Chapter II

Purpose and Need

U.S. Department of Transportation
Federal Railroad Administration

Maryland Department
of Transportation

II. PURPOSE AND NEED

A. Project Background

The existing B&P Tunnel is a crucial link in the greater NEC Main Line, which runs through eight states and Washington, DC. The NEC is the nation's most congested rail corridor and one of the highest volume corridors in the world (Amtrak, 2010a). The NEC came under the control of one owner, Penn Central, in 1969 and under Amtrak in 1971. Currently, the fully electrified NEC provides rail connections from Washington, DC to Boston, Massachusetts, and points between, including Baltimore, Philadelphia, and New York. The NEC moves over 259 million passengers and 14 million car miles of freight cargo each year (Amtrak, 2010a). The NEC is a shared resource used by Amtrak, ten commuter rail operators, and seven freight railroads (NEC Master Plan Working Group, 2010).

As shown in **Figure II-1**, the existing B&P Tunnel is located beneath several West Baltimore neighborhoods, including Bolton Hill, Madison Park, Sandtown-Winchester, and Upton. The tunnel is currently used by MARC, Amtrak, and NS. Built in 1873, the tunnel is one of the oldest structures on the NEC. It is approximately 7,500 feet (1.4 miles) long and is comprised of three shorter tunnels: the John Street Tunnel, the Wilson Street Tunnel, and the Gilmor Street Tunnel. The double-track tunnel was originally constructed out of brick and stone masonry, though repairs have added additional building materials over time. The line was electrified in the 1930s, and the tunnel was rehabilitated in the 1980s. Continual repairs are required to maintain the aging structures.

B. Prior Studies - Baltimore's Railroad Network

Following a July 18, 2001 fire from a CSX train derailment that occurred in the nearby Howard Street Tunnel, Congress mandated that FRA provide a comprehensive assessment of the region's rail system. In response to the Congressional mandate, FRA completed two studies, *Baltimore's Railroad Network: Challenges and Alternatives* (FRA, 2005) and *Baltimore's Railway Network: Analysis and Recommendations* (FRA and MDOT, 2011). The 2005 report characterized the state of the rail network and the demands placed on it. The study evaluated the existing B&P Tunnel, as well as other components of Baltimore's rail network, and underscored the importance of the B&P Tunnel to the NEC. The study also recommended potential actions that could improve passenger and freight railway capabilities in the Baltimore region, including replacement of the existing B&P Tunnel. The 2011 report supplemented the findings of the 2005 report and evaluated passenger and freight alternative routes through Baltimore. The 2011 report states that "the physical condition of the [existing B&P Tunnel] requires that it be rebuilt or replaced within the next 10-20 years." In addition, "the conditions in the [existing] B&P Tunnel—as well as its criticality to the protection of a reliable passenger service—preclude its expanded use for most freight and constrain the flow of commerce to and through the Baltimore region" (FRA and MDOT, 2011).

C. National High-Speed Rail Program Investments

The Passenger Rail Investment and Improvement Act of 2008 (PRIIA) and the American Recovery and Reinvestment Act of 2009 (ARRA) established guidelines for the development of intercity and high-speed rail corridors. These two Acts called for a collaborative effort by the federal government, states, railroads, and other key stakeholders to help transform America's transportation system through the creation of a national network of high-speed rail corridors. To achieve this vision, FRA published the *High-Speed Rail Strategic Plan* in April 2009 (USDOT, 2009) and launched the *High Speed Intercity Passenger Rail (HSIPR) Program* in June 2009.


Liberty Square
Burleith Leighton
Hanlon Longwood
Druid Hill Park
Remington
Better Waverly
Charles Village
CSX
Gwynns Falls Pw
Mondawmin
Penn North
McCulloh St
Reservoir Hill
Barclay
East Baltimore Midway
Walbrook
W North Ave
Coppin Heights/Ash-Co-East
Druid Hill Ave
Existing B & P Tunnel
John St Tunnel
Charles North
Penn Station
Amtrak Northeast Corridor
McMechen St
Wilson St Tunnel
N Monroe St
N Fulton Ave
Eutaw Pl
Bolton Hill
Rosemont
CSX
Sandtown-Winchester
Gilmor St Tunnel
Mid-Town Belvedere
St Paul St
Johnston Square
Howard St Tunnel
Winchester
Bridgeview/Greenlawn
Upton
W Lafayette Ave
Pennsylvania Ave
Fremont Ave
Martin Luther King Jr. Blvd
Mount Vernon
Mosher
Evergreen Lawn
Harlem Park
Seton Hill
Edmondson Ave
Curve 381
W Franklin St
W Mulberry St
West Baltimore MARC
Amtrak Northeast Corridor
Amtrak Gwynns Falls Bridge
Franklin Square
Poppleton
Downtown
University
Carroll-South Hilton
Legend
Existing B&P Tunnel
B & P Tunnel Openings
Light Rail Station
Metro Station
Metro Line
Light Rail Line
Railroad
Interstate
Parks
B&P Tunnel Project
Figure II-1: Existing B&P Tunnel Project Vicinity
0 0.125 0.25 0.5 Miles
NORTH
U.S. Department of Transportation
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The ARRA and the Fiscal Year 2010 Department of Transportation and Related Agencies Appropriations Act provided $10.1 billion to date to expand passenger rail access to new communities and provide Americans with faster and more energy-efficient travel options. This funding has helped transform travel in America through targeted investments in five key "megaregions" around the country (Seattle-Portland, San Francisco-Los Angeles, Charlotte-Raleigh-Washington, DC, Midwest hub, and Northeast Corridor) that together hold roughly 65 percent of the population and are expected to contain the bulk of future population growth. Baltimore, Boston, New York, Philadelphia, and Washington, DC make up the Northeast megaregion, which is the densest and most economically productive megaregion in the country. This megaregion depends on its ability to accommodate frequent business travel among the cities, thus requiring efficient, reliable, and convenient transportation connections (Amtrak, 2010b).

The HSIPR program is improving the safety, reliability, and accessibility of rail infrastructure for passengers around the country through renewal of corridor infrastructure and stations. The national program is expected to:

- serve as a catalyst for growth in regional economic productivity and expansion by stimulating domestic manufacturing, promoting local tourism, and driving commercial and residential development;
- increase mobility by creating new choices for travelers in addition to flying or driving;
- reduce national dependence on oil; and
- foster livable urban and rural communities.

Through the HSIPR program, FRA is investing $950 million to upgrade some of the most heavily used sections of the NEC. The investments will increase speeds from 135 to 160 mph on critical segments, improve on-time performance, and add more seats for passengers, enabling one of the nation's busiest corridors to continue to set ridership and revenue records., The preliminary engineering and NEPA analysis for the existing B&P Tunnel is one of the NEC projects funded through the HSIPR program. The B&P Tunnel Project is critical to existing and future NEC operations because the current tunnel is a bottleneck in the rail corridor, does not have detour options in or near Baltimore, and is approaching the end of its useful life.

The Baltimore Metropolitan Council and MDOT amended the Fiscal Year 2011 State Transportation Improvement Program (STIP) list to add federal funds to the 2011-2014 Baltimore Regional Transportation Board's (BRTB) TIP for the existing B&P Tunnel Improvement Project (TIP # 92-1101-99). This Project is funded by FRA through a HSIPR grant for preliminary engineering and NEPA analysis.

D. Purpose of the Project

The purpose of the Project is to address the structural and operational deficiencies of the existing B&P Tunnel and to accommodate future high-performance intercity passenger rail service goals for the NEC, including:

- To reduce travel time through the B&P Tunnel and along the NEC,
- To accommodate existing and projected travel demand for intercity and commuter passenger services,
- To eliminate impediments to existing and projected operations along the NEC, and
- To provide operational reliability, while accounting for the value of the existing tunnel as an important element of Baltimore's rail infrastructure.

E. Need for the Project

The need for the Project has been defined as follows:

- The existing B&P Tunnel is more than 140 years old and is approaching the end of its useful life with regard to its physical condition. While the tunnel currently remains safe for rail transportation, it requires substantial maintenance and repairs, and it does not meet current design standards. The tunnel

is considered to be structurally deficient due to its age, the original design, and wear and tear. The tunnel is also functionally obsolete and unable to meet current and future rail demands due to the combination of its vertical and horizontal track alignment, i.e., its grades and curves. The low-speed tunnel creates a bottleneck at a critical point in the NEC, affecting operations of the most heavily traveled rail line in the United States.

- The existing B&P Tunnel does not provide enough capacity to support existing and projected demands for regional and commuter passenger service along the NEC.
- The existing B&P Tunnel is not suited for modern high-speed usage due to the current horizontal and vertical track alignment, which limits passenger train speeds through the tunnel to 30 mph.
- The existing B&P Tunnel is a valuable resource. The disposition of the existing tunnel needs to be considered in the Project.

1. Physical Condition

The existing B&P Tunnel's two-track cross-section is horseshoe-shaped arch with an approximate spring line width of 27 feet between the side walls and centerline height of about 21 feet. The majority of the existing double-track B&P Tunnel is supported by a multiple course brick-lined arch and masonry sidewalls. One of the existing B&P Tunnel's tracks is typically designated for northbound traffic and the other for southbound traffic. Safety refuge areas (referred to as manholes) are located in the sidewalls of the tunnel. There is no physical separation of the tracks, which prohibits major improvements to the existing tunnel while in service due to operational and construction safety requirements. The existing track layout causes difficulties for maintenance and repair. Short working windows require multiple mobilizations for repairs, thus slowing progress and substantially increasing maintenance costs.

Water-saturated soil beneath the tunnel is causing its floor slabs to sink, forcing Amtrak to make repeated repairs (NEC Infrastructure and Operations Advisory Commission, 2013). Also, drainage through the tunnel's walls, leakage from existing utility lines, poor drainage of the tunnel's invert, and insufficient clearance were noted in a prior study of the tunnel (FRA and MDOT, 2011). Most recently, the *Existing B&P Tunnel Visual Inspection* prepared by B&P Tunnel Project engineers provides a review of the tunnel's structural integrity, water infiltration[1], drainage system function, railroad components, safety, and security. The inspection was performed between July 8, 2014 and July 18, 2014 and generally reviewed the NEC from Milepost 96 to Milepost 97.5. It covered the full lengths of the three tunnel sections, the north and south portals, and the two intermediate day-light sections between the three tunnels.

The Inspection Report is summarized by tunnel section in the outline below. The report identifies glistening surfaces and/or wet conditions for all three of the tunnel sections. Leaking water through the tunnel walls can lead to structural, electrical and mechanical problems. Leaking water could also carry fill material required for stability from behind the walls; this is a particular problem for horseshoe-shaped tunnels (such as the B&P Tunnel segments) that rely on fill material outside of the tunnel structure to provide resistance to the compressive forces transferred from above. These materials and the proper balance of force is necessary for the continued stability of the tunnel. Once a leak develops and water establishes a flow path, the problem of leaking may continue to develop over time as water flows through the path of least resistance. In addition, the Wilson Street Tunnel and the John Street Tunnel both have "multiple rows of missing brick", indicative of deterioration over time of the tunnels' masonry and concrete elements.

[1] Water infiltration in the existing B&P Tunnel relates to water leaking into the tunnel. This water can carry fine deposits and can leave voids behind the tunnel's liner and under slabs. The water infiltration also has the potential to prematurely age sump pumps and increase maintenance requirements and costs.

a. Gilmor Street Tunnel

Of the three tunnel sections, the Gilmor Street Tunnel is currently in the best physical condition. However, issues with this tunnel include sections of brick and mortar loss. Other problems include:

- transverse (crossways) cracks,
- spalls (chips/fragments) in the bench wall (elevated walkway used by maintenance personnel),
- shallow delaminations (divisions of thin layers) in the gunite (proprietary name of an early form of shotcrete that is a mix of Portland cement and sand) coating, and
- glistening surfaces due to moisture, which may indicate the possibility of water flow that could lead to structural, mechanical, or electrical problems in the tunnel.

b. Wilson Street Tunnel

Of the three tunnel sections, Wilson Street Tunnel is in the poorest physical condition. The majority of the tunnel is wet and actively leaking. Many of the leaks come from behind the tunnel's liner and produce efflorescence (crystalline deposits). Other problems include:

- spalls in the bench wall,
- shallow delaminations in the gunite coating,
- inflow of water from the invert (floor),
- large amount of debris in invert,
- brick debris on top of duct bench,
- deteriorating manholes, and
- multiple rows of missing brick over extended lengths.

c. John Street Tunnel

The leakage and moisture conditions in the Wilson Street Tunnel continue into the John Street Tunnel, but are not present over its entire length. Most of the leakage has pooled in the invert where the drainage system is clogged. Other problems include:

- spalls in the bench wall,
- deteriorating manholes,
- thick efflorescence,
- multiple rows of missing brick, and
- missing mortar.

2. Existing Track Alignment

The existing B&P Tunnel's grades and horizontal alignment limit train speeds, increase travel time, and impact the NEC's ability to support high-speed rail systems. A railroad's efficiency is dependent on its vertical and horizontal alignment, i.e. its grades and curves. Steep grades and the NEC's curvature, especially near Winchester Street (where the existing B&P Tunnel turns sharply at the entrance of the Gilmor Street Tunnel), prohibit high-speed service.

According to *Baltimore's Railroad Network: Challenges and Alternatives* (FRA, 2005), the NEC has "very difficult tunnel alignments" and "especially noteworthy are the restrictions imposed by the [existing] B&P Tunnel" for the roughly two miles between Mileposts 95.9 and 97.7. **Table II-1** shows the maximum allowable speeds on Amtrak's NEC through Baltimore in and adjacent to the existing B&P Tunnel.

Table II-1: Maximum Allowable Speeds on Amtrak's NEC through Baltimore

Route Segment	Max Speed Passenger Service	Max Speed Freight Service
Union Tunnels, north of Baltimore Penn Station	45 mph	30 mph
Existing B&P Tunnel, south of Baltimore Penn Station	30 mph	20 mph
South of existing B&P Tunnel to Baltimore Washington International (BWI) Rail Station	110 mph	50 mph or less

Note: These maximum allowable speeds are general guidelines, always subject to site- and time-specific considerations.
Source: Baltimore's Railroad Network: Analysis and Recommendations, Table 2-7 (FRA and MDOT, 2011).

Maximum allowable speed in the existing B&P Tunnel is 30 mph for Amtrak trains and 20 mph for freight service. All passenger trains must slow down in order to stop at Baltimore Penn Station. Trains traveling from the north must slow down to pass through the B&P Tunnel before gaining speed south of the B&P Tunnel (up to 110 mph for passenger services currently, with higher speeds expected in the future).

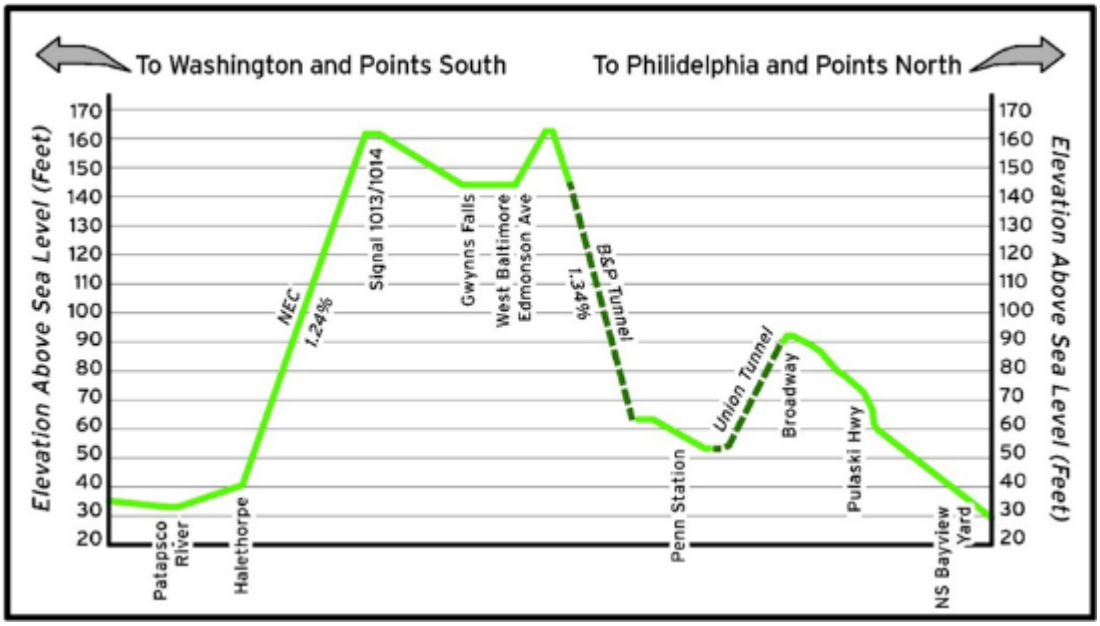
Southbound trains entering the existing B&P Tunnel slow for a sharp (8 degree) curve then ascend on a mile-long 1.34 percent grade, the steepest grade on the NEC between Philadelphia and Washington, DC. **Figure II-2** shows the elevation changes along the NEC. The elevation of the existing B&P Tunnel ranges from 150 feet above mean sea level to 70 feet above mean sea level. (FRA and MDOT, 2011).

Additionally, the approach section to the tunnel at the West Baltimore MARC Station is located on a curve (referred to as Curve 381) that limits train speeds to 55 mph. Curve 381 precludes level boarding of MARC trains, as the high-level platforms on sharp curves (greater than 1 degree) require passengers to negotiate a large gap between the platform and the train car door. As this is considered to be an unsafe condition, platforms on such curves are positioned at grade. The lack of a high-level boarding platform prevents designation of the West Baltimore Station as an accessible boarding location. The need to provide Americans with Disabilities Act (ADA) compliant facilities at the West Baltimore MARC Station has been the subject of previous planning studies conducted by MTA.

3. Bottleneck in NEC Operations

The NEC is the most heavily traveled rail corridor in the United States (NEC Master Plan Working Group, 2010). The NEC traverses eight northeast states and Washington, DC. The NEC is a shared resource used by Amtrak, with ten commuter rail operators and seven freight railroads (NEC Master Plan Working Group, 2010).The NEC connects the five major metropolitan areas of Washington, DC, Baltimore, Philadelphia, New York, and Boston. According to the *NEC Infrastructure Master Plan* (Amtrak, 2010a), this rail network is a centerpiece of the transportation infrastructure that contributes to the economic vitality of the Northeast region. By linking all the major northeastern cities, it moves more than 259 million passengers and 14 million car-miles of freight per year (Amtrak, 2010a).

Figure II-2: Elevation Changes along the NEC



Source: Baltimore's Railroad Network: Analysis and Recommendations, Figure 2-20 (FRA and MDOT, 2011).

Due to the age of the existing B&P Tunnel and the technological advancement of the rail system in the more than 140 years since it was built, the existing B&P Tunnel limits the functionality of railroads through Baltimore and along the NEC. The existing B&P Tunnel is "a major chokepoint for intercity, commuter, and freight operations in the northeast" (Amtrak, 2010a). The tunnel creates a bottleneck in NEC operations due to its reduced travel speeds. The NEC, which has active use of three and four tracks elsewhere, has only two tracks through the existing B&P Tunnel, which must accommodate a mixture of regional and commuter passenger trains and freight service. Therefore, FRA has determined that four tracks through the Project Area would be necessary to alleviate the existing bottleneck and accommodate future demands as predicted by the NEC FUTURE program. The volume of trains forecast by the NEC FUTURE program, as documented in the NEC FUTURE Tier 1 DEIS, would not be accommodated without a four-track alignment through Baltimore (FRA, 2015). See **Section II.E.4.i** below for more information on the NEC FUTURE program.

Travel times through the existing B&P Tunnel are listed in **Table II-2**. Amtrak times are measured between a stop at Baltimore Penn Station and passing block signals 993/994 (at approximately Milepost 99.2, Gwynns Falls Bridge), while MARC times are measured between a stop at Baltimore Penn Station and a West Baltimore Station stop (Milepost 98.5). Trip times through the existing B&P Tunnel range from 5 minutes and 48 seconds to 7 minutes and 16 seconds. As indicated in the table, travel time is longer for northbound trains that stop at Baltimore Washington International (BWI) Rail Station because they must slow down to diverge at the Bridge Interlocking before entering the existing B&P Tunnel.

Table II-2: Current Trip Times Through the Existing B&P Tunnel

Trip Direction	MARC Commuter[1]	Amtrak Regional/Intercity[2]	Acela[3]
Southbound	5 min, 48 sec	6 min, 20 sec	5 min, 52 sec
Northbound (No stop at BWI)	N/A	6 min, 5 sec	5 min, 56 sec
Northbound (Stop at BWI)	6 min, 18 sec	7 min, 16 sec	7 min, 1 sec

[1] *Trainset assumed for MARC Commuter trains: HHP-8 locomotive plus 7 MARC III cars.*

[2] *Trainset assumed for Amtrak Regional/Intercity trains: AEM7 locomotive plus 8 Amfleet cars.*

[3] *Trainset assumed for Acela trains: standard Acela trainset.*

Source: General Orders Timetable (Amtrak, December 2012 and 2014).

4. Operational Needs of the NEC

Three major providers use the existing B&P Tunnel: Amtrak, MARC, and NS. The providers have documented the need for improvements along the NEC, particularly in Baltimore City and the area surrounding the existing B&P Tunnel. The following reports discuss the operational needs of the NEC, including improving the bottleneck created by the existing B&P Tunnel:

- *Baltimore's Railroad Network: Challenges and Alternatives* (FRA, 2005)
- *The Northeast Corridor Infrastructure Master Plan* (Amtrak, 2010a)
- *A Vision for High-Speed Rail in the Northeast Corridor* (Amtrak, 2010b)
- *Baltimore's Railway Network: Analysis and Recommendations* (FRA and MDOT, 2011)
- *The Amtrak Vision for the NEC* (Amtrak, 2012)
- *Critical Infrastructure Needs on the Northeast Corridor* (NEC IOAC, 2013)
- *MARC Growth and Investment Plan - Update 2013 to 2050* (MTA, 2013)
- *Washington Terminal Yard Future Operating Plans* (MARC/Amtrak 2020 and 2030 Plans) (LTK Engineering Services, 2014)
- *NEC FUTURE: A Rail Investment Plan for the Northeast Corridor* (FRA, 2015)
- *Baltimore Penn Station Master Plan* (Amtrak, 2015)

a. Baltimore's Railroad Network: Challenges and Alternatives (2005)

FRA and MDOT developed *Baltimore's Railway Network: Challenges and Alternatives* (FRA and USDOT, 2005) in response to the November 2001 request from Congress. The study evaluates the condition and capabilities of the railroad network's fixed facilities and examines the benefits and costs of various alternatives for reducing congestion and improving safety and efficiency in the rail operations throughout the larger Baltimore region. Part 1 of the report characterizes the state of the network and demands placed on it. The study evaluates the existing B&P Tunnel, among other components of Baltimore's rail network, and emphasizes its importance to the overall NEC system. The study explains that "the conditions in the [existing] B&P Tunnel – as well as its criticality to the protection of a reliable passenger service – preclude its expanded use for most freight and constrain the flow of commerce to and through the Baltimore region." The study also describes the history of renovations made to the existing B&P Tunnel as well as its current car plate (i.e., height and width) clearance restrictions and "difficult geometry," noting that the "sharp curve at the south portal of the tunnel prevents southbound trains departing [Baltimore's Penn Station] from accelerating beyond 30 mph."

Part 1 of the 2005 study examines the horizontal and vertical track alignment of the existing B&P Tunnel, explaining that "grade, particularly in combination with curvature, has a major impact on the tractive effort and horsepower required to move a train of a given tonnage over a line. Collaterally, grades affect the speed, schedule, and on-time performance of a freight train, and to a lesser degree, a passenger train. Curves, in themselves, can severely limit train speeds because of the forces they create as trains pass over them, and the safety, ride quality, maintenance, and cost issues that these forces raise – issues that are worsened in mixed traffic conditions. For example, allowable superelevations (banking) on curves may differ for passenger and freight service. Where both services regularly share the same tracks, compromises must be made that may allow neither service to operate optimally."

The potential actions that could improve passenger and freight railway capabilities in the Baltimore region are detailed in Part 2 of the study. Replacement of the existing B&P Tunnel is a stated objective of the study. The study explains that "the tunnel's basic geometry was substandard when it was completed [in 1873]." Information from this study has been considered and incorporated into subsequent stages of the planning process during development of this EIS.

b. The Northeast Corridor Infrastructure Master Plan (2010)

The Northeast Corridor Infrastructure Master Plan (Amtrak, 2010a), prepared by Amtrak, provides a regional, corridor-wide perspective of the NEC Main Line and all its feeder lines. The Master Plan identifies an initial baseline of infrastructure investment needed to maintain the current NEC system in a state of good repair; integrates intercity, commuter and freight service plans; and moves the NEC forward to meet the expanded service, reliability, and trip-time improvements that are envisioned by the Northeast states and the District of Columbia. The plan identifies the existing B&P Tunnel as one of several major assets along the NEC that are approaching the ends of their useful lives, and which impede the overall speed, capacity, and reliability of the NEC Main Line. This plan states that the existing B&P Tunnel is "a major chokepoint for intercity, commuter, and freight operations in the northeast."

c. A Vision for High-Speed Rail in the Northeast Corridor (2010)

The need for high-speed rail in the NEC for present and future transportation networks is documented by Amtrak in *A Vision for High-Speed Rail in the Northeast Corridor* (Amtrak, 2010b). The report identifies general alignment constraints, such as dedicated tracks and curvature limits that would be required to implement next-generation high speed rail service along the NEC. This report includes a graphic from the 2010 NEC Master Plan, identifying the existing B&P Tunnel as a "previously identified chokepoint" and reiterates that the NEC through Baltimore exceeded 75 percent utilization capacity in 2008 and will exceed 100 percent by 2030. The report explains that "Amtrak services must play an expanded role in meeting the corridor's mobility and economic support needs. The NEC's daily use by major commuter rail operations and by numerous freight trains further underscores this importance. The benefits of the proposed Next-Generation High-Speed Rail system investment would extend beyond intercity rail passengers to air passengers, rail commuters, and highway drivers who will realize transportation network capacity gains."

d. Baltimore's Railroad Network: Analysis and Recommendations (2011)

Baltimore's Railway Network: Analysis and Recommendations (FRA and MDOT, 2011) is a feasibility study by FRA and MDOT that focused on large-scale, regional rail issues. The study supplements the findings of *Baltimore's Railroad Network: Challenges and Alternatives* (FRA and USDOT, 2005). It focuses on the principal elements of Baltimore's network of passenger and freight rail lines extending from Perryville—the junction of Amtrak's NEC with the NS principal route from Harrisburg and points west—to Halethorpe, where CSX Transportation and Amtrak lines from Washington, DC cross. Therefore, this 2011 study includes the existing B&P Tunnel, but covers a much larger area than the proposed B&P Tunnel Project. In Phase I of the report, a number of passenger and freight alternative routes through Baltimore are developed and evaluated. Phase II of the report further refines the engineering and cost aspects of two preferred alternatives.

The study explains that "Amtrak's route through Baltimore is crucial to the viability of all intercity rail passenger service in the United States." Specifically, one-fifth of Amtrak's passenger-trips and one-third of its total revenues stem from trips making use of at least one of the NEC's Baltimore tunnels. Most of these trips depend on both the existing B&P Tunnel and the Union Tunnel (FRA and MDOT, 2011).

The study discusses the deteriorating condition of the existing B&P Tunnel and the tunnel's effects on NEC operations due to limited travel speeds, capacity, freight loading flexibility, and lack of detour route options. Track alignment through the existing B&P Tunnel and clearance are discussed in detail in the study. The study explains that "the physical condition of the tunnel requires that it be rebuilt or replaced within the next 10 to 20 years."

e. The Amtrak Vision for the NEC (2012)

The Amtrak Vision for the NEC report provides an update to the Vision for High-Speed Rail in the Northeast Corridor (Amtrak, 2010b), identifying recent developments in NEC planning and highlighting key findings related to how Amtrak can translate various strategies and concepts for growth and improvement of the NEC into reality. The report states that the entire network is often operating at or near capacity and is routinely hampered with congestion and delays. It recognizes that significant efforts are underway that address rehabilitation needs and reducing existing congestion. The NEC consists of aging infrastructure that will require extensive repair for safe and efficient operations at current traffic levels. Significant investments in the existing NEC will help eliminate key bottlenecks that limit service frequency and negatively affect reliability and performance. This report lists milestones over the next 30 years, with increases in tunnel and terminal capacity. Improvements to the existing B&P Tunnel are identified as a key project for trip-time and frequency improvements between Washington, DC and New York.

f. Critical Infrastructure Needs on the Northeast Corridor (2013)

Critical Infrastructure Needs on the Northeast Corridor (NEC IOAC, 2013) was prepared by the NEC Infrastructure and Operations Advisory Commission. The report was developed through a consensus-based process by the NEC Commission's members, which include representatives from the NEC States, USDOT, and Amtrak. This report recognizes that additional investment is necessary to renew and enhance the NEC as a world-class, high-performance rail corridor supporting the economic development and international competitiveness of the region and the nation with job creation, improved reliability of existing services, and a foundation for future mobility and economic growth. The report notes that the existing B&P Tunnel is one of the oldest structural assets on the NEC, it "severely" limits train speeds in Baltimore, and identifies it as "a major capacity bottleneck for both passenger and freight trains. Development of the B&P Tunnel replacement project would mitigate a chokepoint, eliminate speed restrictions, and enhance freight access to the port of Baltimore" (NEC IOAC, 2013). The report identifies the B&P Tunnel Project as a necessary project on the NEC, and states that "while the alignment and design of any new tunnel is yet to be determined, planning will consider options for supporting higher-speed train service and creating separate routes for passenger and freight trains through Baltimore." The report also explains that "new tunnels could free the existing tunnels for renewal, ultimately for additional capacity, and make Amtrak and MARC less susceptible to maintenance-related delays."

g. MARC Growth and Investment Plan - Update 2013 to 2050 (2013)

The *MARC Growth and Investment Plan - Update 2013 to 2050* (MTA, 2013) by MTA presents a summary of the commuter rail program whose service areas include Baltimore and Washington, DC and surrounding areas, with an average of 36,000 daily trips using the Penn, Camden, and Brunswick Lines. The plan identifies ridership and parking trends, re-aligns agency priorities, updates objectives for MARC service, and summarizes the growth of the Penn, Camden and Brunswick Lines. While the average annual growth from 2007 to 2012 in ridership for the Camden Line and Brunswick Lines were 0.5 percent and 1.7 percent, respectively, the Penn Line reported 3.5 percent growth. The Plan states that ridership demand is expected to continue to grow at historical rates. Challenges identified in the plan include insufficient track capacity on all three lines. In addition, the Plan notes that MARC's flexibility and ability to expand service is constrained by existing infrastructure and interactions with other rail operators.

The MARC Growth and Investment Plan also identifies a new station at West Baltimore under the State of Good Repair long-term plan (2020-2029). The November 2008 West Baltimore Master Plan noted opportunities and plans for economic growth in the area. The USDOT Ladders of Opportunity Program identified the West Baltimore MARC Station as one of seven national locations where the USDOT will help foster sustainable economic development related to planned transportation projects.

h. Washington Terminal Yard Future Operating Plans (MARC/Amtrak 2020 and 2030 Plans) (2014)

Amtrak and MARC developed the *Washington Terminal Yard Future Operating Plans* as draft conceptual Amtrak/MARC operating plans for the 2020 and 2030 time horizons for use in conjunction with the Washington Union Station (WUS) and Washington Terminal Yard (WTY) Master Plans. Based on this ongoing study, MARC expects a 3 percent ridership increase per year on the Penn Line, which is the equivalent of an approximately 60 percent ridership increase through 2030 when compounded annually.

i. NEC FUTURE (2015)

NEC FUTURE (FRA, 2015) is a comprehensive planning effort to define, evaluate, and prioritize long-term future investments in the NEC, from Washington, DC to Boston. The FRA launched NEC FUTURE in February 2012 to consider the role of rail passenger service in the context of current and future transportation demands. Through the NEC FUTURE program, FRA will determine a long-term vision and investment program for the NEC. The Tier 1 Draft Environmental Impact Statement (Tier 1 Draft EIS) for NEC FUTURE was completed in November 2015 and assesses the broad impacts of investment programs to improve passenger rail service within the NEC FUTURE Study Area. FRA will prepare a Service Development Plan (SDP) based on the selection of the investment program identified through the NEC FUTURE Tier 1 EIS Process. The SDP will provide the platform for implementation of the program by the federal government, states, the NEC Infrastructure and Operations Advisory Commission (NEC Commission), and the NEC railroads. More information on the NEC FUTURE program is available on the NEC FUTURE program website at www.necfuture.com.

As part of the NEC FUTURE, FRA developed projections for the future passenger train volumes through the B&P Tunnel for the year 2040. These projections identified the need for a minimum of four tracks through Baltimore to serve the future passenger demand along the NEC. Currently, the NEC has three or four tracks elsewhere but only two tracks through the existing B&P Tunnel.

j. Baltimore Penn Station Master Plan (2015)

Amtrak is in the early planning stages of developing a master plan for the future needs at Baltimore Penn Station (Amtrak, 2015). The plan will outline a series of incremental and phased improvements to the station facility and select land assets to guide the station into the future. The master plan will build off three studies: the Operations and Facilities Study, which will assess the long-term operational and facility requirements for Baltimore Penn Station to meet the growing capacity demands; the State of Good Repair Study; and the Commercial Development Study. Early coordination between the B&P Tunnel Project Team and Baltimore Penn Station representatives indicated that the projects would impact the other. Planned replacement of high level platforms at Baltimore Penn Station would not have any material effect on the alternatives considered for the B&P Tunnel Project.

5. System Linkage and Rerouting

There are no practical detours available to route rail traffic around the existing B&P Tunnel for maintenance or in case of emergencies without rail services experiencing extensive delays. In an emergency or bottleneck situation, there is no way to route NEC traffic over the CSX rail line, or vice versa. This lack of inter-operability came to the forefront during the Howard Street Tunnel fire, when CSX had to route trains via Cleveland, Ohio (FRA and MDOT, 2011). Another constraint associated with system linkage is related to the close proximity of the Union Tunnel, just north of Baltimore Penn Station, and its passenger and freight restrictions with substantial elevation changes.

With no practical detour route options for the existing B&P Tunnel, a major maintenance problem in the tunnel could have a substantial impact to rail operations, since the NEC does not have inherent redundancy at this location. The existing B&P Tunnel's two tracks are in the same structural envelope, which means that incidents that affect service on one track, most likely affect the other track as well, reducing the possibility of single-tracking around an issue. Single-tracking can be accomplished in some cases if a train can safely pass on the other track, but since there is no physical separation between the tracks, tunnel repairs typically impact service on both tracks. Currently, if the existing B&P Tunnel were closed for major renovations/repairs or an emergency, passenger train service along the NEC through Baltimore would be stopped.

In order for NS to avoid using the B&P Tunnel in an emergency, closure due to maintenance, or to circumnavigate Baltimore with a Plate H (or double-stacked) train, a three-hour delay and an additional 111.6 miles are added to the route. Use of the Hagerstown route eliminates the expensive and time-consuming need to exchange high dimension cars in order for a train to be routed through Baltimore.

6. Capacity to Support Existing and Projected Demands

Roughly 50 million people, or one out of every six Americans, live in the NEC region (NEC IOAC, 2013). "It is the country's economic powerhouse, generating $1 out of every $5 in gross domestic product....The density that supports this immense productivity, however, also creates congestion challenges for [the] transportation network… Every day, over 700,000 people, nearly half of all railroad commuters nationally, travel over portions of the NEC… Overall, ridership on Amtrak's NEC services has grown 37 percent since 2000" and the demand for rail service along the NEC is at record levels (NEC IOAC, 2013). "Contributing factors to this growth include a relative rebound in population and employment growth in its major urban markets, increasing delays affecting other major transportation options including highways and air travel, and the reliability and convenience of rail in serving core-city markets for both intercity and local travel. The NEC, however, cannot continue to accommodate this rising demand due to infrastructure that is highly constrained and in need of repair" (NEC IOAC, 2013).

As population increases and dependency on rail transportation grows, the demand for more efficient, better rail service within the Northeast megaregion is expected to rise. This will increase the service demands for the number of passenger trains for Amtrak and MARC along the NEC and require additional capacity and improved operations throughout the Project limits.

a. Existing Use

i. *Commuter and Passenger Rail*

As shown in **Table II-3**, 57 MARC trains currently use the existing B&P Tunnel each day. Of those, 17 trains travel through the tunnel during the four-hour evening peak period. MARC has approximately 4,600 passenger trips that use the tunnel per day with 1,900 passenger trips using the tunnel during the four-hour evening peak period.

Amtrak has a total of 88 trains that currently use the existing B&P Tunnel each day. That number consist of 33 Acela Express trains, 43 Northeast Regional service trains, and 12 long-distance trains. Of those, 18 trains travel through the tunnel during the four-hour evening peak period. Amtrak has approximately 17,000 passenger trips that use the tunnel per day, with 3,400 passenger trips using the tunnel during the four-hour evening peak period.

Table II-3: NEC Trips through the Existing B&P Tunnel Corridor

	Number of Trains (2014)		Number of Passengers (2014)	
Types of Service	Daily	4-Hour PM Peak Period	Daily	4-Hour PM Peak Period
Intercity (Amtrak)	88	18	17,000	3,400
MARC Commuter Rail Service	57	17	4,600	1,900
NS Freight	2	0	N/A	N/A
TOTAL	**145**	**35**	**21,600**	**5,300**

Source: (Amtrak, December 2012 and 2014).

i. *Freight Rail*

Approximately 50 Class 1 and regional freight trains use the NEC each day to serve industries, power plants, and ports in the Northeast and Midwest. This heavy volume of freight traffic reinforces the NEC's role as a vital link in the national freight network. However, due to capacity, speed, and loading constraints, all rail freight movements between the northeast and southwest parts of the Port of Baltimore are difficult and costly to accomplish. The Port is a major economic player in the Baltimore region and generates $1.5 billion in business revenue annually (Amtrak, 2010a). Freight usage through the tunnel is limited and most freight on the NEC is routed around the existing B&P Tunnel. No CSX freight currently utilizes the B&P Tunnel due to lack of connectivity, clearance issues, and other constraints along the NEC through Baltimore.

Amtrak has statutory and contractual obligations to permit the continued operation of freight trains. Currently, NS operates one train which makes a round trip through the existing B&P Tunnel daily for freight purposes, and does not travel through the tunnel during the four-hour peak evening period, as shown in **Table II-3**.

Vertical clearance is a limiting characteristic of the existing B&P Tunnel. The existing vertical clearance of the B&P Tunnel ("Plate C") is unable to support passage of larger, newer freight cars ("Plate H"). **Table II-4** shows the critical dimensions and examples of associated car types. "Plate" refers to a standard-sized vertical and horizontal clearance of the train.

Table II-4: Critical Dimensions and Associated Car Types

Plate	Maximum Height Above the Top of Rail	Width at Maximum Height Above Top of Rail	Typical Car Types Satisfying Plate
C	15'6"	7'0"	Conventional box cars, flats (depending on load), gondolas, coal hopper cars
H	20'2"	8'6⅜"	Double-stack container cars, tri-level auto rack cars, high-cube box cars

The existing B&P Tunnel's Plate C clearances do not allow sufficient clearance for modern, efficient Plate H double-stack container cars, tri-level auto carriers, and high-cube box cars (FRA and MDOT, 2011). For clearance Plate C, the maximum height above the top of rail is 15'6" and width at maximum height above top of rail is 7'0". Typical car types used with clearance Plate C are conventional Amtrak and MARC passenger cars, box cars, flats, gondolas, and coal hopper cars. None of the north-south traffic lanes through Baltimore can currently accommodate Plate H double stack container cars and tri-level auto carriers. Therefore, NS cannot service any local shippers south of Baltimore with the most modern cars. In Washington, DC, the District Department of Transportation (DDOT) and CSX are studying the Virginia Avenue Tunnel in order to accommodate Plate H clearances and address another major bottleneck in the eastern seaboard freight network. Completion of the

Virginia Avenue Tunnel project[2] would lead to a greater focus on the existing B&P Tunnel as a freight clearance impediment, and further emphasize the need to replace the existing tunnel with a new tunnel featuring the proper clearances.

b. Future Needs

"The aging and congested multimodal transportation network of the Northeast region is facing a crisis. An expected increase in population, estimated to grow by 30 percent from roughly 50 million residents today to 65 million in 2050, will create additional travel demand and strain an already stressed network that routinely operates near or at capacity along key segments" (Amtrak, 2012). According to the *Baltimore Railroad Network: Analysis and Recommendations* (FRA and MDOT, 2011), the demand for train movements of all types is expected to increase by 40 percent northeast of Baltimore and 37 percent southwest of Baltimore between 2008 and 2050. By mid-century, a heightened pressure for rail transport would place a huge incremental load on an antiquated rail network that, if left unchanged, would continue to detract from the speedy, efficient, and economical movement of passengers and goods along the East Coast (FRA and MDOT, 2011).

i. *Commuter and Passenger Rail*

Future needs for Amtrak in the NEC are identified in the series of reports and plans covered under **Section II.E.4.,** Operational Needs of the NEC.

The average annual growth from 2007 to 2012 for the MARC Penn Line was 3.5 percent, and ridership demand is expected to continue to grow at historical rates. MARC service is expected to increase substantially both north and south of Baltimore, with possible extensions to Elkton, Maryland, or Newark, Delaware, in the longer term. The *MARC Growth and Investment Plan Update - 2013 to 2050* identifies challenges related to trains being crowded at rush hour and states that adding flexibility and expanding service is constrained by infrastructure (MTA, 2013). MARC expects a three percent future ridership increase per year on the Penn Line, which is the equivalent of approximately a 60 percent ridership increase through 2030 when compounded annually (LTK Engineering Services, 2014).

The *West Baltimore MARC Station Master Plan (Transit-Centered Community Development Strategy)* identifies improvements to the Penn Line and West Baltimore MARC Station that would reduce the amount of time between trains (Baltimore City and MDOT, 2008). The proposed improvements would allow a decrease from 25-minute to 15-minute headways during rush hour, from once an hour to once every 30 minutes in non-rush hour times, and provision of late evening and weekend service.

The MTA has been evaluating options to make the West Baltimore MARC Station fully accessible, in compliance with ADA. One method to accomplish this would be to relocate the existing MARC platforms several hundred feet south of the existing West Baltimore MARC Station.

ii. *Freight Rail*

According to the *Baltimore's Railroad Network - Challenges and Alternatives* report, the freight capacity of the Baltimore network is not sufficient to handle the expected freight volumes forecasted for 2050 (FRA, 2005). A 44 percent national increase in freight traffic is projected by 2030 (Amtrak, 2010a).

[2] Please refer to "www.virginiaavenuetunnel.com" for additional information regarding the Virginia Avenue Tunnel project.

F. Summary

The Project purpose is to address the structural and operational deficiencies of the existing B&P Tunnel and support future high-speed rail services along the NEC. The Project would improve operations along the NEC, improve passenger rail services, and support existing and future demands along the NEC. The physical condition of the existing B&P Tunnel requires that it be rebuilt or replaced within the next 10-20 years (FRA and MDOT, 2011). Not only is the structure over 140 years old, the design of the railway is unable to support higher speed trains or more passenger and freight capacity. The structural and operational deficiencies result in a transit bottleneck along the NEC in Baltimore.

According to the *Northeast Corridor Infrastructure Master Plan*, the B&P Tunnel is important not only for Baltimore, but also the entire NEC (Amtrak, 2010a). The NEC traverses eight states and Washington, DC. It is shared by eight commuter railroads and three freight railroads. It connects the five major metropolitan areas of Washington, DC, Baltimore, Philadelphia, New York, and Boston. The existing B&P Tunnel is a centerpiece of the Baltimore rail network that contributes to the economic vitality of the Northeast region. The NEC Master Plan identifies the need to maintain the current NEC system in a state of good repair; integrate intercity, commuter, and freight service plans; and move the NEC forward to meet the expanded service, reliability, frequency, and trip-time improvements that are envisioned by the Northeast states and the District.