 million to $454.6 million.

Table 6-1. Restriction Locations on HX Corridor

Segment	Restrictions	Range of Estimated Improvement Cost ($2019 millions)	Cumulative Segment Cost Estimates [17] ($2019 millions)
HX 1	3	0.2-32.6	0.6-162.6
HX 2	1	0.4-130	0.4-130
HX 3	6	5.8-33.6	6.2-163.6
HX 4	5	0.3-48.4	6.5-212
HX 5	1	0.1-1.9	6.6-213.9
HX 6	2	0.1-29.4	6.7-243.2
HX 7	5	0.4-43.2	7.1-286.5
HX 8	4	2.8-135.5	9.8-422
Total	**27**	**10-454.6**	

See Appendix C Restriction Locations and Engineering Cost Estimates for detailed descriptions of the restriction locations, the recommended strategies on alleviating them and individual conceptual level cost-estimates to execute them.

6.2.3 Industrial Opportunities

Common commodities transported on the HX Corridor include brick, chemicals, food products and ingredients, lumber, and plastics. The HX Corridor has 33 identified rail freight customers that occupy approximately 174 acres of land. It is estimated that properties along this corridor with the potential for development or redevelopment after rail improvements were made, total approximately 1,490 acres of land.

The following table shows the developable surface available for potential industrial development and in use by existing active rail shippers.

[17] Due to the location of the access point to the unrestricted freight rail network and the nature of local freight operations, these costs cannot simply be added up from first to last segment.

Table 6-2. Developed and Developable Surface Area for Rail Freight Customers on HX Corridor

Segment	Rail Freight Customers (sqft)					Industrial Opportunity (sqft)	Total (sqft)	Total (acres)
	Brick	Chemicals	Food	Lumber	Plastics			
HX 1						12,504,000	12,504,000	287
HX 2		356,000	606,000	195,000	590,000	18,465,000	20,211,000	464
HX 3	41,000	341,000	2,080,000	12,000	1,178,000	16,589,000	20,240,000	465
HX 4			176,000			1,953,000	2,129,000	49
HX 5					311,000	9,703,000	10,014,000	230
HX 6	88,000		398,000		350,000	1,248,000	2,084,000	48
HX 7				117,000		2,689,000	2,806,000	64
HX 8					749,000	1,773,000	2,522,000	58
Total	**129,000**	**697,000**	**3,259,000**	**324,000**	**3,177,000**	**64,924,000**	**72,509,000**	**1,665**

See the industrial opportunity geodatabase for the most up-to-date surface area data at individual parcel level.

6.2.4 Economic Impact

The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the HX Corridor is estimated to be over 18,000 jobs and $1.3 billion in annual federal, state and local tax revenues.

Table 6-3. Potential Economic Impact on HX Corridor

Segment	Estimated On-Site Jobs	Estimated Annual Tax Revenue ($2019 millions)
HX 1	3,055	228.7
HX 2	5,030	377.7
HX 3	5,180	365.5
HX 4	540	37.7
HX 5	2,450	182.0
HX 6	565	33.8
HX 7	700	51.0
HX 8	630	43.4
Total	**18,145**	**1,319.9**

6.2.5 Cost-Benefit Analysis

Table 6-4. Costs and Opportunities per HX Corridor Segment

Segment	Range of Estimated Improvement Costs ($2019 millions)	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
HX 1	0.2-32.6	287	3,055	228.7
HX 2	0.4-130	464	5,030	377.7
HX 3	5.8-33.6	465	5,180	365.5
HX 4	0.3-48.4	49	540	37.7
HX 5	0.1-1.9	230	2,450	182.0
HX 6	0.1-29.4	48	565	33.8
HX 7	0.4-43.2	64	700	51.0
HX 8	2.8-135.5	58	630	43.4
Total	**10-454.6**	**1,665**	**18,145**	**1,319.9**

6.3 Raritan Valley Corridor

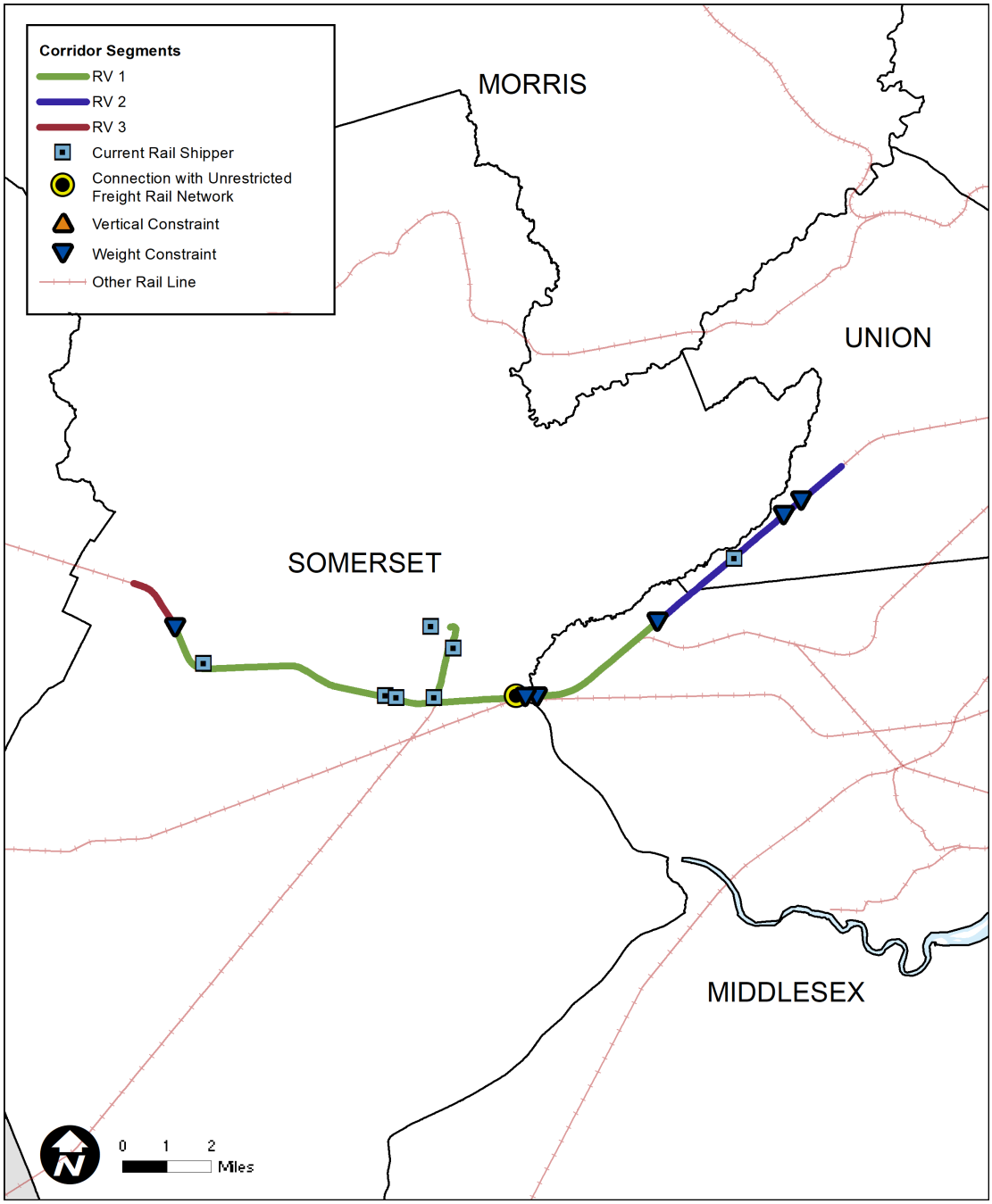


Figure 6-4. Raritan Valley Corridor

6.3.1 Description

The Raritan Valley Corridor consists of 19 miles of NJ TRANSIT's Raritan Valley Line between Plainfield and North Branch, along with a 2-mile connecting freight-only track in Bridgewater Township. Although primarily used as a commuter rail line, the Raritan Valley Corridor also has local freight

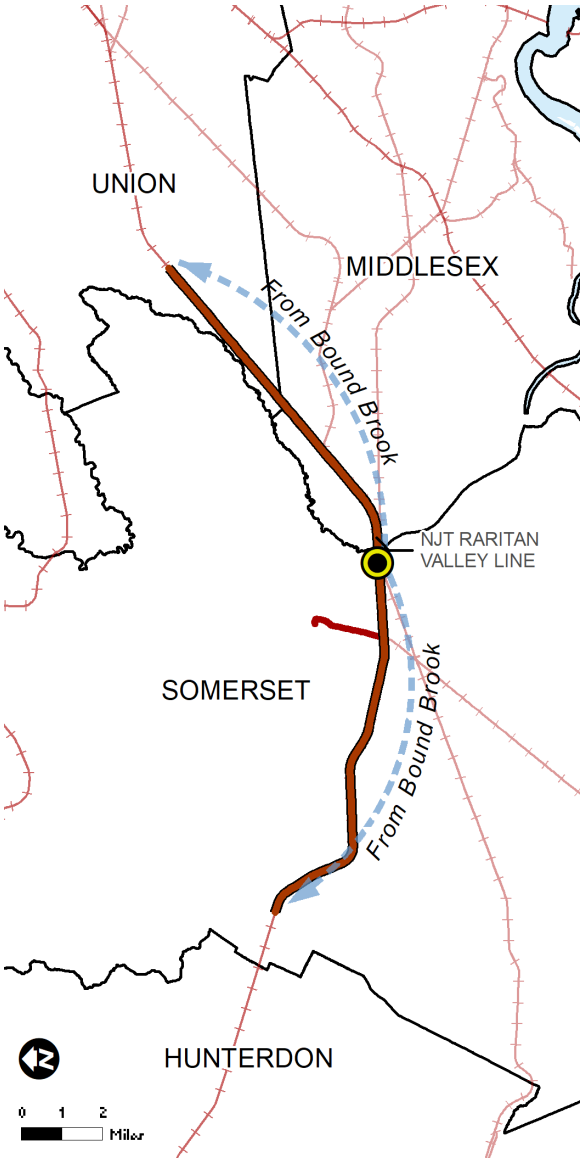


Figure 6-5. Freight Operations on Raritan Valley Corridor

rail service, which is provided by Conrail and NS. The Raritan Valley Corridor is located primarily in Somerset County, but also serves Middlesex County and Union County. The corridor has a high-density passenger rail operation with approximately 52 NJT trains per day.

The Raritan Valley Corridor's connection to the unrestricted rail network is located at the Brook interlocking in Bound Brook on NJT's Raritan Valley Line. Local freight trains originate at a nearby rail yard in Manville, then operate on freight-only tracks until they reach the Raritan Valley Corridor at Brook interlocking. From there, trains can operate east or west as required to serve rail freight customers along the corridor.

6.3.2 Restriction Locations

There are six restriction locations on the Raritan Valley Corridor. They are all weight constraints. Estimated costs to alleviate these restrictions range from $1.3 million to $23.5 million.

Table 6-5. Restriction Locations on Raritan Valley Corridor

Segment	Restrictions	Range of Estimated Improvement Cost ($2019 millions)	Cumulative Segment Cost Estimates [18] ($2019 millions)
RV 1	2	0.1-5.3	0.1-5.3
RV 2	3	0.1-16.7	0.2-22
RV 3	1	1.1-1.5	1.2-6.8
Total	**6**	**1.3-23.5**	

See Appendix C Restriction Locations and Engineering Cost Estimates for detailed descriptions of the restriction locations, the recommended strategies of alleviating them and individual conceptual level cost-estimates to execute them.

6.3.3 Industrial Opportunities

Common commodities transported on this corridor include plastics, chemicals, and aggregates. The Raritan Valley Corridor has seven identified rail freight customers that occupy approximately 490 acres of land. It is estimated that properties along this corridor with the potential for development or redevelopment after rail improvements were made, total approximately 1,593 acres of land.

The following table shows the developable surface available for potential industrial development and in use by existing active rail shippers.

Table 6-6. Developed and Developable Surface Area for Rail Freight Customers on Raritan Valley Corridor

Segment	Rail Freight Customers (sqft)			Industrial Opportunity (sqft)	Total (sqft)	Total (acres)
	Aggregate	Chemicals	Plastics			
RV 1	17,790,000	2,558,000	676,000	62,215,000	83,239,000	1,911
RV 2			338,000	2,497,000	2,834,000	65
RV 3				4,693,000	4,693,000	108
Total	**17,790,000**	**2,558,000**	**1,013,000**	**69,405,000**	**90,766,000**	**2,084**

See the industrial opportunity geodatabase for the most up-to-date surface area data at individual parcel level.

[18] Due to the location of the access point to the unrestricted freight rail network and the nature of local freight operations, these costs cannot simply be added up from first to last segment.

6.3.4 Economic Impact

The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the Raritan Valley Corridor is estimated to be nearly 17,900 jobs and more than $1.4 billion in annual federal, state and local tax revenues.

Table 6-7. Potential Economic Impact on Raritan Valley Corridor

Segment	Estimated On-Site Jobs	Estimated Annual Tax Revenue ($2019 millions)
RV 1	16,010	1,303.1
RV 2	700	50.6
RV 3	1,145	85.8
Total	**17,855**	**1,439.6**

6.3.5 Cost-Benefit Analysis

Table 6-8. Costs and Opportunities per Raritan Valley Corridor Segment

Segment	Range of Estimated Improvement Costs ($2019 millions)	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
RV 1	0.1-5.3	1911	16,010	1,303.1
RV 2	0.1-16.7	65	700	50.6
RV 3	1.1-1.5	108	1,145	85.8
Total	**1.3-23.5**	**2084**	**17,855**	**1,439.6**

6.4 Amboy Corridor

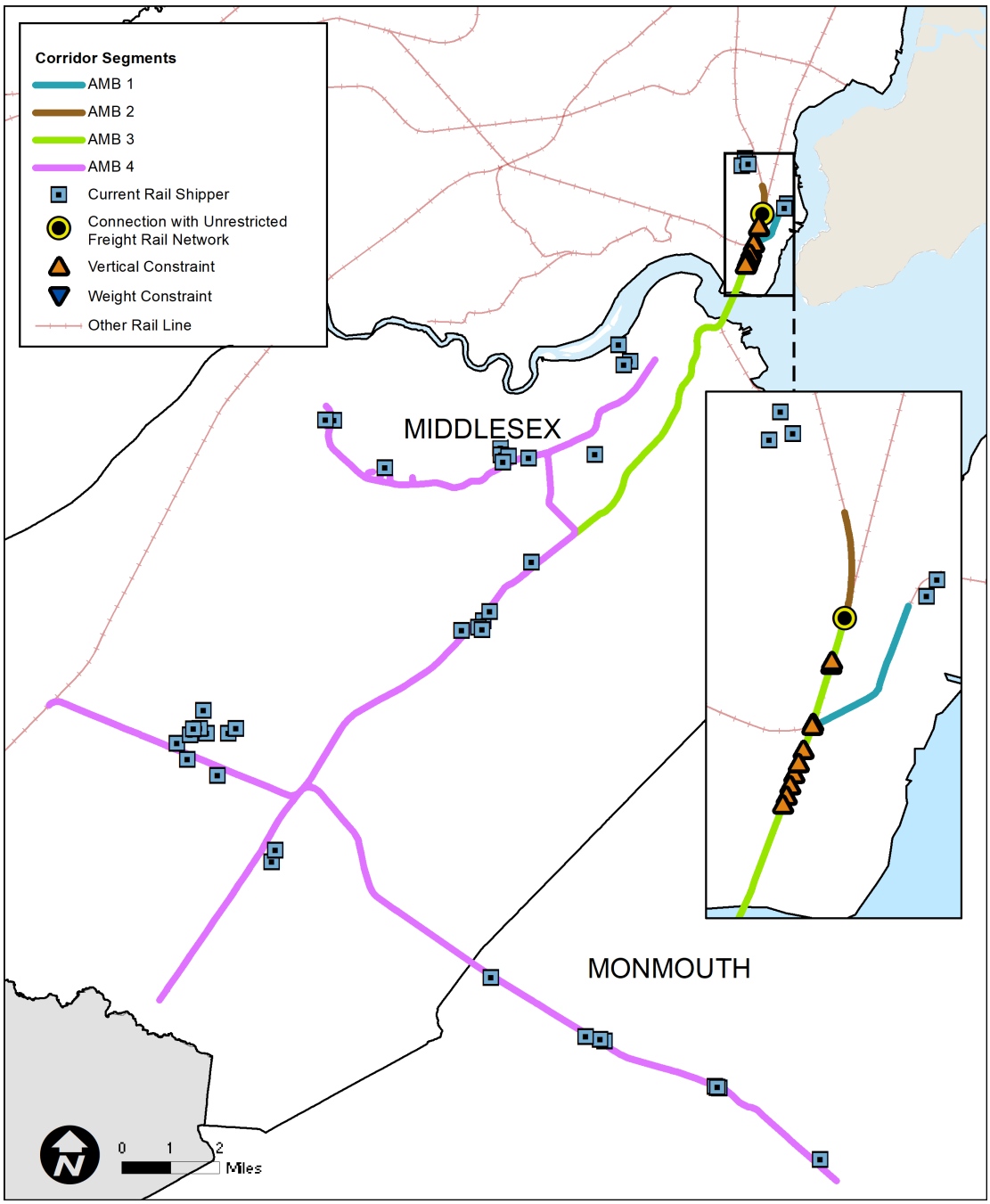


Figure 6-6. Amboy Corridor

6.4.1 Description

The Amboy Corridor is made up of 55 miles of railroad lines in northern New Jersey. The corridor includes three rail lines owned and operated by Conrail:

- Conrail's Perth Amboy Industrial Track between Perth Amboy and Woodbridge Township, 3.2 miles

- Conrail's Amboy Secondary between South Amboy and Monmouth Junction, 19.0 miles
- Conrail's Freehold Industrial Track between Jamesburg and Freehold, 14.3 miles

The Amboy Corridor also includes one NJT commuter line that hosts Conrail local freight service and contains the corridor's connection to the unrestricted national freight rail network:

- NJT's North Jersey Coast Line between Perth Amboy and South Amboy, 3.6 miles

The Amboy Corridor also includes several connecting freight-only tracks in Sayreville and Cranbury that depend on the Amboy Secondary for access to the national freight rail network. The Amboy Corridor is located in Middlesex County and Monmouth County. Through Perth Amboy, the corridor has a high-density passenger rail operation with approximately 85 NJT trains per day. This section of NJ TRANSIT is electrified with overhead catenary that provides power to the passenger trains.

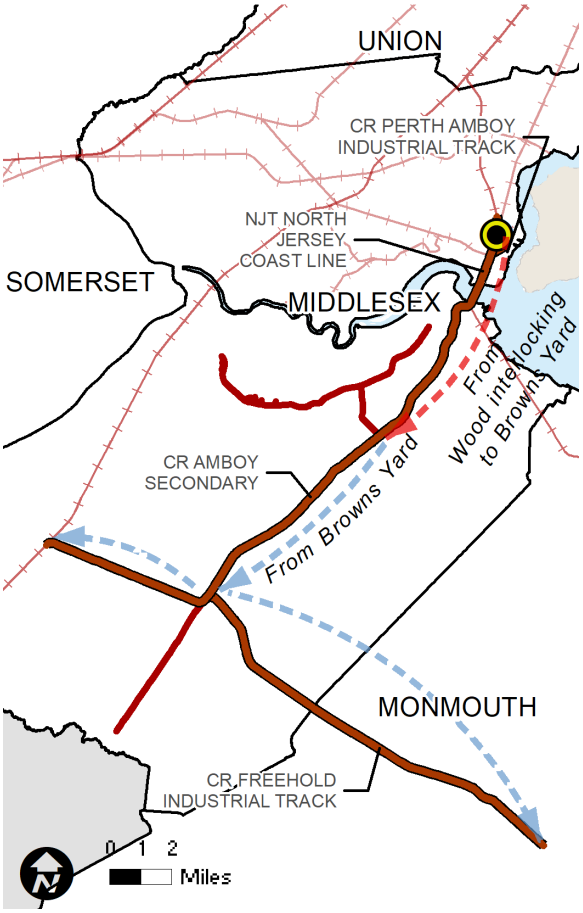


Figure 6-7. Freight Operations on Amboy Corridor

The Amboy Corridor's connection to the unrestricted rail network is located at the Wood interlocking in Perth Amboy on NJT's North Jersey Coast Line. From that location, local freight trains operate directly east and west to serve rail freight customers in Perth Amboy along the North Jersey Coast Line and the Perth Amboy Industrial Track. Other freight trains operate west from the Wood interlocking nonstop along the North Jersey Coast Line across the Raritan River to South Amboy, then use the Conrail Amboy Secondary to reach Browns Yard at Old Bridge. This is the base of operations for the local freight trains that will then make the final delivery of freight cars to rail customers along the Amboy Secondary, Freehold Industrial Track, and connecting freight tracks.

Figure 6-8. Conrail Freight Train on Amboy Corridor near Perth Amboy

6.4.2 Restriction Locations

There are 10 restriction locations on the Amboy Corridor. They are all vertical constraints. The estimated costs to alleviate these restrictions range from $9.6 million to $64.9 million.

Table 6-9. Restriction Locations on Amboy Corridor

Segment	Restrictions	Range of Estimated Improvement Cost ($2019 millions)	Cumulative Segment Cost Estimates ($2019 millions)
AMB 1	0	0-0	0-0
AMB 2	0	0-0	0-0
AMB 3 [19]	10	9.6-64.9	9.6-64.9
AMB 4	0	0-0	9.6-64.9
Total	**10**	**9.6-64.9**	

See Appendix C Restriction Locations and Engineering Cost Estimates for detailed descriptions of the restriction locations, the recommended strategies of alleviating them and individual conceptual level cost-estimates to execute them.

6.4.3 Industrial Opportunities

Common commodities transported on the Amboy Corridor include brick, chemicals, fertilizer, food products and ingredients, lumber, metals, paper, plastics, scrap metal, and steel. The Amboy Corridor has 44 identified rail freight customers that occupy approximately 803 acres of land. It is estimated that properties along this corridor with the potential for development or redevelopment after rail improvements were made, total approximately 4,046 acres of land.

The following table shows the developable surface available for potential industrial development and in use by existing active rail shippers.

[19] The segment of trackage identified as AMB 3, located between Wood interlocking in Perth Amboy and Browns Yard in Old Bridge, is shared by two FRIO corridors: the Amboy Corridor and the Coast Line Corridor. Improvements made to provide modern freight rail access for one corridor will also benefit the other corridor in that segment of shared trackage and, if made, can be deducted from the other corridor's improvement needs.

Table 6-10. Developed and Developable Surface Area for Rail Freight Customers on Amboy Corridor

Segment	Rail Freight Customers (sqft)											Industrial Opportunity (sqft)	Total (sqft)	Total (acres)
	Brick	Chemicals	Fertilizer	Food	Lumber	Metals	Paper	Plastics	Steel, Scrap Metal	Waste	Unknown Commodity			
AMB 1		783,000								1,999,000		3,332,000	4,115,000	94
AMB 2		1,848,000										11,488,000	13,336,000	306
AMB 3 [20]												12,127,000	12,127,000	278
AMB 4	2,075,000	2,311,000	470,000	2,664,000	172,000	1,071,000	6,704,000	5,907,000	2,358,000		6,630,000	149,295,000	181,655,000	4,170
Total	**2,075,000**	**4,943,000**	**470,000**	**2,664,000**	**172,000**	**1,071,000**	**6,704,000**	**5,907,000**	**2,358,000**	**1,999,000**	**6,630,000**	**179,522,000**	**211,234,000**	**4,849**

See the industrial opportunity geodatabase for the most up-to-date surface area data at individual parcel level.

6.4.4 Economic Impact

The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the Amboy Corridor is estimated to be approximately 50,000 potential jobs and nearly $3.9 billion in annual federal, state and local tax revenues.

[20] See previous footnote

Table 6-11. Potential Economic Impact on Amboy Corridor

Segment	Estimated On-Site Jobs	Estimated Annual Tax Revenue ($2019 millions)
AMB 1	995	108.0
AMB 2	3,235	321.1
AMB 3 [21]	2,960	221.8
AMB 4	42,810	3,199.9
Total	**50,000**	**3,850.8**

6.4.5 Cost-Benefit Analysis

Table 6-12. Costs and Opportunities per Amboy Corridor Segment

Segment	Range of Estimated Improvement Costs ($2019 millions)	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
AMB 1	0-0	94	995	108.0
AMB 2	0-0	306	3,235	321.1
AMB 3 [22]	9.6-64.9	278	2,960	221.8
AMB 4	0-0	4,170	42,810	3,199.9
Total	**9.6-64.9**	**4,849**	**50,000**	**3,850.8**

[21] See previous footnote

[22] See previous footnote

6.5 Coast Line Corridor

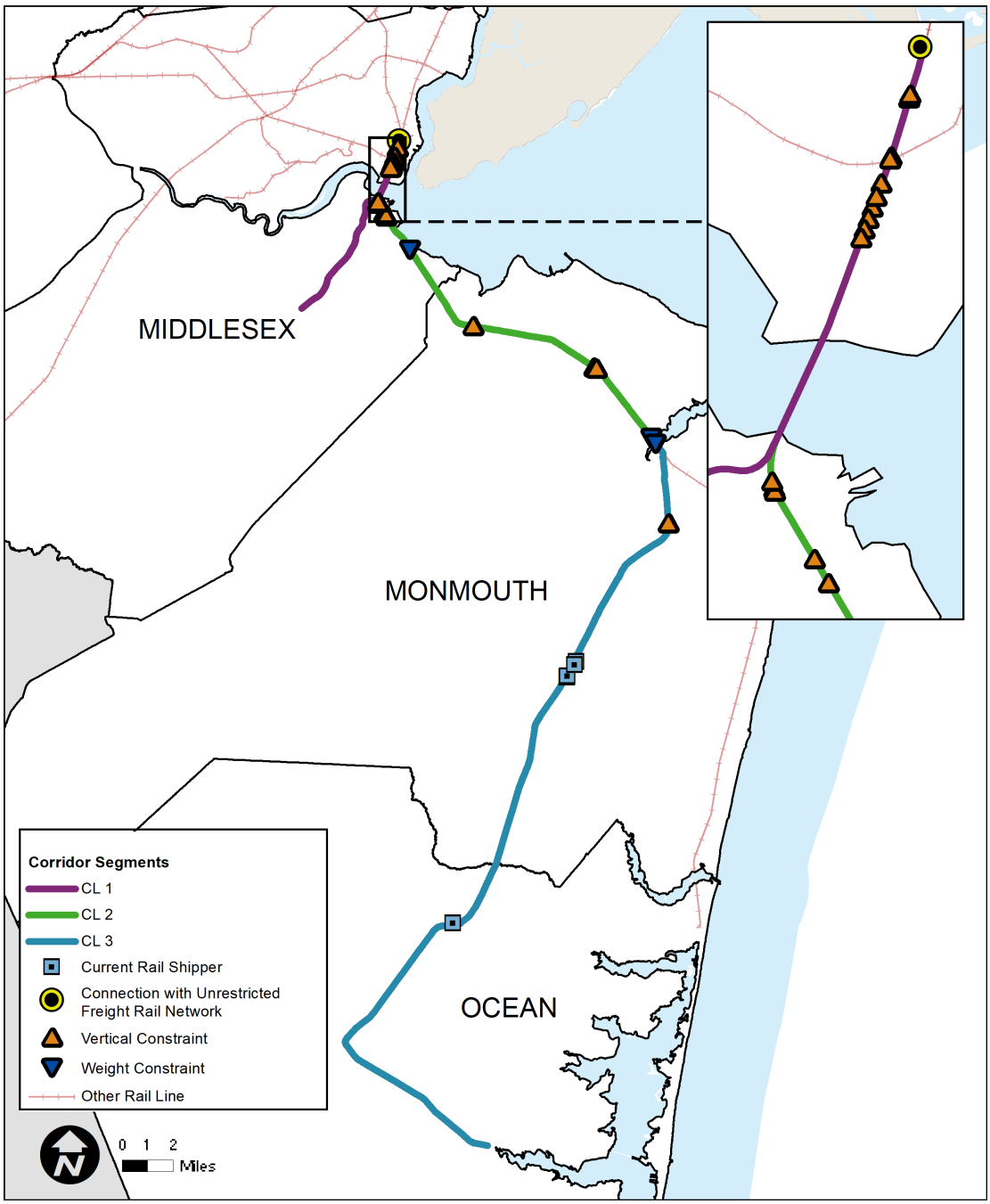


Figure 6-9. Coast Line Corridor

6.5.1 Description

The Coast Line Corridor is made up of 59 miles of railroad lines in Northern and Central New Jersey. The corridor includes segments of NJT commuter lines that host local freight service and contain the corridor's connection to the unrestricted national freight rail network:

- NJT's North Jersey Coast Line between Perth Amboy and South Amboy, 2.3 miles
- NJT's freight-only Church Running Track in South Amboy, 0.5 miles
- NJT's North Jersey Coast Line between South Amboy and Red Bank, 14.6 miles

The Coast Line Corridor also includes two rail lines owned and operated by Conrail:

- Conrail's Amboy Secondary between South Amboy and Old Bridge, 6.9 miles
- Conrail's Southern Secondary between Red Bank and Lakehurst, 27.6 miles

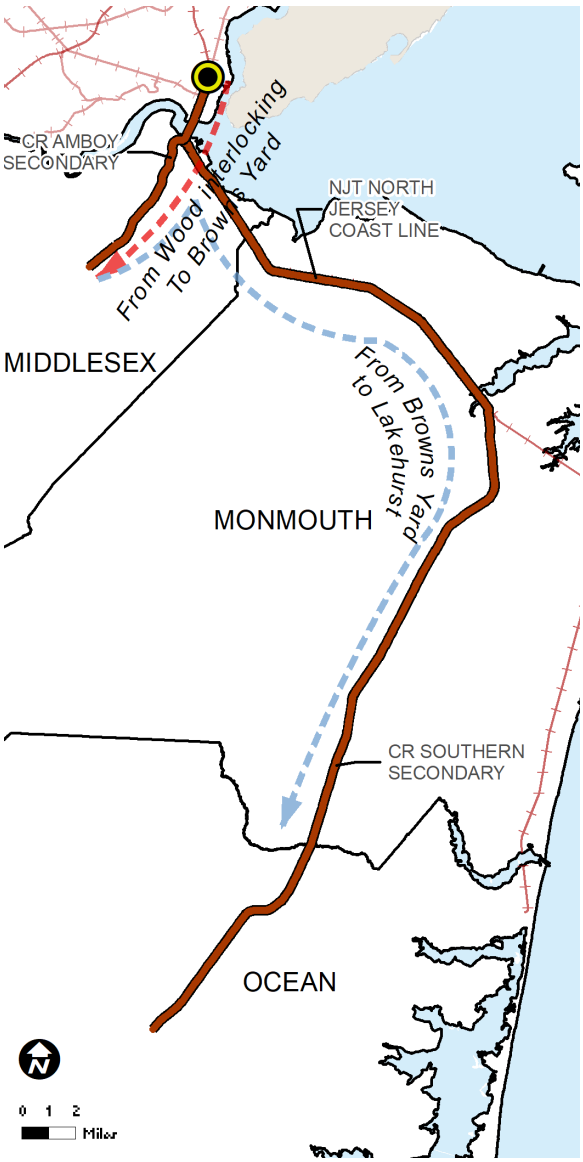


Figure 6-10. Freight Operations on Coast Line Corridor

Several connecting freight-only tracks in Lakehurst that are currently inactive also depend on the Coast Line Corridor for access to the national freight rail network. The Coast Line Corridor is located in Middlesex Count, Monmouth County, and Ocean County. Through Perth Amboy, the corridor has a high-density passenger rail operation with approximately 85 NJT trains per day. This section of NJT is electrified with overhead catenary that provides power to the passenger trains.

The Coast Line Corridor's connection to the unrestricted rail network is located at the Wood interlocking in Perth Amboy on NJT's North Jersey Coast Line. From that location, freight trains operate west nonstop along the North Jersey Coast Line across the Raritan River to South Amboy, then use the Conrail Amboy Secondary to reach Browns Yard at Old Bridge. This is the base of operations for the local freight trains that will then make the final delivery of freight cars to rail customers along the Coast Line Corridor between South Amboy, Red Bank, and Lakehurst.

Figure 6-11. Conrail Freight Train on Coast Line Corridor

6.5.2 Restriction Locations

There are 22 restriction locations on the Coast Line Corridor. They are both vertical constraints and weight constraints. The estimated costs to improve these restrictions range from $16.4 million to $139.3 million.

Table 6-13. Restriction Locations on Coast Line Corridor

Segment	Restrictions	Range of Estimated Improvement Cost ($2019 millions)	Cumulative Segment Cost Estimates ($2019 millions)
CL 1 [23]	10	9.6-64.9	9.6-64.9
CL 2	9	5.9-20.7	15.5-85.5
CL 3	3	1-53.8	16.4-139.3
Total	**22**	**16.4-139.3**	

[23] The segment of trackage identified as CL 1, located between Wood interlocking in Perth Amboy and Browns Yard in Old Bridge, is shared by two FRIO corridors: the Amboy Corridor and the Coast Line Corridor. Improvements made to provide modern freight rail access for one corridor will also benefit the other corridor in that segment of shared trackage and, if made, can be deducted from the other corridor's improvement needs.

See Appendix C Restriction Locations and Engineering Cost Estimates for detailed descriptions of the restriction locations, the recommended strategies of alleviating them and individual conceptual level cost-estimates to execute them.

6.5.3 Industrial Opportunities

Common commodities transported on the Coast Line Corridor include brick, chemicals, and lumber. The Coast Line Corridor has four identified rail freight customers at three identified rail-served locations that occupy approximately 81 acres of land. It is estimated that properties along this corridor with the potential for development or redevelopment after rail improvements were made, total approximately 8,281 acres of land.

The following table shows the developable surface available for potential industrial development and in use by existing active rail shippers.

Table 6-14. Developed and Developable Surface Area for Rail Freight Customers on Coast Line Corridor

Segment	Rail Freight Customers (sqft)				Industrial Opportunity (sqft)	Total (sqft)	Total (acres)
	Brick	Chemicals	Lumber	Steel, Scrap Metal			
CL 1 [24]					12,127,000	12,127,000	278
CL 2					12,160,000	12,160,000	279
CL 3	196,000	1,378,000	1,622,000	336,000	336,441,000	339,974,000	7,805
Total	**196,000**	**1,378,000**	**1,622,000**	**336,000**	**360,729,000**	**363,763,000**	**8,362**

See the industrial opportunity geodatabase for the most up-to-date surface area data at individual parcel level.

6.5.4 Economic Impact

The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the Coast Line Corridor is estimated to be more than 89,000 potential workers and over $6.7 billion in annual federal, state and local tax revenues.

[24] See previous footnote

Table 6-15. Potential Economic Impact on Coast Line Corridor

Segment	Estimated On-Site Jobs	Estimated Annual Tax Revenue ($2019 millions)
CL 1 [25]	2,960	221.8
CL 2	2,970	222.4
CL 3	83,170	6,266.9
Total	**89,100**	**6,711.2**

6.5.5 Cost-Benefit Analysis

Table 6-16. Costs and Opportunities per Coast Line Corridor Segment

Segment	Range of Estimated Improvement Costs ($2019 millions)	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
CL 1 [26]	9.6-64.9	278	2,960	221.8
CL 2	5.9-20.7	279	2,970	222.4
CL 3	1-53.8	7,805	83,170	6,266.9
Total	**16.4-139.3**	**8,362**	**89,100**	**6,711.2**

[25] See previous footnote

[26] See previous footnote

6.6 Morris/Warren Corridor

The analysis of this corridor incorporates work performed as part of the FRIO Corridors Program, as well as work previously performed by the NJTPA for the “Morris/Warren County Rail Corridor Study”.

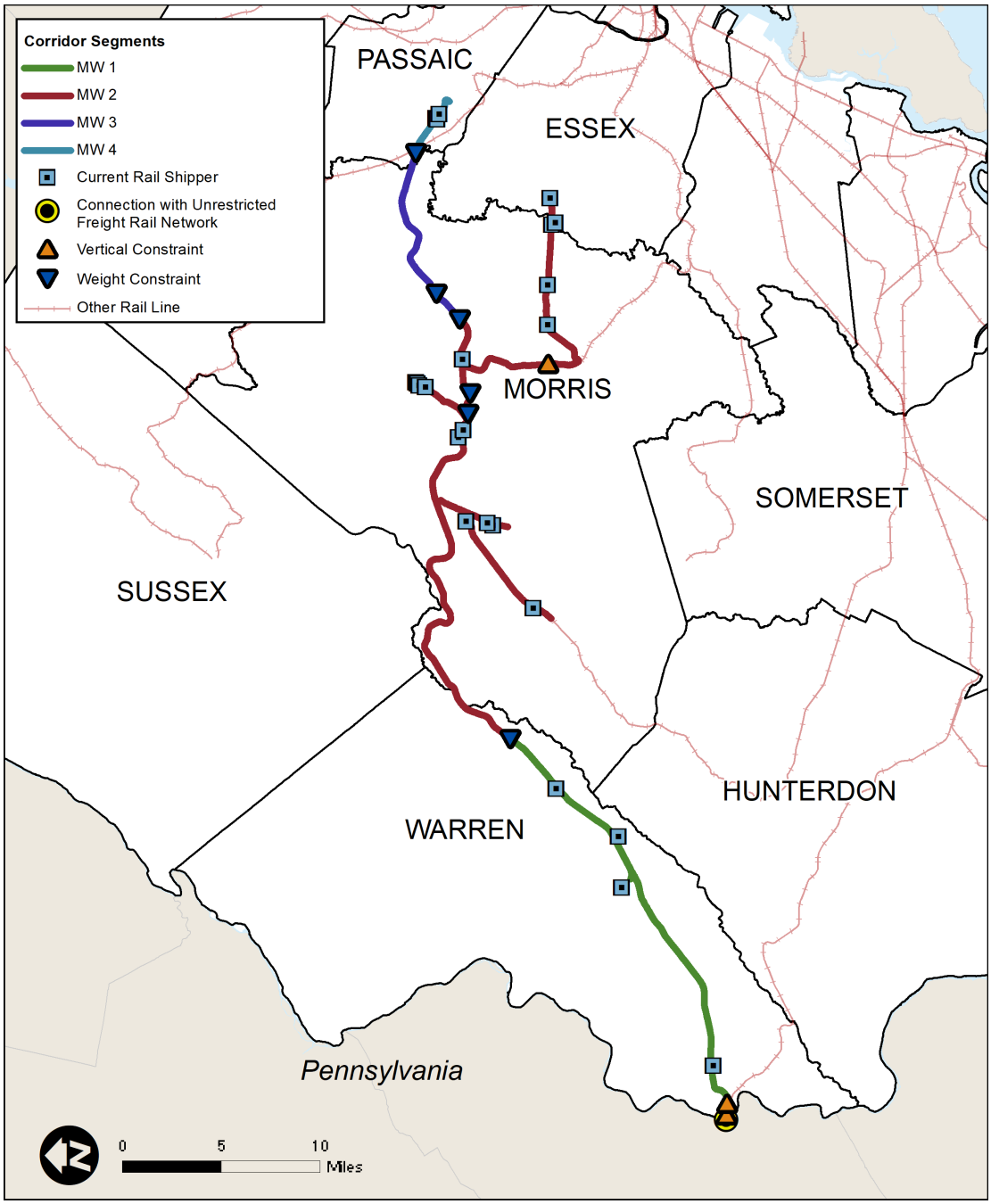
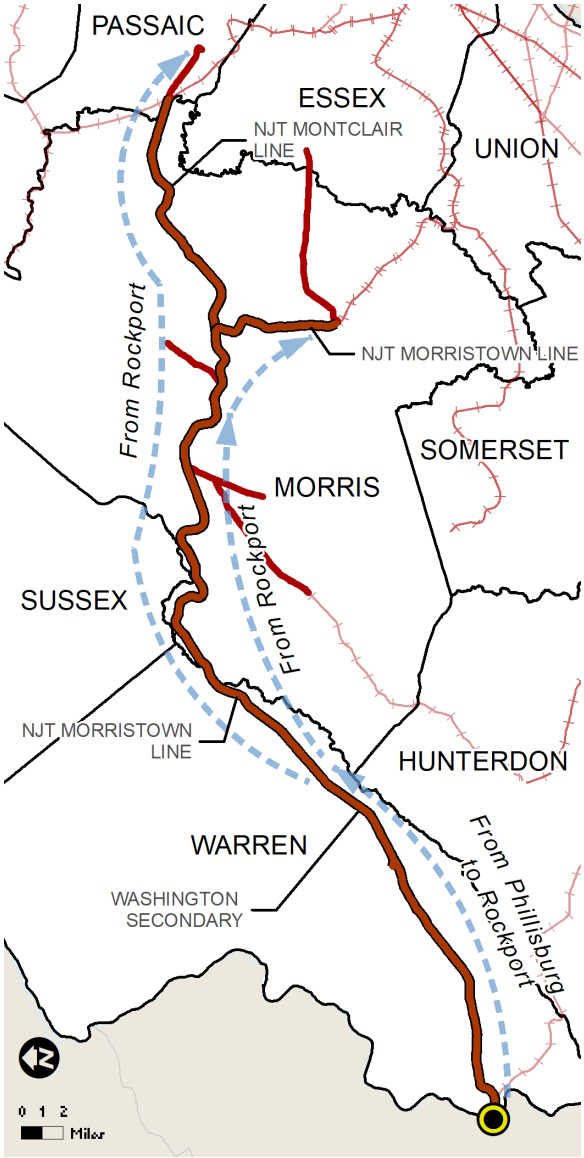


Figure 6-12. Morris/Warren Corridor

6.6.1 Description

The Morris/Warren Corridor is made up of 95 miles of railroad lines in Northern New Jersey. The corridor includes NJT commuter rail lines and local freight rail lines operated by shortline railroads that together span the state from the Delaware River to the Pompton and Passaic rivers through Warren, Morris, Passaic, and Essex counties. The primary rail lines that form the Morris/Warren Corridor are:

- NJT's Morristown Line from Hackettstown to Morristown, 30.5 miles
- NJT's Montclair Line from Denville to Wayne, 12.8 miles
- Dover & Delaware River Railroad's Washington Secondary from Phillipsburg to Hackettstown, 22.3 miles



The Morris/Warren corridor also contains several connecting freight-only tracks that depend on the NJ TRANSIT lines for access to the national freight rail network. These include three branch lines owned by Morris County and operated by the shortline railroad Dover & Rockaway River Railroad (an affiliate of the Dover & Delaware River Railroad), trackage in Morris and Essex counties owned and operated by the shortline railroad Morristown & Erie Railway, and the Dover & Delaware River Railroad's Totowa Spur in Passaic County. The corridor has two high-density passenger rail lines that join at Denville, which sees more than 85 NJ TRANSIT trains per day.

Figure 6-13. Freight Operations on Morris/Warren Corridor

The Morris/Warren Corridor's connection to the unrestricted rail network (where physical barriers no longer exist) is located in Phillipsburg. From that location, freight trains operate east along the corridor, switching customers as needed, until reaching a railroad yard at Rockport. This is the base of operations for the local freight trains run by the Dover & Delaware River Railroad that will make the final delivery of freight cars to rail customers along the Morris/Warren Corridor, and also exchange freight cars with two connecting shortline railroads in the area, the Dover & Rockaway River and the Morristown & Erie.

Figure 6-14. Morristown & Erie Freight Train on Morris/Warren Corridor

6.6.2 Restriction Locations

There are eight restriction locations on the Morris/Warren Corridor. They are both vertical constraints and weight constraints. The estimated costs to improve these restrictions ranges from $14.6 million to $27.4 million.

Table 6-17. Restriction Locations on Morris/Warren Corridor

Segment	Restrictions	Range of Estimated Improvement Cost ($2019 millions)	Cumulative Segment Cost Estimates ($2019 millions)
MW 1 [27]	1	1.0-3.0	1.0-3.0
MW 2	4	12.5-19.5	13.5-22.5
MW 3	3	1.1-4.9	14.6-27.4
MW 4	0	0-0	14.6-27.4
Total	**8**	**14.6-27.4**	

See Appendix C Restriction Locations and Engineering Cost Estimates for detailed descriptions of the restriction locations, the recommended strategies of alleviating them and individual conceptual level cost-estimates to execute them.

6.6.3 Industrial Opportunities

Common commodities transported on the Morris/Warren Corridor include plastics, chemicals, lumber, and food ingredients. The NS, NJT, and Morristown & Erie segments of the Morris/Warren Corridor have 23 identified rail freight customers that occupy approximately 264 acres of land. It is estimated that properties along this corridor with the potential for development or redevelopment after rail improvements were made, total approximately 2,653 acres of land.

The following table shows the developable surface available for potential industrial development and in use by existing active rail shippers.

[27] The vertical constraint restriction in segment MW 1 is planned to be cleared by Dover & Delaware River Railroad in 2019.

Table 6-18. Developed and Developable Surface Area for Rail Freight Customers on Morris/Warren Corridor

Segment	Rail Freight Customers (sqft)							Industrial Opportunity (sqft)	Total (sqft)	Total (acres)
	Chemicals	Food	Lumber	Paper	Plastics	Steel, Scrap metal	Unknown Commodity			
MW 1					2,186,000		2,315,000	30,066,000	33,711,000	794
MW 2	275,000	377,000	1,375,000	499,000	1,273,000	29,000	2,826,000	73,835,000	80,490,000	1,848
MW 3								6,700,000	6,700,000	154
MW 4		162,000					184,000	4,958,000	5,304,000	122
Total	**275,000**	**539,000**	**1,375,000**	**499,000**	**3,459,000**	**29,000**	**5,326,000**	**115,560,000**	**127,061,000**	**2,917**

See the industrial opportunity geodatabase for the most up-to-date surface area data at individual parcel level.

6.6.4 Economic Impact

The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the Morris/Warren Corridor is estimated to be more than 31,000 potential jobs and over $2.2 billion in annual federal, state and local tax revenues.

Table 6-19. Potential Economic Impact on Morris/Warren Corridor

Segment	Estimated On-Site Jobs	Estimated Annual Tax Revenue ($2019 millions)
MW 1	9,015	655.7
MW 2	19,405	1,427.5
MW 3	1,635	122.6
MW 4	1,285	93.1
Total	**31,340**	**2,298.8**

6.6.5 Cost-Benefit Analysis

Table 6-20. Costs and Opportunities per Morris/Warren Corridor Segment

Segment	Range of Estimated Improvement Costs ($2019 millions)	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
MW 1	1.0-3.0	794	9,015	655.7
MW 2	12.5-19.5	1,848	19,405	1,427.5
MW 3	1.1-4.9	154	1,635	122.6
MW 4	0-0	122	1,285	93.1
Total	**14.6-27.4**	**2,917**	**31,340**	**2,298.8**

6.7 Black River & Western Corridor

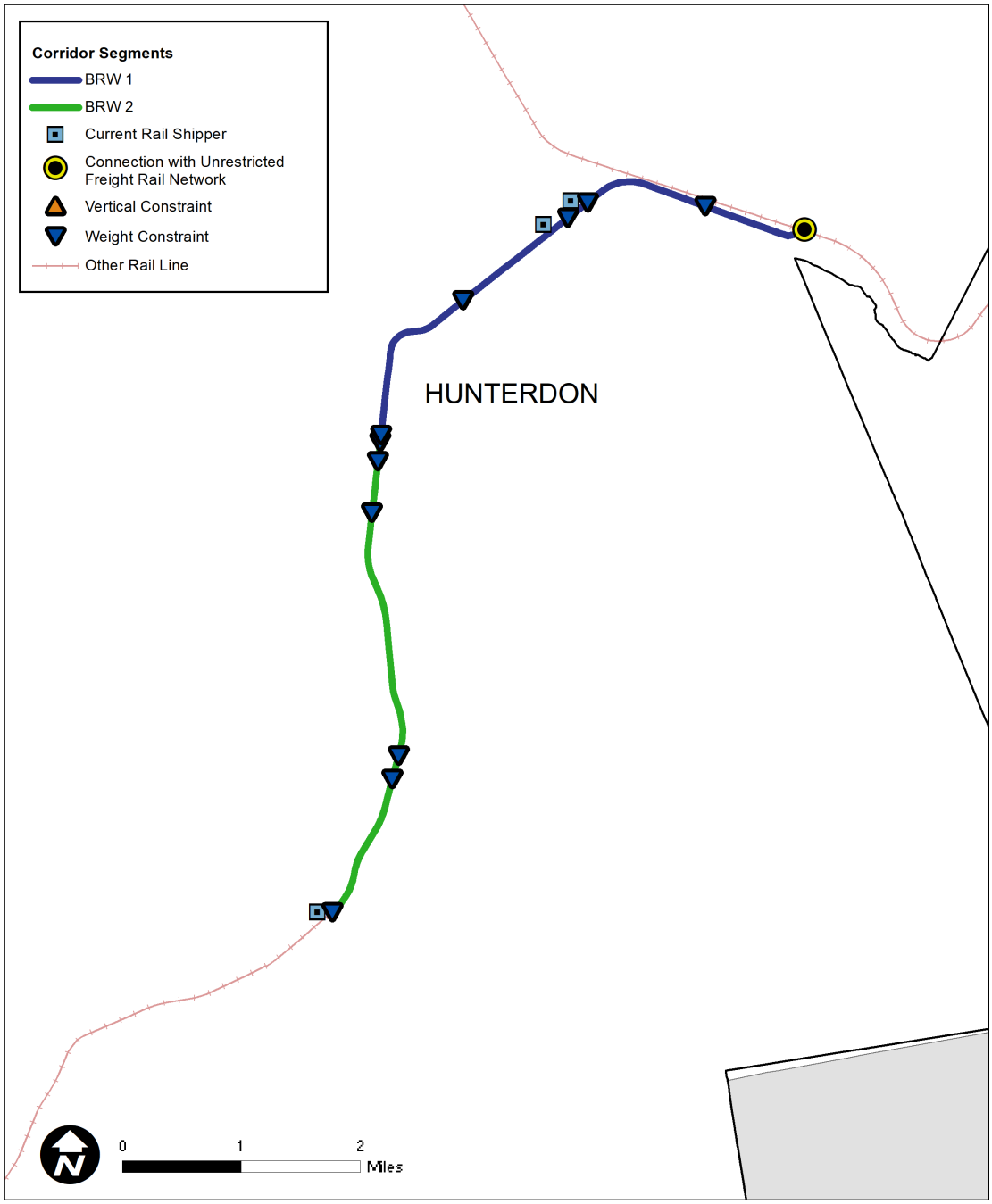


Figure 6-15. Black River & Western Corridor

6.7.1 Description

The Black River & Western (BR&W) Corridor consists of the main line of the BR&W RR, a nine-mile Class III shortline railroad operating in Hunterdon County between Ringoes and a Class I railroad interchange with NS at Three Bridges. The BR&W was formed in the 1960s to operate steam train

passenger excursions between Flemington and Ringoes, at a time when the tracks were still owned by larger Northeastern railroads. The excursion operator eventually purchased the tracks and began providing its own freight rail service on the corridor. To this day, the BR&W RR continues to operate both freight trains and passenger excursions. The BR&W Corridor was assembled from branch lines built more than a century ago by different Northeast railroads to serve customers in the Flemington area.

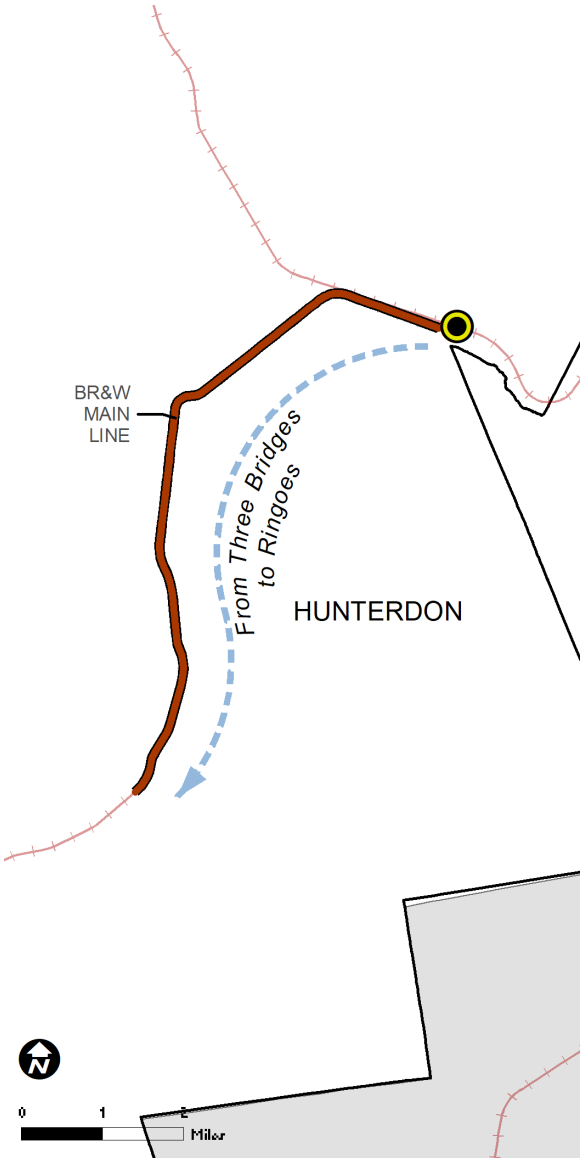


Figure 6-16. Freight Operations on Black River & Western Corridor

The BR&W Corridor's connection to the unrestricted rail network is located at Three Bridges, where the BR&W RR interchanges freight cars with its Class I railroad connection, NS. From Three Bridges, local freight trains operate south to serve freight rail customers along the line to Ringoes, the railroad's base of operations. Ringoes is also the site of a transload facility, where customers can transfer products between rail cars and trucks, in order to make last-mile deliveries to off-line locations.

6.7.2 Restriction Locations

There are 11 restriction locations on the BR&W Corridor. They are all weight constraints. The estimated costs to improve these restrictions range from $0.4 million to $67.3 million.

Table 6-21. Restriction Locations on Black River & Western Corridor

Segment	Restrictions	Range of Estimated Improvement Cost ($2019 millions)	Cumulative Segment Cost Estimates ($2019 millions)
BRW 1	4	0.2-54.4	0.2-54.4
BRW 2	7	0.2-12.9	0.4-67.3
Total	**11**	**0.4-67.3**	

See Appendix C Restriction Locations and Engineering Cost Estimates for detailed descriptions of the restriction locations, the recommended strategies of alleviating them and individual conceptual level cost-estimates to execute them.

Figure 6-17. Weight Restriction Raritan River/Red Rock Lake on BR&W Corridor

6.7.3 Industrial Opportunities

The BR&W Corridor has three identified rail freight customers that occupy approximately 50 acres of land. It is estimated that properties along this corridor with the potential for development or redevelopment after rail improvements were made, total approximately 192 acres of land.

The following table shows the developable surface available for potential industrial development and in use by existing active rail shippers.

Table 6-22. Developed and Developable Surface Area for Rail Freight Customers on Black River & Western Corridor

Segment	Rail Freight Customers (sqft)	Industrial Opportunity (sqft)	Total (sqft)	Total (acres)
	Unknown Commodity			
BRW 1	1,298,000	2,928,000	4,225,000	81
BRW 2	18,000	2,091,000	2,109,000	162
Total	**1,316,000**	**5,019,000**	**6,334,000**	**242**

See the industrial opportunity geodatabase for the most up-to-date surface area data at individual parcel level.

6.7.4 Economic Impact

The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the BR&W Corridor is estimated to be over 2,200 potential jobs and nearly $160 million in annual federal, state and local tax revenues.

Table 6-23. Potential Economic Impact on Black River & Western Corridor

Segment	Estimated On-Site Jobs	Estimated Annual Tax Revenue ($2019 millions)
BRW 1	1,385	95.8
BRW 2	855	63.8
Total	**2,240**	**159.6**

6.7.5 Cost-Benefit Analysis

Table 6-24. Costs and Opportunities per BR&W Corridor Segment

Segment	Range of Estimated Improvement Costs ($2019 millions)	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
BRW 1	0.2-54.4	81	1,385	95.8
BRW 2	0.2-12.9	162	855	63.8
Total	**0.4-67.3**	**242**	**2,240**	**159.6**

6.8 Northeast Corridor

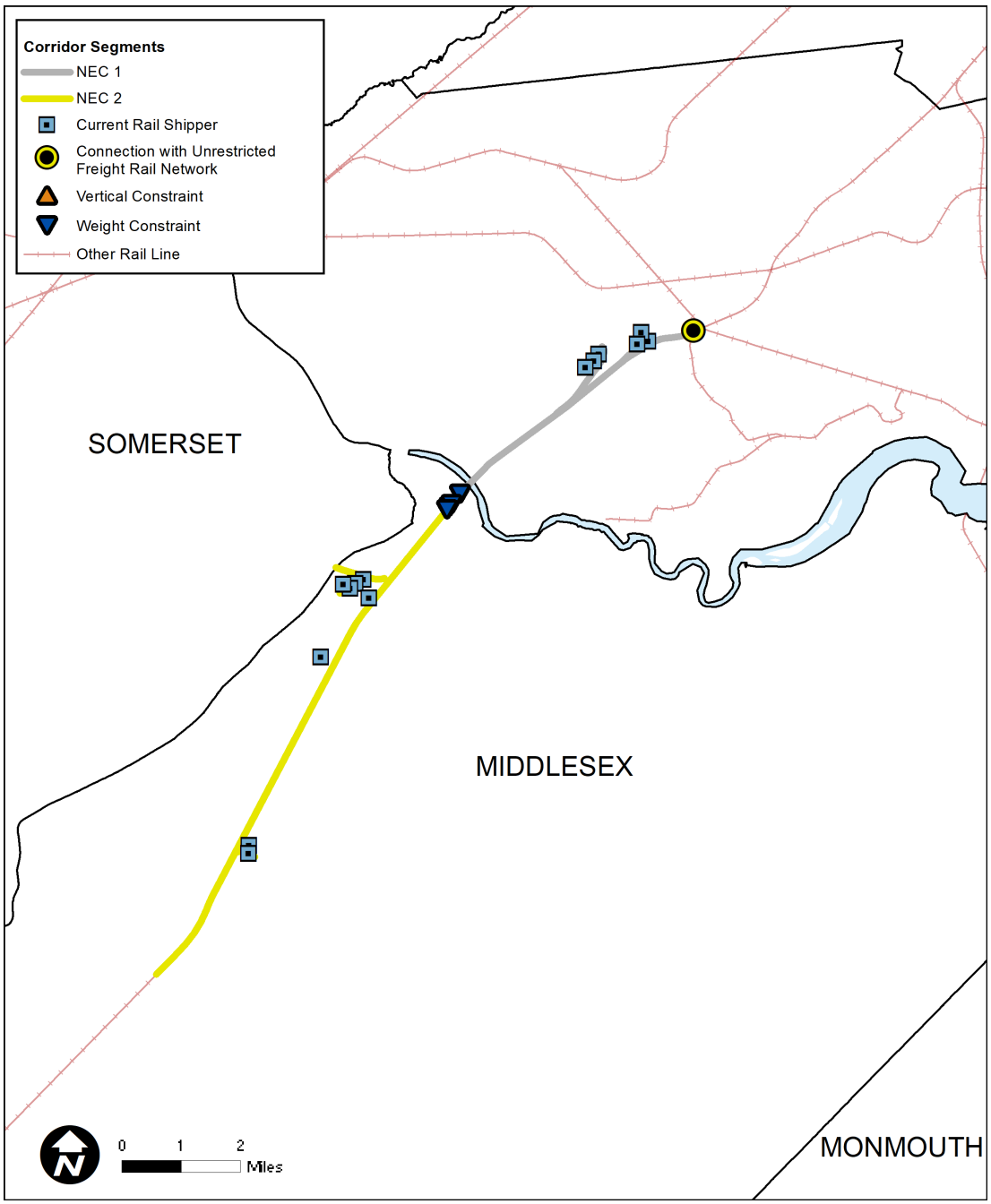


Figure 6-18. Northeast Corridor

6.8.1 Description

The Northeast Corridor consists of 15 miles of Amtrak's Northeast Corridor main line through Middlesex County, along with 4 miles of connecting freight-only industrial tracks that branch off the main line to serve nearby warehouses, manufacturing facilities, and other sites. The Northeast Corridor

is owned by Amtrak, which operates intercity passenger trains on the line at speeds of up to 135 miles per hour, and is used by NJT commuter trains. Local freight service on the Northeast Corridor is provided by Conrail, which owns the connecting freight-only branch lines. Conrail is North Jersey's primary local freight railroad, and is jointly owned by the two large Eastern U.S. freight rail companies, CSX and NS. More than 100 Amtrak trains and more than 100 NJT trains per day use this section of the Northeast Corridor, between Metuchen, New Brunswick, and South Brunswick. The line is electrified with overhead catenary that provides power to the passenger trains.

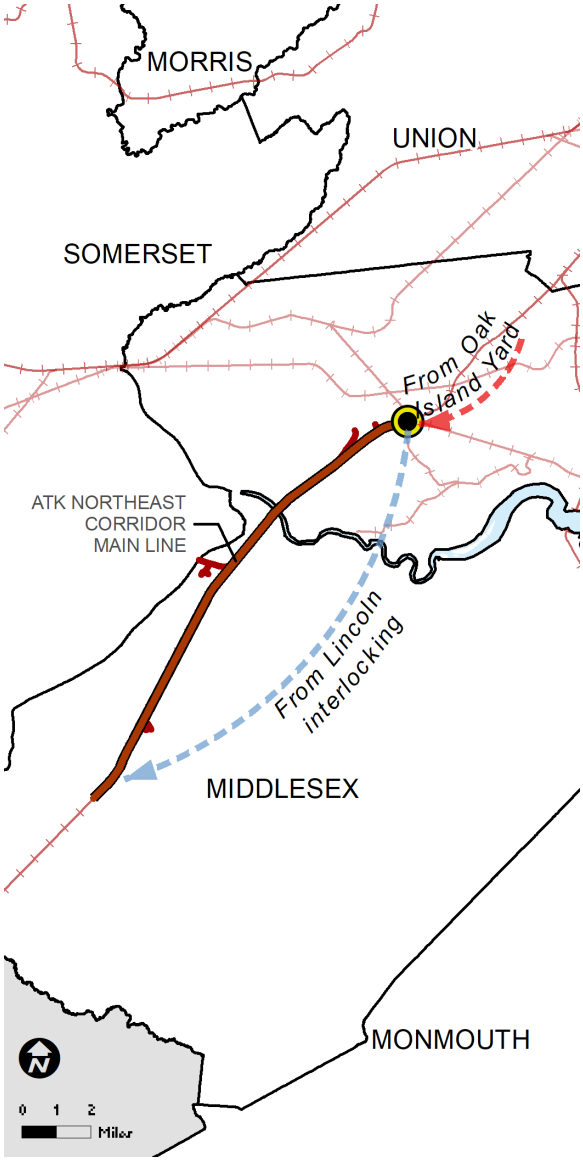


Figure 6-19. Freight Operations on Northeast Corridor

The Northeast Corridor's connection to the unrestricted rail network is located at the Lincoln interlocking in Metuchen on Amtrak's Northeast Corridor. Under an agreement signed in 2018, Amtrak has begun allowing 286,000-pound freight cars to operate on the Northeast Corridor north of Lincoln interlocking in Metuchen as far as Newark. Conrail local freight trains make daily trips on the Northeast Corridor to shuttle cars between the Oak Island Yard freight classification terminal in Newark and a local freight yard in Metuchen, off the Northeast Corridor and east of Lincoln interlocking. From the Metuchen yard, local freight trains will re-enter the Northeast Corridor at Lincoln interlocking and operate south to serve customers between Metuchen and South Brunswick.

6.8.2 Restriction Locations

The Northeast Corridor has four identified weight restrictions, among 35 undergrade structures

identified along the Amtrak-owned study area. Additional data and analysis is required to assess the full set of potential restriction locations.

Data provided by Amtrak indicates that only the center two tracks of the four-track Northeast Corridor passenger line are cleared for Plate “F” rail cars.

The estimated costs to alleviate these four restrictions range from $0.4 million to $162.3 million.

Table 6-25. Restriction Locations on Northeast Corridor

Segment	Restrictions	Range of Estimated Improvement Cost ($2019 millions)	Cumulative Segment Cost Estimates ($2019 millions)
NEC 1	0	0.0	0.0
NEC 2	4	0.4-162.3	0.4-162.3
Total	**4**	**0.4-162.3**	

See Appendix C Restriction Locations and Engineering Cost Estimates for detailed descriptions of the restriction locations, the recommended strategies of alleviating them and individual conceptual level cost-estimates to execute them.

Figure 6-20. Conrail Freight Train on Northeast Corridor

6.8.3 Industrial Opportunities

Common commodities transported on the Northeast Corridor include brick, food products, plastics, salt, and scrap metal. The Northeast Corridor has 14 identified rail freight customers that occupy approximately 228 acres of land. It is estimated that properties along this corridor with the potential for development or redevelopment after rail improvements were made, total approximately 1,524 acres of land.

The following table shows the developable surface available for potential industrial development and in use by existing active rail shippers.

Table 6-26. Developed and Developable Surface Area for Rail Freight Customers on Northeast Corridor

Segment	Rail Freight Customers (sqft)					Industrial Opportunity (sqft)	Total (sqft)	Total (acres)
	Brick	Food	Plastics	Steel, Scrap Metal	Unknown Commodity			
NEC 1		295,000	1,295,000	785,000	1,615,000	17,168,000	21,157,000	486
NEC 2	1,392,000		2,030,000	267,000	2,243,000	49,213,000	55,145,000	1,266
Total	**1,392,000**	**295,000**	**3,325,000**	**1,051,000**	**3,858,000**	**66,381,000**	**76,302,000**	**1,752**

See the industrial opportunity geodatabase for the most up-to-date surface area data at individual parcel level.

6.8.4 Economic Impact

The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the Northeast Corridor is estimated to be almost 18,400 potential jobs and more than $1.3 billion in annual federal, state and local tax revenues.

Table 6-27. Potential Economic Impact on Northeast Corridor

Segment	Estimated On-Site Jobs	Estimated Annual Tax Revenue ($2019 millions)
NEC 1	5,005	356.0
NEC 2	13,345	963.7
Total	**18,350**	**1,319.7**

6.8.5 Cost-Benefit Analysis

Table 6-28. Costs and Opportunities per Northeast Corridor Segment

Segment	Range of Estimated Improvement Costs ($2019 millions)-0.0	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
NEC 1	0.0	486	5,005	356.0
NEC 2	0.4-162.3	1266	13,345	963.7
Total	**0.4-162.3**	**1752**	**18,350**	**1,319.7**

7 Funding Options

Freight projects such as those identified by the FRIO effort are often unique and may not have a single path towards implementation including a dedicated source of funding. As part of the ongoing Pilot Freight Concept Development Program effort, the NJTPA completed research into potential funding options that could be used to advance freight projects toward and through implementation. The product of this research is a comprehensive database of federal and state funding sources and specific programs and is presented in Appendix D Funding Options. The following information is summarized for each of the funding options:

- Funding Source
- Funding Availability (by Fiscal Year)
- Match/Funding/Application Requirements
- Eligible Applicants
- Eligible Transportation Modes or Types of Projects
- Eligible Project Phases
- Additional Eligibility Requirements

8 Conclusions and Next Steps

Both existing freight rail customers and potential rail shippers could benefit from the ability to support their operations through the use of national standard rail freight cars. It is estimated that both the existing rail-served properties located along FRIO Corridors as well as parcels with the potential for development or redevelopment after rail improvements were made, total approximately 21,600 acres of land.

Based on the calculations of land occupied by both existing and potential rail customers, the NJTPA used a Multi-Regional Input-Output model to develop an economic impact assessment of the corridor, considering direct, indirect, and induced benefits that could accrue to municipalities, counties, and the State if the sites were fully developed. These economic measurements include employment effects, business output and revenue, personal income effects, and the effect of taxes, based on a mix of known industrial activities that occur in the corridor. The maximum potential economic value of new development attributable to alleviating the barriers to modern rail freight car access in the FRIO corridors is estimated to be over 224,000 jobs and more than $16.8 billion in annual federal, state and local tax revenues.

These potential benefits are balanced with the cost of addressing the impediments in each FRIO Corridor. Table 8-1 compares the estimated costs to alleviate the barriers to modern freight rail access in each corridor, and the resulting benefits in direct employment and annual tax revenues (federal, state, and local) that are estimated to accrue. In each corridor, the estimated economic benefits greatly exceed the costs, even at the high range of infrastructure solutions.

Table 8-1. Estimated Costs and Benefits per Corridor

Corridor	Length (miles)	Range of Estimated Improvement Costs ($2019 millions)	Total Industrial Opportunity (acres)	Economic Benefits (direct employment)	Economic Benefits (total tax revenues in $2019 millions)
HX	61.5	10-454.6	1,665	18,145	1,319.9
Raritan Valley	20.8	1.3-23.5	2,084	17,855	1,439.6
Amboy*	54.6	9.6-64.9	4,849	50,000	3,850.8
Coast Line*	58.7	16.4-139.3	8,362	89,100	6,711.2
Coast Line w/o shared section with Amboy*	50.8	6.8-74.4	8,084	86,140	6,489.4
Morris/Warren	95.0	14.6-27.4	2,917	31,340	2,298.8
Black River & Western	9.0	0.4-67.3	242	2,240	159.6
Northeast	18.7	0.4-162.3	1,752	18,350	1,319.7

* Amboy and Coast Line Corridors share a segment. Improvements made to provide modern freight rail access for one corridor will also benefit the other corridor in that segment of shared trackage.

Addressing the restrictions to this standard is critical to the region's economy as potential new businesses often make their location decisions based on having national standard rail access. In addition, existing businesses dependent on freight rail transportation for their operations may be forced to relocate in order to be able to receive cost-competitive modern rail freight access. Further, a looming shortage of non-standard rail freight equipment, often the older cars in a fleet and candidates for retirement, will soon make Plate "F" access an absolute necessity for rail customers.

The NJTPA recognizes the importance of this issue. As such, all of the restriction locations identified in this study will become candidate projects for the NJTPA Freight Concept Development Program. This program involves carrying out a wide array of tasks that culminate in a preliminary preferred alternative for a project to advance toward implementation. Tasks would include, but are not limited to: data collection, community outreach, development of the purpose and need statement, development of alternatives, selection of preliminary preferred alternative and NEPA (National Environmental Policy Act) classification. The restriction locations identified by the FRIO study will be evaluated and prioritized following the NJTPA's project intake process criteria, and those that are selected will then go through the concept development phase and advance toward implementation. The NJTPA also will work with railroads, county and municipal agencies, and existing and potential freight rail customers to identify funding sources for the

capital improvements that will eliminate physical restrictions and strengthen New Jersey's economic competitiveness through modern rail freight access.