LONG BRIDGE STUDY

District Department of Transportation

LONG BRIDGE STUDY

January 2015

Cover photo credits:
Zefiro 280 High Speed Rail Train courtesy of Bombadier.

Table of Contents

Figures

Tables

Images

ACKNOWLEDGEMENTS & ACRONYMS

Acknowledgements

The District Department of Transportation (DDOT) would like to thank the Federal Rail Administration (FRA) for the opportunity to complete this study through a FRA American Recovery and Reinvestment Act grant (ARRA No. FR-HSR-00074). The study represents an important step in determining the future needs of the Long Bridge and the service it provides to freight and passenger service.

The Long Bridge Study Team would like to thank all those who participated in this yearlong effort to document and analyze the Long Bridge's assets and needs and to lay the groundwork for future phases of work for this important transportation corridor. Thanks to everyone who attended the public meetings, workshops, and stakeholder meetings and provided valuable input that helped guide the study and the preparation of this final report.

DDOT would like to extend a special thank you to CSX, Virginia Railway Express and Amtrak for information sharing and coordination throughout the project. We would also like to thank the Federal Railroad Administration for serving as the federal oversight agency for this study. Additionally, DDOT acknowledges all of the stakeholders and our partners in other District of Columbia government agencies for their input and engagement throughout the process.

The following study was conducted from September 2012 to December 2014. The information within this report reflects the regional development activity at that time. Future work for the Long Bridge will account for the evolving new developments within the project area.

Study Lead Team

Lezlie Rupert, Project Manager, DDOT

Faisal Hameed, Deputy Chief Engineer, DDOT

Vic Siaurusaitis, Michael Baker Jr., Inc. (Baker), Project Manager

DDOT Coordination Team

Othman Chebli

James Cheeks

Eulois Cleckley

Clarence Dickerson

Shannon Hake

Jamie Henson

Kristin Kersavage

Rick Kenney

Romanus Onyeama

Steve Strauss

Stakeholder Agencies

AMTRAK
City of Alexandria
Arlington County
United States Commission on Fine Arts
CSX Transportation, Inc.
DC State Historic Preservation Office
DC Water
Federal Aviation Administration
Federal Railroad Administration
Federal Highway Administration
Federal Transit Administration
Maryland Rail Commuter Service (MARC of the Maryland Transit Administration)
Metropolitan Washington Council of Governments
Metropolitan Washington Airport Authority
National Capital Planning Commission
National Park Service
Department of the Navy
Norfolk Southern
Washington Metropolitan Area Transit Authority
Virginia Department of Transportation
Virginia Department of Rail and Public Transportation
Virginia Railway Express

Consultant Team

Michael Baker Jr., Inc.
M&N Engineering and Diving Services (MBE)
Parsons Transportation Group
Precision Measurements, Inc. (MBE)
Sharp & Company, Inc. (MBE)
Vanasse Hangen Brustlin, Inc.

Acronyms

AAR – Association of American Railroads

AASHTO – American Association of State Highway and Transportation Officials

AREMA – American Railway Engineering and Maintenance-of-Way Association

AMTRAK – American Track National Rail Passenger Corporation

ANC – Advisory Neighborhood Commission

ARRA – American Recovery and Reinvestment Act

CLRP – Constrained Long Range Plan

DDOT – District Department of Transportation

DEIS – Draft Environmental Impact Statement

DRPT – Virginia Department of Rail and Public Transportation

EPA – Environmental Protection Agency

FAF – Freight Analysis Framework

FEIS – Final Environmental Impact Statement

FRA – Federal Railroad Administration

FHWA – Federal Highway Administration

HAZMAT – Hazardous Material

HSIPR – High-Speed Intercity Passenger Rail

HSR – High Speed Rail

KSI – Kilograms per Square Inch

LOS – Level of Service

MARC – Maryland Rail Commuter Service

MPH – Miles per hour

MWAA – Metropolitan Washington Airports Authority

MWCOG – Metropolitan Washington Council of Governments

NAAQS - National Ambient Air Quality Standards

NCPC – National Capital Planning Commission

NCR – National Capital Region

NEC – Northeast Corridor

NEPA – National Environmental Policy Act

NPS – National Park Service

NRHP – National Registry of Historic Places

NRHS – National Railway Historical Society

OP – District Office of Planning

PSI – Pounds per Square Inch

RTC – Rail Traffic Controller Operations Analysis Model

RTSP – WMATA Regional Transit System Plan

SEHSR – Southeast High Speed Rail Corridor

SHPO – State Historic Preservation Office

SIP – State Implementation Plan

TPB – Transportation Planning Board

USGS – United States Geological Survey

V/C – Volume-to-Capacity Ratio

VRE – Virginia Railway Express

WMATA – Washington Metropolitan Area Transit Authority

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

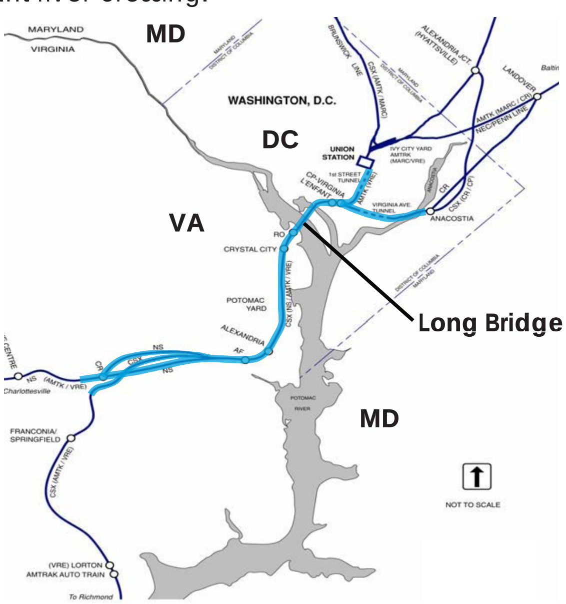
Introduction

The District Department of Transportation (DDOT) is committed to developing and maintaining a multimodal transportation system that delivers safe and efficient ways to move people and goods in the District of Columbia (District). The Long Bridge is an important component of the District's transportation network and is a key element of the regional commuter rail service and national rail system for intracity and intercity passenger rail service and freight rail in the Northeastern United States. Passenger, commuter, and freight rail play an important part in supporting economic growth and vitality. This study provided an opportunity to evaluate the improvements needed on this important railroad crossing over the Potomac River while also evaluating needs for other transportation modes in the area.

The Long Bridge is a two-track railroad bridge that was constructed in the late 19th and early 20th centuries. It is the only railroad bridge that connects the District and the Commonwealth of Virginia (Virginia). The Long Bridge is owned and maintained by CSX Transportation (CSX). The bridge carries rail traffic from three operators: CSX, Amtrak, and Virginia Railway Express (VRE). Norfolk-Southern (NS) has trackage and haulage rights on the CSX RF&P Subdivision between Alexandria, Virginia and Landover, Maryland, which includes the mainline tracks across the CSX Long Bridge. NS train crews must contact the CSX chief dispatcher for permission to enter the CSX RF&P subdivision prior to occupying the mainline tracks.

While the Long Bridge is not owned or maintained by DDOT, it is an important component of the District's transportation system. The Long Bridge provides an important rail connection across the Potomac River and is a key element of the Northeastern national rail system. DDOT recognizes the importance of rail transportation and has taken the opportunity to work with the Federal Railroad Administration (FRA) and various railroad organizations to understand the existing and future transportation needs of this important river crossing.

In 2011, FRA awarded DDOT a grant to study the short-term and long-term needs of the Long Bridge. DDOT launched this study in August 2012. Public, agency, and stakeholder engagement occurred throughout the study. The grant included the analysis of the structural integrity of the Long Bridge; multimodal connectivity; opportunities for operational improvements; and the long-term multimodal capacity improvements, including the future opportunity for high-speed and intercity passenger rail, commuter rail, freight rail, transit, bicycle and pedestrian, and vehicular traffic.



The study area included the full length of the Long Bridge and north and south approaches in the immediate vicinity of the bridge for analysis of transportation,

1808
Long Bridge construction authorized by Congress

1809
First Long Bridge opened

1814
Burned and restored to service in1816

1850s
Freight crossed the bridge by horse

1863
Parallel structure built for locomotive use

1870
Federal Government ceded control to the Pennsylvania Railroad

1904
New structure (current Long Bridge) was constructed; after 1906 the 1863 structure was demolished

1918
Pennsylvania Railroad officially became the owner of the Long Bridge

1930
Southernmost spans washed out and were replaced

1934
Electrified caterary added

1942
Bridge piers added to accommodate WWII heavy equipment

1960
Electrified catenary decomissioned

1965
Last opening of main span

1999
CSX Transportation Inc. acquired ownership

engineering, and the environment. Included in this study were conceptual engineering plans to assess different bridge and tunnel layout configurations and the number of tracks needed for future operations of all rail uses. The operational analysis extended beyond the immediate Long Bridge area and included operations down to the Alexandria interlocking in Virginia and, in the District, to the point where the rails splits past the L'Enfant passenger station to either continue to Union Station for passenger and commuter service or to the Virginia Avenue Tunnel for freight (CP Virginia).

History

Congress authorized the original Long Bridge in 1808, and it first opened in May 1809. The Long Bridge was built on timber piles and included moveable/opening spans. Throughout its history it has served multiple modes and has been reconstructed several times for different purposes. In the 1850s, the Long Bridge was used as a crossing for horse-drawn carriage and foot traffic. A locomotive bridge was built parallel to the original structure in 1863 to support heavy rail and trolley cars. In 1904, the existing structure was built.

Year	Owner of Long Bridge
1870	Federal government ceded control of the Long Bridge to the Pennsylvania Railroad (Penn RR)
1918	Penn RR officially became owner
1968	Combined ownership when the New York Central merged with Penn RR into Penn Central Railroad
1976	Penn Central Railroad and five other railroads became Conrail
1999	CSX Transportation, Inc. acquired ownership

Bridge Structure

The current bridge is comprised of 22 through girder spans and a double span swivel swing truss for a total of 24 spans over the Potomac River totaling 2,529 feet. It contains elements of the 1904 bridge (the swing span and 12 piers) and of the 1942 improvements (the girder spans and 11 piers) that were added to reinforce the bridge and accommodate the movement of heavier goods. The Long Bridge is comprised of two railroad tracks for a width of 36 feet 6 inches that narrows to 28 feet 8 inches at the swing truss. The vertical clearance under the bridge is limited to 20 feet at the swing trusses.

Purpose and Need

The purpose of the study was to complete a comprehensive analysis of the Long Bridge to identify short- and long-term structural needs, identify long-term capacity improvements, identify and analyze alternatives to enhance multimodal connectivity, and make a recommendation for the National Environment Policy Act (NEPA) class of action level required to move forward in project development. The following needs were identified in the study:

A. Transportation demand

B. Operational improvements

C. Structural conditions

D. Long-term capacity

E. Multimodal access

F. Intermodal connectivity

Chapter 2 fully describes the needs.

Bridge Condition and Current Operations

The Long Bridge is a two-track railroad bridge that is part of the CSX main line of operations, serving the Eastern Seaboard of the United States (US). Currently, the Long Bridge serves three different users: CSX for freight; VRE for weekday commuting; and Amtrak for intercity passengers. The bridge is a two-way operating stretch of rail between two points, one two miles south of Virginia Interlocking and the other past L'Enfant Plaza where passenger trains continue to the District's Union Station and freight rail continues toward the Virginia Avenue Tunnel. From both directions three-track systems connect to the Long Bridge two-track crossing, creating a bottleneck for competing passenger and freight traffic with potential conflicts for crossing the Potomac River. Additionally, due to the bridge's current condition, the bridge and track approaches have speed restrictions in place. The combination of speed restrictions and the bottleneck limits operational capacity.

The Long Bridge study included evaluation of the structural conditions of the bridge, which was completed by conducting a visual survey and a load capacity analysis. The visual survey, performed by staff by boat, assessed the individual elements of the structure. It is important to note that certain areas of the bridge were not observed (deck, interior faces of the girder or truss member, underwater piers, and foundations). The visual survey resulted in a "fair" assessment for the superstructure and "satisfactory" to "good" for the substructure. However, a formal inspection is recommended. The load capacity analysis analyzed the loading and the service life of the structure. This analysis recommended that some elements of the bridge need to be strengthened, and overall trains crossing the Long Bridge must reduce their speed to help extend the longevity of the bridge's useful life.

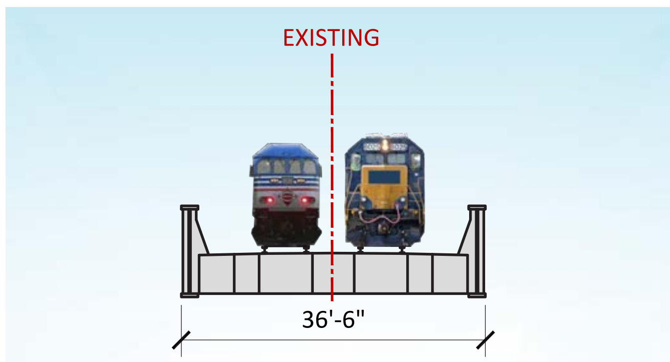
In 2013, there were 79 daily trains using the Long Bridge. The freight use is approximately 30 percent of that traffic, or 23 trains, and the passenger and commuter rail make up approximately 70 percent, or 56 trains. The daily capacity of the Long Bridge is 96 trains. The current volume-to-capacity ratio demonstrates that the bridge is at capacity operationally during the morning (6:00 am to 9:00 am) and evening (4:00 pm to 7:00 pm) peak periods. Existing conditions are covered in greater detail in Chapter 3.

Alternatives

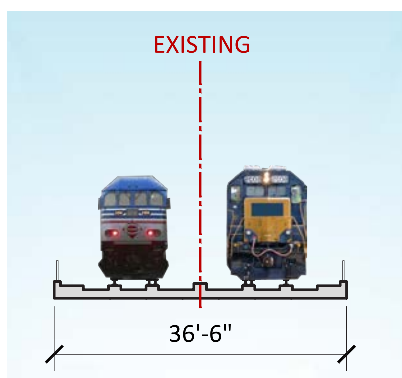
A number of alternatives were developed in the study and shared with the stakeholders, agencies, and public. Ultimately eight alternatives, including the No Build, were moved forward in the study for further analysis. These alternatives were analyzed and then divided into rail only and those that expand beyond rail and introduce additional modes. Chapter 4 provides more detailed description of the alternatives.

The alternatives that moved through analysis are:

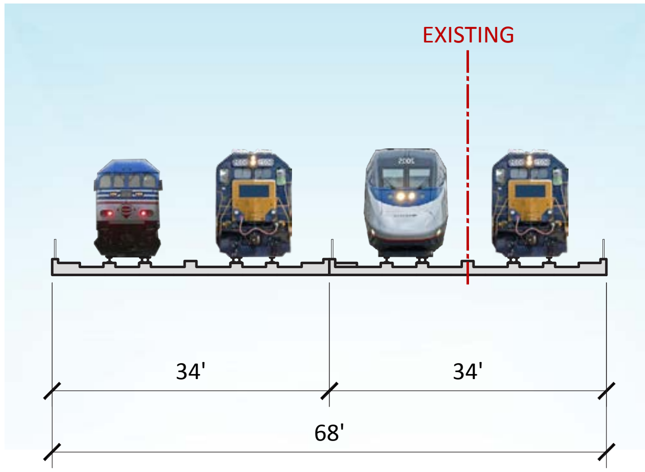
- Alternative 1 – No Build



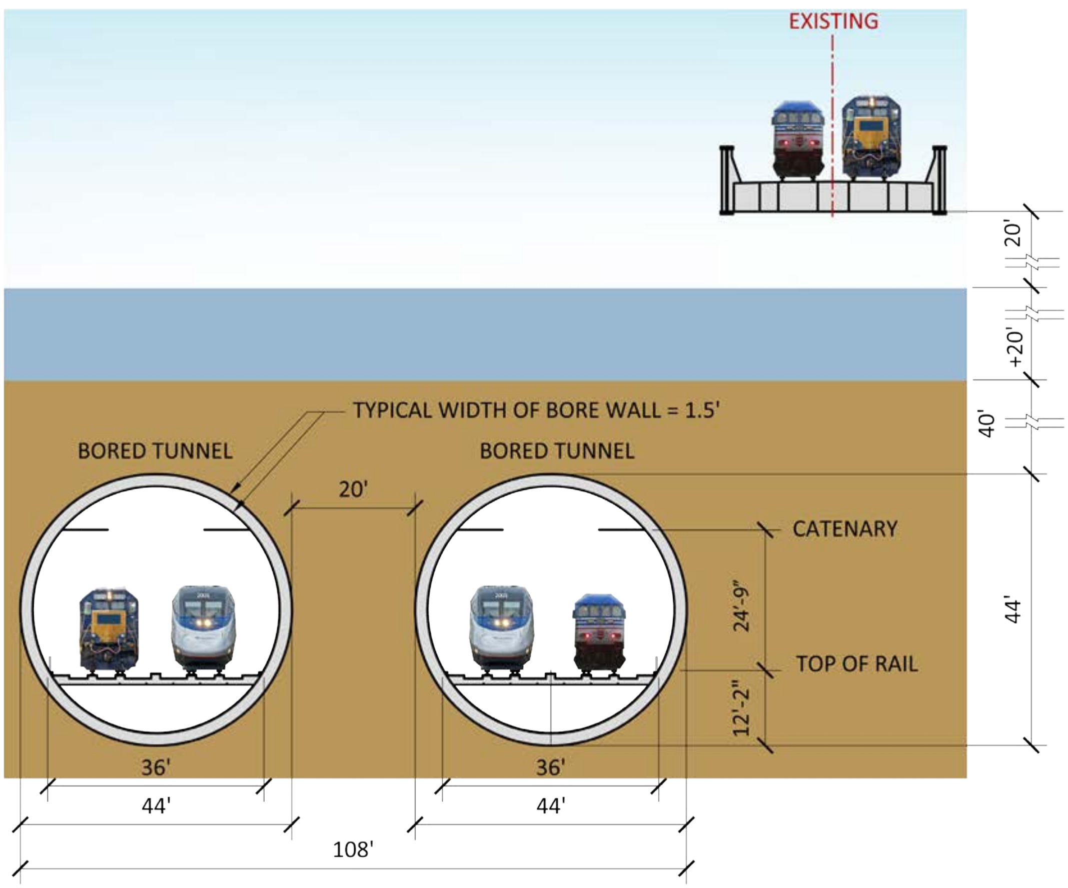
- Alternative 2 – Two-track bridge (rehabilitation or reconstruction of existing system)



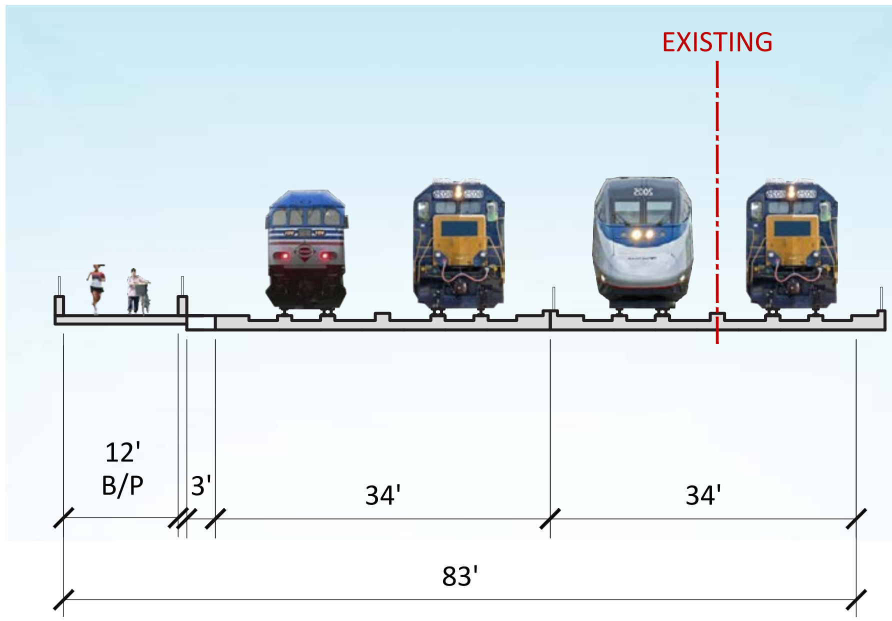
- Alternative 3 – Four-track bridge



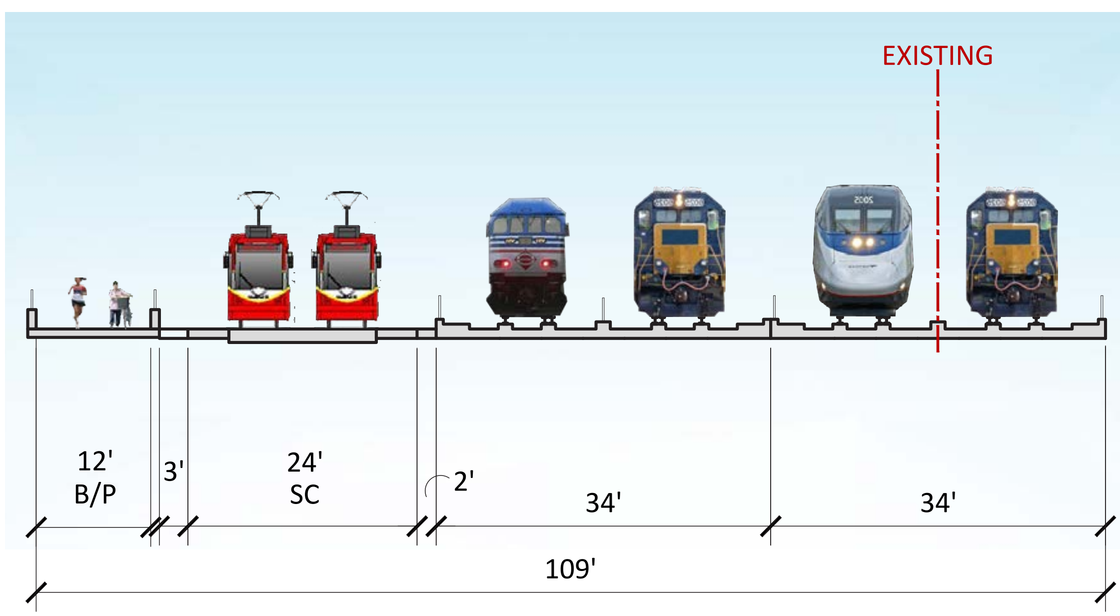
- Alternative 4 – Four-track tunnels



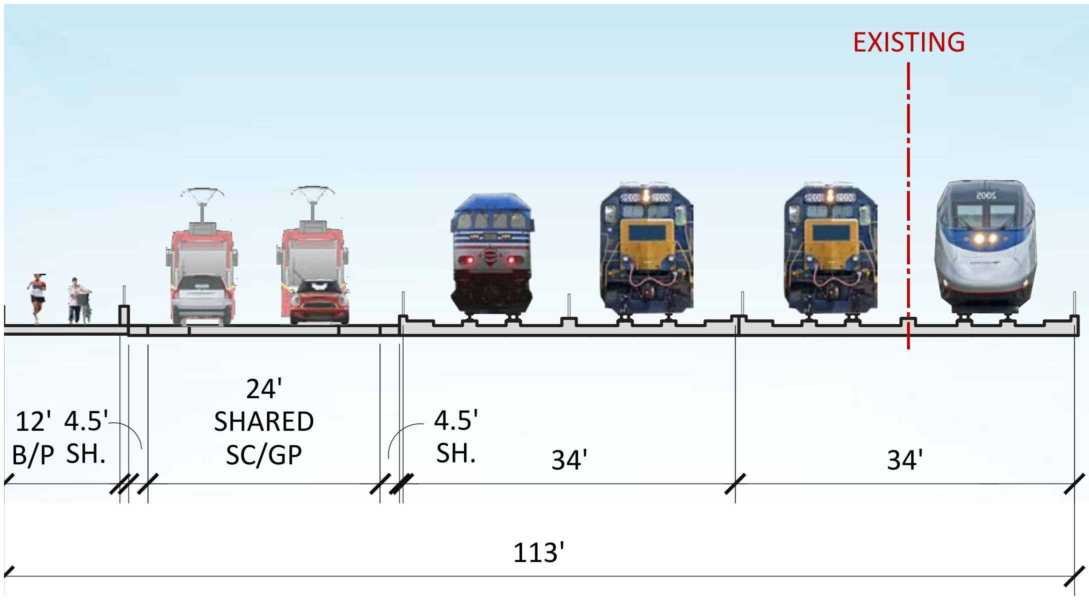
- Alternative 5 – Four-track bridge with bicycle/pedestrian connection



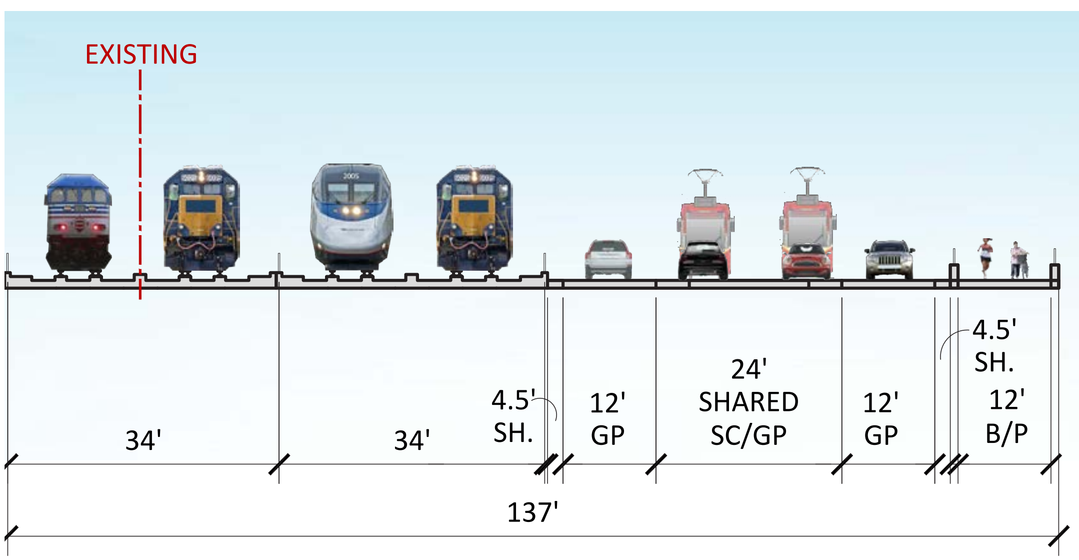
- Alternative 6 – Four-track bridge + two streetcar lanes with bicycle/pedestrian connection

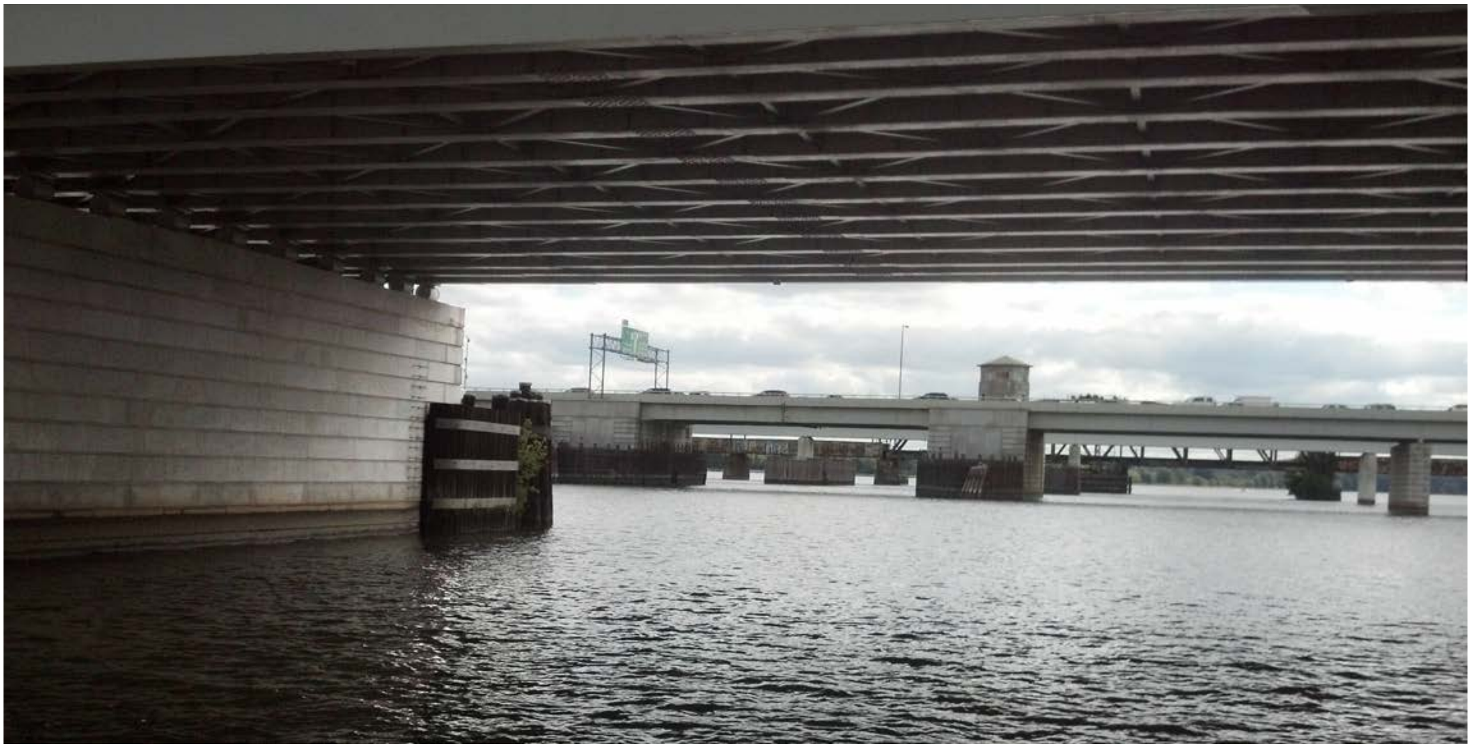


- Alternative 7 – Four-track bridge + two streetcar/general-purpose lanes with bicycle/pedestrian connection



- Alternative 8 – Four-track bridge + two streetcar/general-purpose lanes + two general-purpose with bicycle/pedestrian connection





Railroad Alternatives

Alternative 1: No Build

The No Build alternative assumed no physical modifications to the existing rail bridge. It served as a benchmark for the alternatives and provided a starting point to assess the capacity needs of future freight and passenger service. The No Build consisted of two tracks with a bridge width of 36 feet 6 inches.

Alternative 2: Two-Track Bridge

Alternative 2 focused on the existing Long Bridge two-track structure for either rehabilitation or a complete reconstruction of the existing bridge. The superstructure rehabilitation took into consideration the existing coating system, which had widespread surface corrosion and needed to be repaired or replaced. Rehabilitation to the substructure would include the installation of additional vertical batter piles around the existing piers, installation of cofferdams and piles (if needed), modifications to existing piers, and connection between the existing structures and rehabilitation improvements. Reconstruction of the existing bridge assumed a two-track replacement of the current bridge structure that could be designed using one of the bridge type concepts identified in this study. The superstructure and/or substructure rehabilitation could be pursued separately depending upon the condition and life expectancy of the structures. Additional analysis would be required to make this determination including an underwater inspection, inspection of the superstructure, reassessment of the train load ratings, and completion of a fatigue life study. This alternative would impact rail operations as it would require shutting down traffic during reconstruction.

Alternative 3: Four-Track Bridge

Alternative 3 introduced two additional railroad tracks to the existing two-track bridge for a four-track rail system. The expanded four-track bridge would accommodate future rail operations. Any option that included reconstruction of the existing bridge would require that two tracks always remain in operation for current operations. Therefore, two new tracks could maintain operations while the existing tracks were being reconstructed.

Alternative 4: Four-Track Tunnel

Alternative 4 presented the only belowground option of all the alternatives. A single tunnel or combination of tunnels would be exclusively used for four rail tracks. Tunnel options consisted of several types of tunnel designs, including jacked segmental, submersed segmental, or twin bore. Development of a rail tunnel option would require consideration of numerous physical constraints along the potential alignment, as well as consideration of industry standard operations, equipment performance, and design criteria.

Tunnel alternatives for this study required any tunnel option to pass below the Potomac River navigation channel and any landside underground structures such as Metrorail tunnels, utilities, and bridge/building foundations. This essentially required Alternative 4 to assume a deep bore tunnel concept.

The tunnel would accommodate double-stack freight container cars. The concepts developed assumed separate tunnels for a two-track freight operation and a two-track passenger operation. Alternative 4 envisioned an underground rail station between Banneker Circle and 3rd Street, SW, connecting to L'Enfant Metro Station and allowing passengers to access the Southwest waterfront area from belowground.

The tunnel alternative assumed that all tracks could be electrified with the catenary system located at the required height for clearance of double-stack freight trains. A full four-track universal interlocking was envisioned between the Washington Channel and approximately 9th Street, SW, before the underground passenger station, to provide full operational flexibility.

Railroad and Other Modal Alternatives

Alternative 5: Four-Track Bridge and Pedestrian/Bicycle

Alternative 5 introduced two additional railroad tracks to the existing two-track bridge for a four-track rail system and also introduced a new adjacent pedestrian/bicycle pathway across the Potomac River.

The pedestrian/bicycle pathway would make new connections to Long Bridge Park in Virginia; National Park Service (NPS) land at George Washington Memorial Parkway/Mount Vernon Trail on the Potomac River waterfront in Virginia; NPS land at East Potomac Park, allowing easy access to the amenities at Hains Point; and at the Tidal Basin at Maine Avenue, SW, and the Southwest waterfront in the District.

Alternative 6: Four-Track Bridge with Pedestrian/Bicycle and Streetcar

Alternative 6 built upon the expansion of the existing bridge as described in Alternative 5 by adding two exclusive streetcar lanes.

This alternative assumes new construction will occur down river (southeast) of the existing bridge. The addition of a southeast streetcar and pedestrian/bicycle pathway were complicated on the Virginia side due to having to cross over or under the rail tracks. Currently, the rail bed sits on a raised earth berm, making an underpass option more viable than a flyover for these modes. The streetcar alignment in Virginia's Long Bridge Park would continue and connect to the Arlington County streetcar network and have an overlapping station at PenPlace. In the District, at the point where rail tracks pass below the surface streets and plaza at the Mandarin Oriental Hotel, the streetcar would continue onto the Mandarin Plaza and continue to 12th Street, SW. There, the streetcar would have the option to turn down 12th Street, SW, towards Maine Avenue, SW, or continue to 7th Street, SW, eventually connecting to a future streetcar line.

Alternative 7: Four-Track Bridge with Pedestrian/Bicycle and Shared Streetcar/General-Purpose Lanes

Similar to the previous alternatives, Alternative 7 continued to build on the modal choices to cross the Long Bridge and introduced shared lanes for streetcar and general-purpose.

General-purpose traffic options at the Mandarin Oriental Hotel Plaza in the District were the same as those for streetcar. The general-purpose lanes could provide a local connection access to 12th Street, SW, or D Street, SW, in the District or use the same route as streetcar if the Maryland Avenue decking is completed between 12th Street, SW, and 7th Street, SW. A second option could include vehicular ramp access to Maine Avenue, SW, before reaching the Mandarin Plaza. These would be slip ramps that

would most likely have to be signal controlled because of the proximity to the split between Maine Avenue to the Southwest waterfront and the expressway.

Alternative 8: Four-Track Bridge with Pedestrian/Bicycle, Shared Streetcar/General-Purpose Lanes and Additional General-Purpose Lanes

Alternative 8 presented the largest footprint of any of the previous alternatives and was a departure from the location of the footprints shown in Alternatives 5 through 7. Alternative 8 provided for an expansion on the up river (northwest) side of the current bridge.

The general purpose connection to Maine Avenue on the northwest side in the District was more difficult than if the expansion was on the southeast side of the bridge. The northwest side general-purpose connection to Maryland Avenue, SW, could act much like the streetcar connection. General-purpose lane access to Maryland Avenue was the same for a northwest or southeast expansion since the general-purpose lanes (like streetcar) rose above the rail track bed in the vicinity of the Tidal Basin Bridge and were grade separated at Mandarin Plaza with the rail bed passing below the plaza.

The local connection for general-purpose lanes was also more favorable on the northwest side on the Virginia side for the same reasons as streetcar, including allowing for a local road connection onto Long Bridge Drive at Boundary Drive. Boundary Drive is planned for reconstruction into roundabouts. General-purpose lanes from this alternative could connect to the new roundabout, which in turn would have access to I-395.

Transportation Analysis

A detailed analysis of freight and passenger rail was conducted in the study. Analysis was also performed for additional non-rail modes. A detailed description of the analysis can found in Chapter 5 as well as technical memorandums that are located in Appendix A.

Freight and Passenger Rail

Passenger, commuter, and freight rail are using the same two-track railroad to cross the Long Bridge. Each service provider operates to maximize its service with the throughput of goods for freight trains and the provision of on-time passenger service. The project team looked at the existing service crossing the bridge and forecasted future demand for service to determine the maximum number of any type of train that can utilize the Long Bridge and the associated delay and performance for each analyzed scenario and track configuration.

The rail analysis was conducted for current, 2020 and 2040 typical delay operations for two- three and four-track scenarios.

The performance of the bridge is a function of the delay percentage for both freight and passenger operations and on-time performance for passenger trains. For passenger trains percent delay should be very low as an operating plan should schedule trains to run as efficiently as possible, with as little delay as possible. An acceptable delay percentage for passenger operations is in the 0 to 5 percent range. On-time performance refers to the percentage of operating passenger trains that arrive within five minutes of their scheduled arrival times. Freight does not have on-time performance statistics because the freight trains do not operate on fixed schedules.

Analysis was performed under typical delay conditions to observe the effects on the performance of operations. This is representative of typical operating conditions and is important in order to observe the overall stability of the rail operating system during periods of delay. Typical delays happen in real day-to-day rail operations due to signal or track maintenance, malfunctioning equipment, disabled trains, dwell times at stops, or conflicts between freight and passenger operations. In reality, freight trains do not operate on fixed schedules, so often times they create conflicts with other railroad services when they do arrive at junctions or congested areas.

Freight delay was decreased as the analysis introduced additional tracks for crossing the Potomac River at Long Bridge. With a two-track configuration, under existing conditions, 30 percent of freight operations were at less than the maximum operating speed. This percentage jumped to 72% for a two-track configuration with 2040 forecasted trains. The addition of a third track on Long Bridge resulted in a 2020 delay of 30 percent less than maximum operating speed which jumped to 45 percent of freight trains less than maximum operating speed with 2040 forecasted trains. The addition of four tracks on Long Bridge significantly reduced freight delay in the 2020 and 2040 analysis to 5% and 6% respectively for freight trains less than maximum operations speed.

The existing railroad infrastructure within the Long Bridge study area can support the existing operations under certain typical delay events today. However, due to the physical constraints of the existing infrastructure there is a limited ability to increase passenger and freight operations in the future. Much of the delay experienced by today's passenger trains originates from conflicts with freight operations due to the bottleneck surrounding the Long Bridge. Current operations are hindered by a combination of poor track and infrastructure conditions leading to severe speed restrictions across the bridge and VRE's limited platforms further restricting operations that cause many of the delays experienced in this area of the corridor.

Rail Operations Summary

Scenario	Tracks	Daily Freight Trains	Daily Passenger Trains	Daily Trains	Typical Delay %		Passenger On-Time Performance
					Passenger	Freight	
Existing	2-Track	23	56	79	1.5%	30.7%	99.0%
2020	3-Track	29	108	137	1.1%	30.1%	99.0%
	4-Track				0.9%	5.1%	99.0%
2040	2-Track	34	132	166	3.4%	72.1%	97.0%
	3-Track				3.3%	45.3%	98.2%
	4-Track				1.8%	6.4%	98.5%

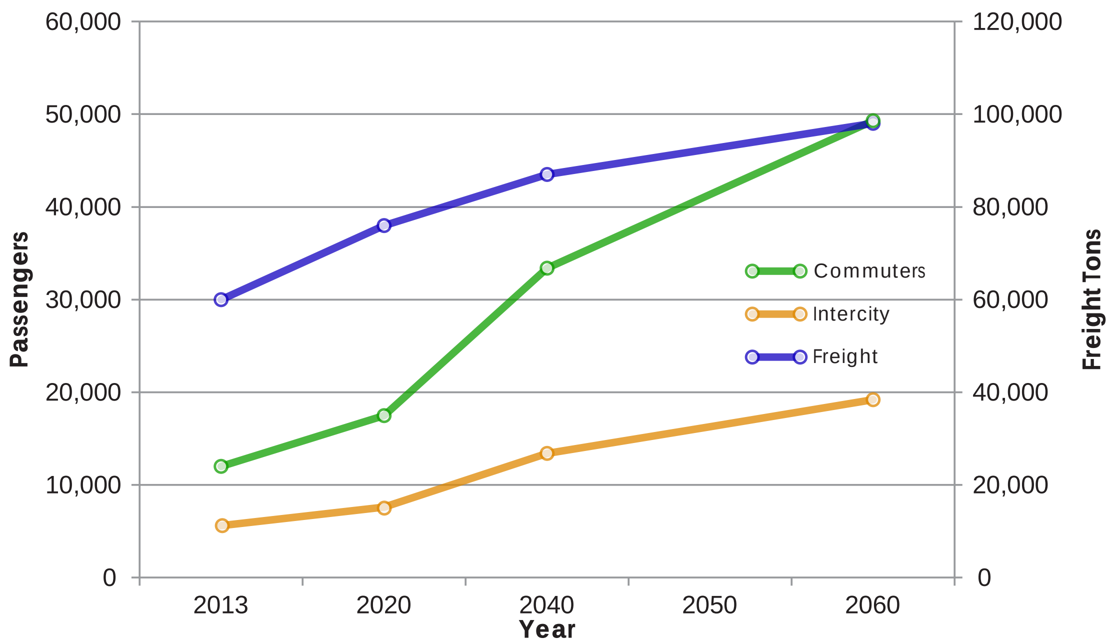
Freight trains in the 2040 two-track bridge alternative experienced 60 percent more delay then in the three-track bridge alternative, and more than ten times the delay when compared to the four-track bridge alternative. Due to the randomized nature of freight traffic, trains operating through the area during the peak periods are consistently delayed until there is available infrastructure to travel across the Long Bridge. With future increases in freight volumes and the frequent ten minute headways for VRE peak period service over Long Bridge, passenger train delays would cascade quickly, and not recover until the peak period has ended for the existing two-track bridge configuration.

This analysis reflects that the proposed station platforms, the reconfigured interlockings and signal spacing could greatly increase the landside capacity through the study area. The future plans to bring high-speed operations to this corridor further supports the need for additional tracks across the bridge. The four-track system accommodates the future service needs for passenger, commuter, and freight rail. Beyond the capacity of a four-track system, it also provided a better serviceability in terms of track sharing and station platform layout for passenger and commuter rail service. In future scenarios, proposed center island platforms at L'Enfant and Crystal City Stations would allow passenger trains to stop in both directions, allowing future bidirectional Amtrak, high-speed rail, VRE, and MARC service.

Rebuilding a two-track Long Bridge to accommodate train speeds in excess of 60 miles per hour without expanding to three- or four-tracks across the Long Bridge does not alleviate the bottleneck operation surrounding the bridge and does not allow for an increased separation between passenger and freight operations.

Freight and Passenger Outlook

To provide insight into to carrying capacity of the Long Bridge rail system, the existing and forecasted freight and passenger train volume was converted into tonnage and number of passengers crossing the Long Bridge. The future of freight and passenger rail development lies in the effective utilization of existing capacity and the creation of new rail capacity for anticipated growth. The railroad industry will continue to exhibit a consistent increase in the demand for the movement of freight and passengers. The performance of rail for moving passengers rivals highways and air travel. Moving freight commodities competes with truck freight for long-distance hauling speed and the capacity to carry more goods. Additional tracks across Long Bridge would reduce the bottleneck for operations and limit the amount of conflicts between passenger and freight operations in this area. The four-track bridge alternative provides the most separation between freight and passenger operations, and allows for efficient use of future high-speed rail on the corridor.



Growth in Long Bridge Freight Tonnage and Passengers 2013-2060

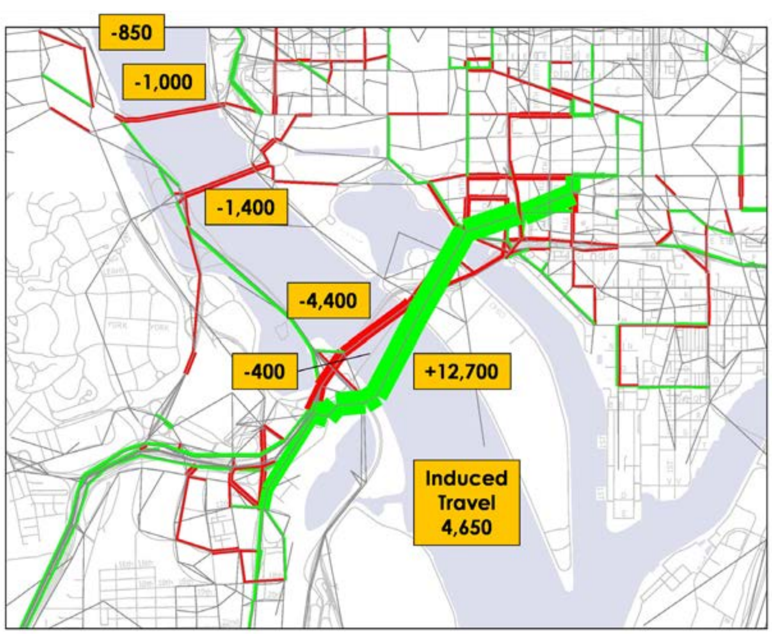
Analysis of Pedestrians and Bicycles

The study area already has several trails and networks for bicycle and pedestrian users. The pedestrian/bicycle alternatives for this study created new connections to the Southwest waterfront, Tidal Basin, Anacostia Riverwalk Trail, East Potomac Park, Mount Vernon Trail, and Long Bridge Park. Modeling for 2040 showed an increase in pedestrian/bicycle use of the trail network with the alternatives additional connections. The majority of the increased usage was generated from the District.

Analysis of Transit and Vehicular Modes

Transit and vehicular modes were analyzed in the study. The travel demand forecast for these modes was developed using the Metropolitan Washington Council of Governments' (MWCOG) Travel Demand Model. Alternatives for this study incorporated the general-purpose and streetcar alternative scenarios into the established MWCOG future models that included network definitions as detailed in the 2013 MWCOG Constrained Long Range Transportation Plan (CLRP), as well as adopted MWCOG Round 8.2 land use available at the time of this study.

The study utilized the MWCOG model to forecast future streetcar ridership. Volumes ar estimated in terms of passengers per day. The streetcar connection analyzed in



this study would connect to the District's streetcar network via Maryland Avenue, SW, or Maine Avenue, SW. On the Virginia side of the bridge, the streetcar would connect at PenPlace. Alternatives 6, 7, and 8 all introduced a streetcar system. Alternative 6 (streetcar only) would have 4,216 daily crossings; alternative 7 (shared streetcar and general-purpose) would have 4,252 daily crossings; and alternative 8 (shared streetcar/ general-purpose + general-purpose) would have 4,280 daily crossings. Sixty-seven percent of the trips were work trips, and 33 percent were non-work trips.

The MWCOG model showed that the existing daily volume for vehicular traffic across the Potomac River was 893,190 and it is projected to increase by approximately 20 percent by 2040. The Long Bridge general-purpose lane alternatives were forecasted to carry approximately 13,000 daily vehicles. The travel forecast shows that the travelers that would use the new connection across the Potomac River via the Long Bridge would not all be new travelers across the Potomac River. Some drivers would choose to use the new connection instead of the existing Potomac River roadway crossings, as shown in the diversion graphic shown below. The model predicted a decrease of 4,800 users per day from the adjacent bridges, including I-395/14th Street Bridges, and a total increase of 4,650 new travelers per day across the Potomac River.

Engineering, Constructability and Costing

Four bridge types were assessed in detail for this study: tied arch, through arch, deck arch, and extradosed (cable-stayed). Bridge elevations and cross sections were developed for each type. Engineering considerations used in the development of these concepts included constructability and construction impact, long-term maintenance, adaptability, and aesthetics. Engineering is further discussed in Chapter 6 and constructability and a full discussion of costing is in Chapter 8.

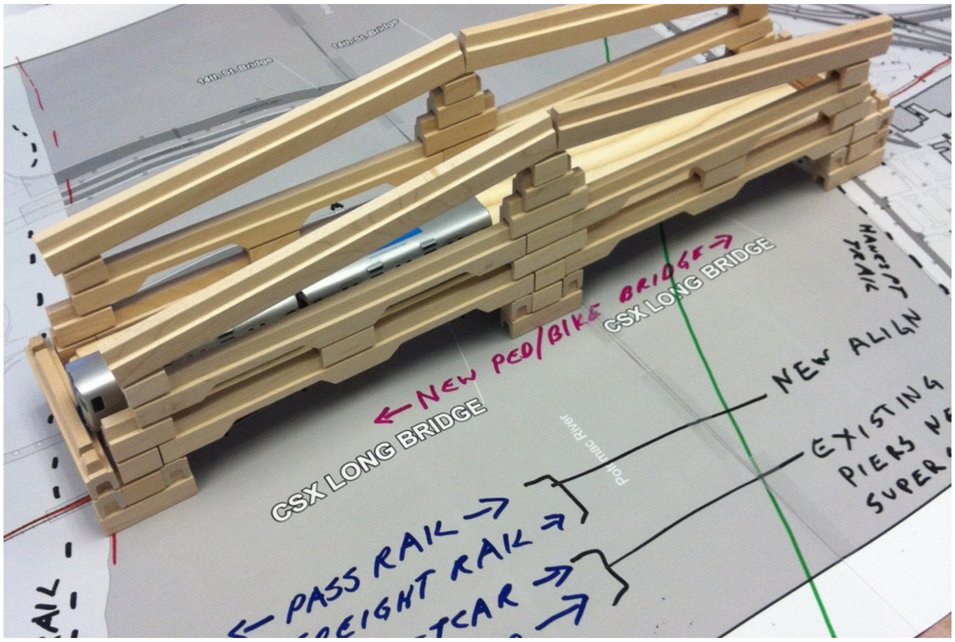
The tied arch bridge would consists of a single tied arch main span of approximately 280 feet with nine (Virginia side) to 13 (District side) approach spans ranging from 85 to 108 feet each. The bridge would provide a vertical clearance of 25.75 feet beneath the structure for river navigation.

The through arch bridge is similar to the tied arch concept. The main span length would be approximately 440 feet with eight (Virginia side) to 13 (District side) approach spans ranging from 85 to 108 feet each. The vertical clearance is 25.75 feet for river navigation.

The deck arch bridge would have 15 spans, approximately 170 feet long. The navigational clearance would be 42 feet. Arches for this concept could be constructed as either solid elements or with spandrels.

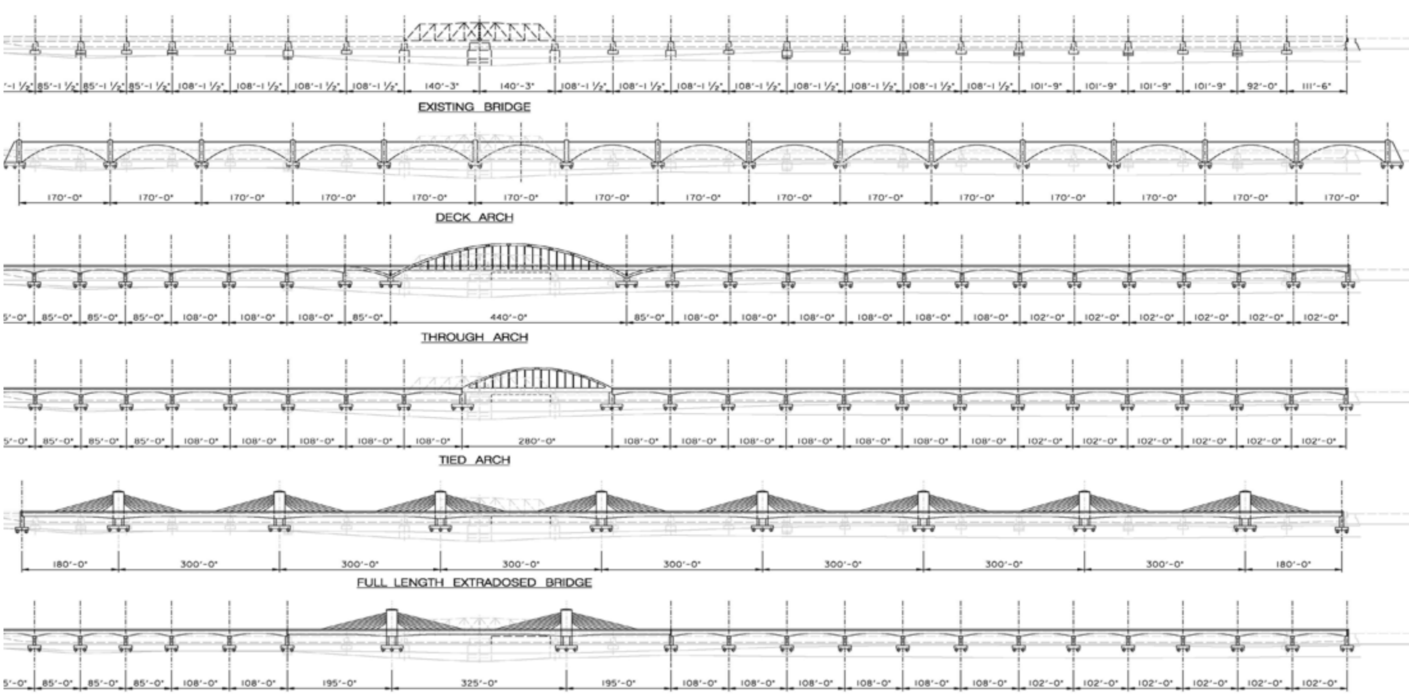
Alternative 8, the widest alternative footprint, would be 137 feet wide for the tied, through, and deck arch bridge concepts.

The extradosed bridge uses a series of cable-supported spans to cross the Potomac River. Each of the seven full spans would be approximately 300 feet with two additional 180-foot spans to the banks of the Potomac River. The bridge would have a 20-foot clearance for river navigation. Additional analysis would be required to determine if the extradosed concept could accommodate the Alternative 8 bridge width of 137



feet. Preliminary analysis as part of this study suggested that two structures might be required. This would result in separate rail and multimodal bridges.

Tunnel options included jacked segmental, submersed segmental and twin bore. Tunnel concepts assumed that all tracks could be electrified with the catenary and guide wire above the maximum height requirement for double-stacked freight trains. Assessment of the vertical alignment and anticipated profile for each tunnel option considering the depth requirements to avoid existing underground structures made it



unlikely that a jacked or submersed tunnel will be constructed. Twin bore tunnels were the most viable option with separate freight and passenger tunnels under the Potomac River and included full switching (interlocking) capabilities of all tracks for both freight and passenger use in the District and Virginia. In the District, a new underground passenger station was considered to provide access to the Southwest watefront as well as options to connect underground to Metrorail's L'Enfant Station.

Each bridge and tunnel concept was also evaluated for its constructability. Accessing the construction site from the northwest side would require access from federal lands. Construction for the southeast side of the bridge could be done from the river on a barge.

The costing was estimated using order of magnitude basis and included a 35 percent contingency added on the sum of structure, rail, and "other" costs of each option. This preliminary level of cost evaluation differentiates the alternatives on the basis of anticipated construction cost of the bridge or tunnel structure and associated rail components. Elements considered for the construction of the bridge included structure, bridge deck, and approach areas. Tunnel elements included tunnel sections, portals, ventilation, underground passenger facilities, and associated tunnel requirements. Additionally, costs were estimated for the related right-of-way and the relocation of utilities. A full description of the costs is provided in Appendix E.

4-Track Concepts - Alternatives 2-4

(2013 Dollars) - Order of Magnitude Costs*			
Structure Type	**Alternative 2**	**Alternative 3**	**Alternative 4**
1. Steel Tied Arch	$137M - $197M	$355M - $464M	(A) Shallow Jacked Segmental Tunnel $6.222 Billion
2. Steel Through Arch	$151M - $217M	$378M - $494M	
3. Extradosed	$291M - $393M	$598M - $762M	(B) Shallow Submersed Segmental Tunnel $6.243 Billion
3a. Partial Extradosed	$205M - $289M	$458M - $594M	
4. Concrete Deck Arch	$160M - $225M	$402M - $521M	(C) Twin Bored Tunnel $5.728 Billion
4a. Standard Girder Structure with Concrete Arch Façade Elements	$154M - $210M	$365M - $467M	

*These costs and the bridge and tunnel types discussed herein are conceptual in nature.

4-Track Concepts - Alternatives 5-8				
(2013 Dollars) - Order of Magnitude Costs*				
Structure Type	Alternative 5	Alternative 6	Alternative 7	Alternative 8
1. Steel Tied Arch	$424M - $556M	$607M - $794M	$623M - $816M	$733M - $963M
2. Steel Through Arch	$450M - $590M	$638M - $837M	$655M - $859M	$770M - $1.012B
3. Extradosed	$700M - $893M	$917M - $1.169B	$941M - $1.200B	$1.104B - $1.410B
3a. Partial Extradosed	$535M - $695M	$709M - $919M	$727M - $943M	$849M - $1.104B
4. Concrete Deck Arch	$483M - $628M	$664M - $862M	$686M - $890M	$815M - $1.062B
4a. Standard Girder Structure with Concrete Arch Façade Elements	$431M - $555M	$587M - $758M	$604M - $781M	$710M - $923M

*These costs and the bridge and tunnel types discussed herein are conceptual in nature.

Environmental Review and Resource Identification

The project's study area included many resources that will need to be addressed and assessed during an environmental study. There are historic landmarks, national parks, state and local parks, and water bodies. In addition to these resources, the environmental study will need to look further into environmental justice issues,

air quality, and noise and vibration. This project presents a unique opportunity for partnerships, as there are many federal agencies and private sector interests in this bridge and its location.

The environmental phase for this project will have to carefully consider all NEPA implications, as well as Section 106, Section 4(f), and Section 6(f). A bridge replacement or reconstruction can be a Categorical Exclusion (Cat Ex); however, any major replacement, such as some of the expanded alternatives developed in the report, may require an Environmental Assessment (EA) or an Environmental Impact Statement (EIS).

Findings

The study found the following:

- The Long Bridge is an important railroad crossing in the District. It carries local, regional, and national freight, passenger, and commuter traffic.
- The Long Bridge will maintain its importance in the national railroad network due to the continuing commuter, passenger, and freight rail needs and the future high-speed rail requirements.
- The current Long Bridge structure will require regular inspection and maintenance and likely need a major rehabilitation to support the continued operation of passenger, commuter, and freight service.
- The existing bridge has a two-track system, which provides operational challenges even for existing operations. The existing superstructure and substructure of the bridge cannot accommodate any additional tracks due to the limited width available to expand and the limitation on bearing any additional loads. If the crossing is to meet the future passenger, commuter, and freight service demands, it will require expansion.
- The bridge should be able to accommodate double-stacked trains.
- The bridge should be able to accommodate electrified trains.
- The Long Bridge is part of the future high-speed rail network and provisions should be made to accommodate high-speed rail on the bridge.
- The Long Bridge area possesses high transportation demand for all surface transportation modes. The future Long Bridge could be built to accommodate modes such as transit, general purpose, and pedestrian/bicycle. The study developed a number of alternatives that can meet the future demand.
- If other non-rail modes are introduced, safety provisions will have to be made to accommodate those modes, which may require physical separation, physical barriers, and separate bridge spans.

- The land use on both sides of the Long Bridge is showing continued growth. Access to and from these sites and connectivity to these land uses should be considered in any future Long Bridge improvements or future bridge design.

- The Long Bridge is adjacent to the District's monumental core. Any future bridge improvements should complement the historic and monumental context of the District in its design and architecture.

- The Long Bridge area includes several sensitive environmental resources such as national parks, historic landmarks and areas, and water bodies, which will require detailed analysis.

- A tunnel can be built to provide for the future rail needs in addition to the existing bridge or as a replacement of the bridge.

- Any future extensive improvements to the bridge such as bridge replacement or reconstruction would require substantial funding.

- The future of the Long Bridge will require coordination among many stakeholders and users for continued success and to effectively move people and goods across the Potomac River.

Project Coordination

The project team conducted several meetings, a site visit, and workshops with a number of agencies and other project teams that were conducting projects that could affect the Long Bridge Study. Coordination with FRA and CSX was continuous throughout the study. The project had an extensive stakeholder and agency participation list:

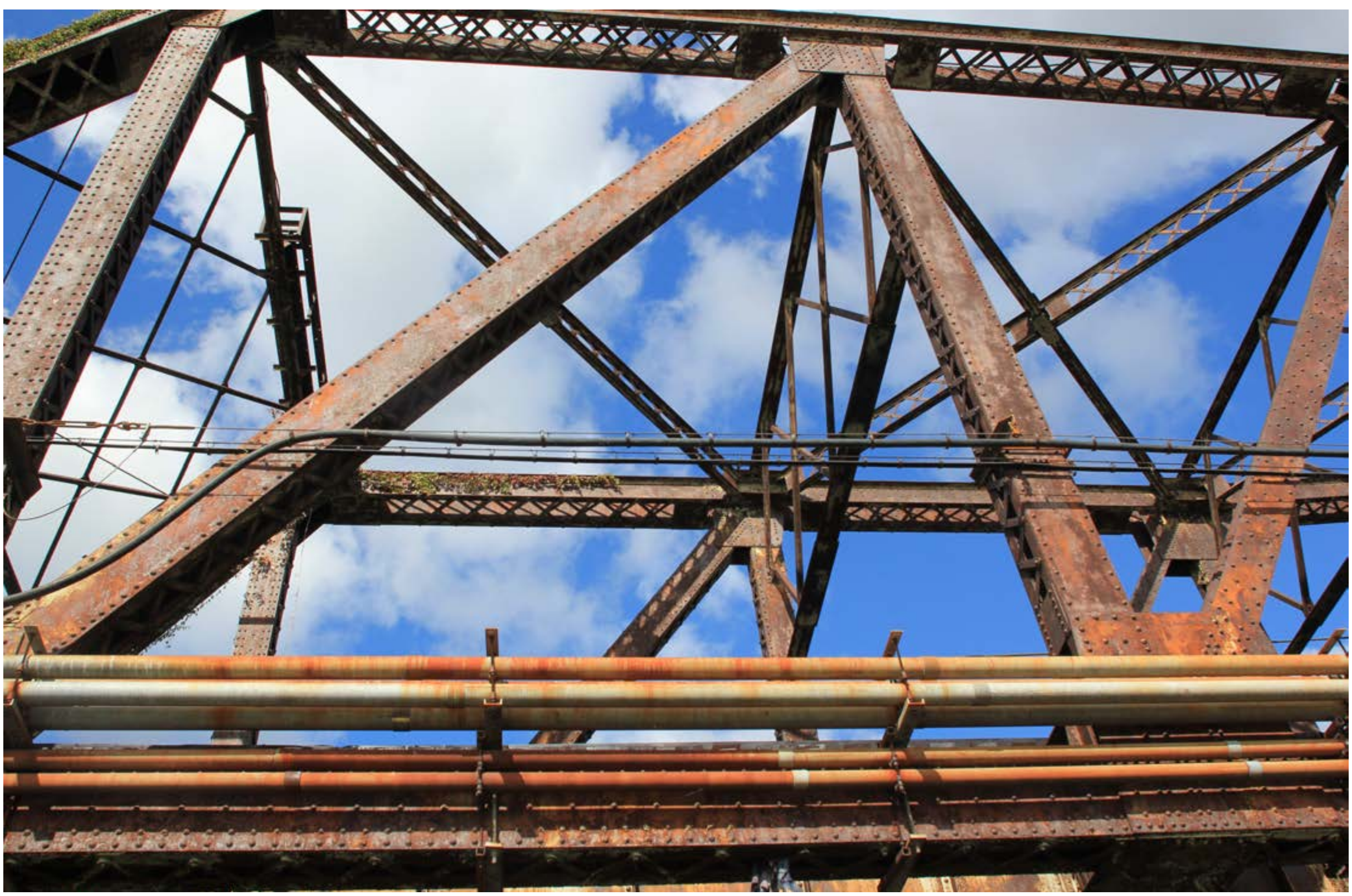
- AMTRAK
- City of Alexandria
- Arlington County
- Commission on Fine Arts
- CSX Transportation
- DC State Historic Preservation Office
- DC Water
- Federal Aviation Administration
- Federal Railroad Administration
- Federal Highway Administration
- Federal Transit Administration
- MARC
- Metropolitan Washington Council of Governments
- Metropolitan Washington Airports Authority
- National Capital Planning Commission
- National Park Service
- Department of the Navy
- Norfolk Southern
- Washington Metropolitan Area Transit Authority
- Virginia Department of Transportation
- Virginia Department of Rail and Public Transportation
- Virginia Railway Express

The project team held three public meetings for feedback and engagement:

Public Meetings		
Meeting	Date	Location
1	November 13, 2012 4:00 pm- 6:00 pm	Westminster Presbyterian Church 401 I Street, SW
2	June 6, 2013 4:00 pm- 7:00 pm	Westminster Presbyterian Church 401 I Street, SW
3	December 5, 2013 4:00 pm- 7:00 pm	St. Augustine's Episcopal Church 600 M Street, SW

Acknowledgements

DDOT would like to thank all those who participated in the study for their input and participation in the many meetings, workshops, and coordination efforts throughout the project.



Page left blank intentionally.

CHAPTER 1: OVERVIEW

CHAPTER 1: OVERVIEW

The Long Bridge Study was conducted by the District Department of Transportation (DDOT) and the Federal Railroad Administration (FRA) from the Summer of 2012 through the Winter of 2014 under an American Recovery and Reinvestment Act (ARRA) grant in the High-Speed Intercity Passenger Rail (HSIPR) Program. The Long Bridge is a two track railroad bridge spanning over the Potomac River connecting the rail lines within the District of Columbia and the Commonwealth of Virginia. It was constructed in the late 19th and early 20th century and is the only railroad bridge over the Potomac River in the District. The bridge currently carries freight, commuter, and passenger rail traffic from CSX Transportation Inc. (CSX), Virginia Railway Express (VRE), and Amtrak. The bridge is owned by CSX, with user rights held by Norfolk Southern.

The purpose of the Long Bridge Study was to analyze structural and operational needs of the bridge for existing and future conditions.

Background

DDOT is responsible for maintaining and managing the transportation infrastructure in the District. DDOT's mission is to develop and maintain a cohesive, sustainable transportation system that delivers safe, affordable, and convenient ways to move people and goods, while protecting and enhancing the natural, environmental, and cultural resources of the District. Even though the Long Bridge is not owned or maintained by DDOT, it is an important component of the District's transportation system. The Long Bridge provides an important rail connection across the Potomac River and is a key element of the national rail system in the Northeastern United States (US). DDOT recognizes the importance of rail transportation and has taken the opportunity to work with the Federal Railroad Administration (FRA) and various railroad organizations on this study to understand the existing and future transportation needs for this important river crossing.

Passenger, commuter, and freight rail play an important part in supporting economic growth and vitality. This study provided an opportunity to identify the improvements needed for the rail transportation system, while also analyzing the potential of improving multimodal connectivity across the Potomac River.

The Long Bridge

The Long Bridge is a two-track railroad bridge over the Potomac River connecting the District and the Commonwealth of Virginia (Virginia). The National Park Service (NPS) owns the landings on the District and Virginia sides of the river, as well as the riverbed. The bridge is over a navigational channel overseen by the US Coast Guard. Current navigation operations consider the minimum width of the channel at 110 feet and the minimum clearance at 20 feet.

The bridge is constructed of fixed concrete and stone piers in the Potomac River waterway; a horizontal truss and girder system defines the bridge deck. The bridge has 22 through girder spans and a double swing truss span totaling 24 spans for a length of 2,529 feet. The two-track rail system on the bridge is 36 feet 6 inches wide, narrowing to 28 feet 8 inches at the swing truss. There is an additional two-span bridge that continues to cross the Tidal Basin between Potomac Park and the Southwest waterfront.

Study Area

The study area for this project generally extends from Control Point (CP) AF at Milepost CFP 104.3 in Alexandria, Virginia through the VRE L'Enfant Plaza Station at Milepost CFP 111.9 in the District, which are on the CSX Transportation RF&P Subdivision. This area includes the full length of the Long Bridge (MP CFP 110.8 to MP CFP 111.2) and abutments for analysis of transportation, engineering, and the environment, as well as an extended area to understand the operational needs of freight and passenger rail beyond the limits of the physical Long Bridge. Figure 1.1 shows Long Bridge and the surrounding area.

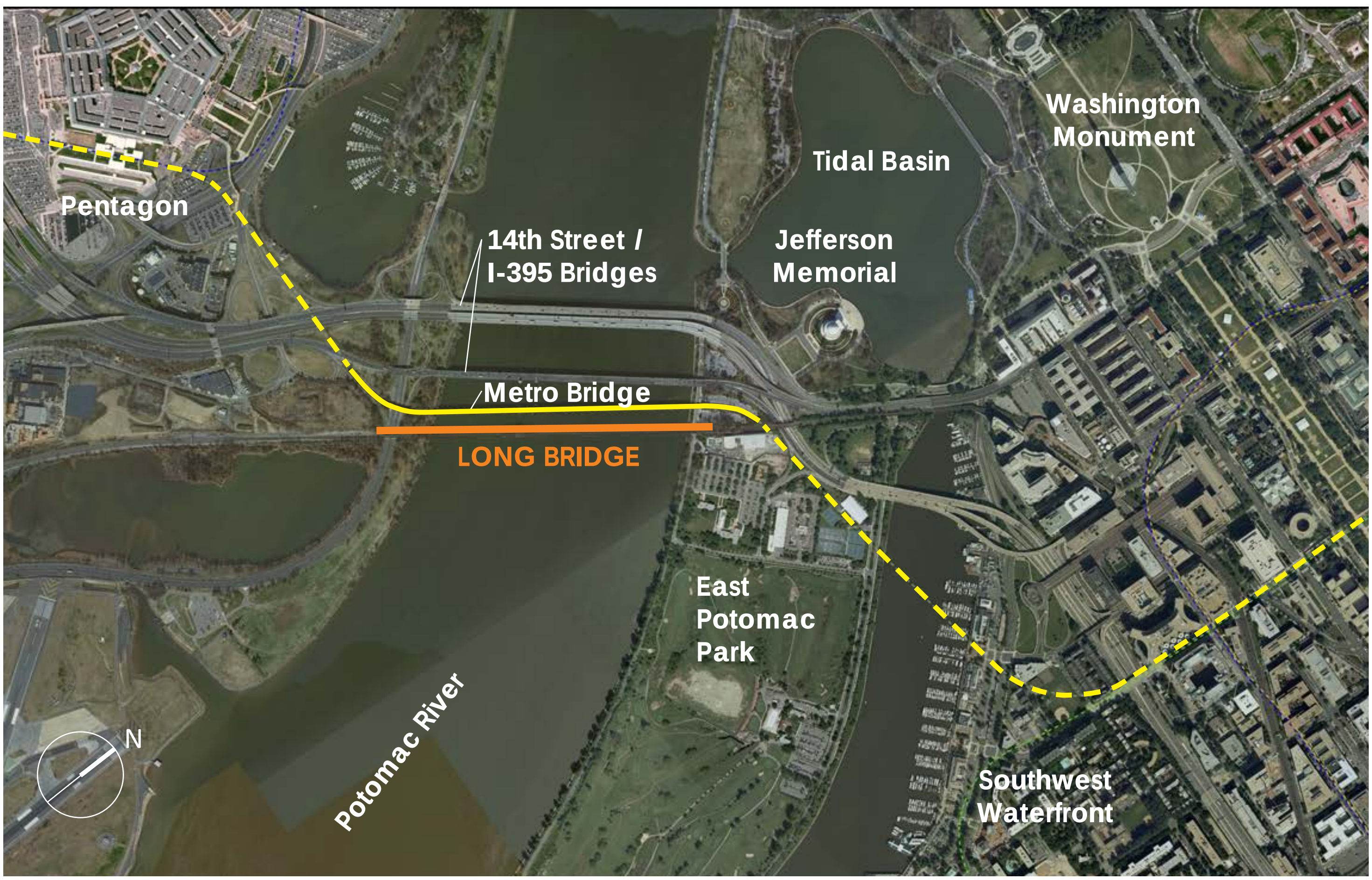


Figure 1.1: Long Bridge Study Area

There are several other bridges in close proximity of the Long Bridge. The Washington Metropolitan Area Transit Authority's (WMATA) Metrorail bridge for the yellow line is the first bridge located northwest of the Long Bridge, followed by the 14th Street Bridges complex that includes the George Mason Memorial Bridge, the Rochambeau Bridge, and the I-395/Route 1 Bridge.

In the District, the Long Bridge crosses East Potomac Park and the Washington Channel at the Southwest waterfront. The Wharf waterfront area is known for its fish market, as a destination for boat tours and docking of private boats, and as a recreational connection for pedestrians and cyclists to the Tidal Basin and entry to the monumental core. The railroad tracks continue from the Washington Channel on elevated tracks around the Mandarin Oriental Hotel to a subgrade rail bed. Beyond the subgrade rail bed, passenger trains stop at L'Enfant Station, which is a major commuter hub for Amtrak and VRE. The L'Enfant area includes the WMATA Metrorail green, yellow, blue, and orange line stops. The area surrounding L'Enfant houses many federal agencies, making it a major employment destination.

Future plans to change the Southwest waterfront area include a number of update plans that focus on some of the Long Bridge Study area. Private development of The Wharf waterfront area will bring mixed-use development to the Southwest waterfront along Maine Avenue SW. The National Capital Planning Commission's (NCPC) SW Ecodistrict Initiative includes plans that will transform the area's major federal land holding into a mixed-use neighborhood. These plans are supported by the District's Office of Planning (OP) and their recommendations are included in the Maryland Avenue SW Small Area Plan.

On the river, several companies run water taxis or tours that travel to the Georgetown waterfront, around East Potomac Park/Hains Point, and to National Harbor. Additionally, transport barges and recreational boats travel along this section of the Potomac River. The waterway route of the Captain John Smith Chesapeake National Historic Trail is in the study area along the Potomac River.

On the Virginia side, the Mount Vernon Trail parallels the Potomac River and passes underneath the Long Bridge. The project corridor is in close proximity to one of Arlington County's major planning corridors, the Jefferson Davis Metro Corridor for Crystal City. Immediately adjacent to the project corridor is Long Bridge Park. The park is under construction and will be developed into an urban park with spaces for recreational facilities, including plans for a future aquatics center.

Image 1.1: Long Bridge over Potomac River

Freight, Passenger, and Commuter Rail

The Long Bridge, located on the CSXT RF&P Subdivision, represents an important link between the Northeast Corridor (NEC) and Southeast High Speed Rail Corridor (SEHSR), represents an important link in the national rail system for freight, passenger, and intercity commuter movements. The expansion of the Panama Canal, scheduled for completion in 2015, will impact freight activity. Use of the Long Bridge will grow as the volume of goods and commodities increases through this corridor. The Long Bridge will also be an important link in the future of high-speed rail and projected passenger and commuter travel along the East Coast.

The two-track Long Bridge currently carries five peak period (6:00 am to 9:00 am and 4:00 pm to 7:00 pm) and 18 off-peak period freight trains. Freight use of the bridge comprises roughly one-third of daily train activity, with passenger trains comprising the remaining two-thirds.

Passenger service currently provides 36 peak period (27 VRE, nine Amtrak) and 20 off-peak period (five VRE, 15 Amtrak) trains. The combination of daily freight and passenger trains accounts for 82 percent of the daily total capacity of the Long Bridge. Critical to future bridge operations will be the ability to meet demand in the peak and off-peak periods. Currently, the rail traffic is at 98 percent of capacity during peak hours and at 70 percent of capacity during non-peak hours.

The Long Bridge represents one of the most critical regional and national rail corridor linkages along the Eastern Seaboard. Projections indicate that freight and passenger growth will exceed the capacity of the current two-track bridge across the Potomac River. Future demand will require new options and expanded infrastructure to avoid interrupting the movement of goods and passengers across the Potomac River and to provide service to economic centers north and south of the Long Bridge.

Long Bridge History

Congress authorized the original Long Bridge in 1808, and it first opened in May 1809 (Figure 1.2). Named for its length, the Long Bridge was built on timber piles and included moveable/opening spans. This bridge was destroyed in 1814 by invading British forces and subsequently rebuilt and restored to service in 1816.

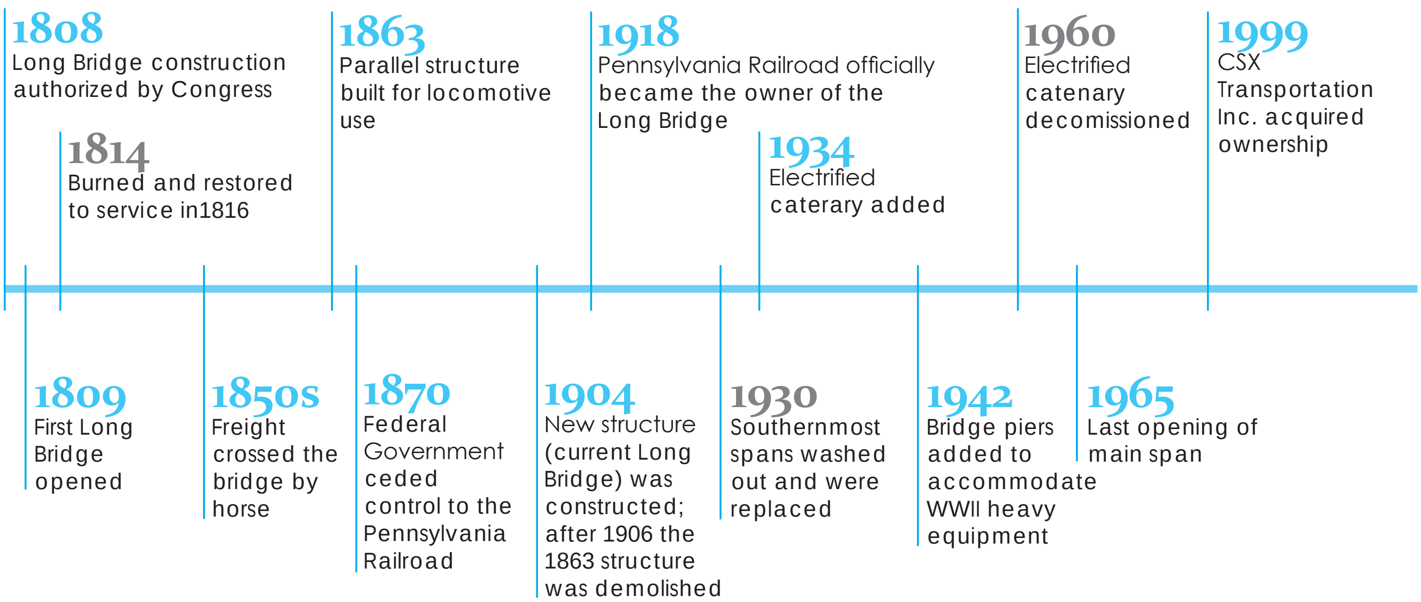


Figure 1.2: Long Bridge History

Until the 1850s, the bridge carried only foot and horse-drawn traffic. Rails were first installed on the bridge during the Civil War; however, the structure could not safely support the weight of locomotives and freight cars. Loaded freight cars were pulled by horse across the bridge to connect the movement of goods across the Potomac River. By 1863, a new parallel bridge was built to support heavy locomotive and freight car use. The 1863 structure was about 100 feet south of the original alignment and included two moveable spans. The original structure was used throughout the Civil War and then abandoned, eventually falling into disrepair. Portions of the bridge were disassembled and used elsewhere.

In 1870, the federal government ceded control of the Long Bridge to the Pennsylvania Railroad provided that the railroad company would maintain the bridge in good working order. By 1896, the bridge was carrying freight and interurban trolleys; an estimated 250 freight trains and passenger trolleys crossed the bridge daily for six different railroad companies and the trolley company. During that time, the moveable span opened an estimated 20 times per day.

In 1904, a third (and the current) Long Bridge was built approximately 150 feet north of its 1863 location and approximately 50 feet north from the original structure. Sometime after 1906, the 1863 Long Bridge was demolished. The 1904 two-track bridge was constructed to accommodate the continuing increase in freight and passenger traffic crossing the Potomac River. The 1904 bridge was built by the government and maintained and operated by private railroad companies that had rights to use the bridge. It included a single center swing span measuring 280 feet, providing two 100 foot wide navigation channels. In addition to the center swing spans, the bridge was composed of 11 fixed spans. Ten of the fixed spans were reused spans that had been dismantled from a bridge in Trenton, New Jersey. In 1906, the trolley crossing moved to the newly constructed 14th Street Bridge, making the Long Bridge a crossing for heavy rail freight and passenger train.

The southernmost spans of the Long Bridge and the 14th Street Bridge were washed out between 1929 and 1932. Those southernmost spans were subsequently replaced as part of the George Washington Memorial Parkway project. Between 1934 and 1935, the Pennsylvania Railroad added electrified catenaries to the Long Bridge, which remained in use until the early 1960s. The unused catenary remains in place today. In 1942, the fixed truss spans were removed, new piers were added, effectively doubling the number of piers, and the current girder spans were added. These changes allowed the load capacity to increase from a rating of E-40 to E-65, a reasonable design loading appropriate for that time period. (Note that the current railroad loading rating is designated as E-80, a proportional strength increase over E-65 of 23 percent.)

The last known opening of the Long Bridge swing truss was March 3, 1969, when it allowed passage of the construction equipment for demolition of the 1906 14th Street Bridge. In the 1970s, due to vandalism, the operator house was removed from the Long Bridge. In 1999, the Long Bridge ownership was transferred from Conrail to the present owner, CSX Transportation, Inc. Table 1.1 below shows the ownership history of the Long Bridge.

Table 1.1: Ownership of Long Bridge

Year	Owner of Long Bridge
1870	Federal government ceded control of Long Bridge to the Pennsylvania Railroad (Penn RR)
1918	Penn RR officially became owner
1968	Combined ownership when the New York Central merged with Penn RR into Penn Central Railroad
1976	Penn Central Railroad and five other railroads became Conrail
1999	CSX Transportation, Inc. acquired ownership

The existing Long Bridge is comprised of multiple low-level spans and a two-span through truss swing bridge. Immediately southwest of the existing structure, there are submerged timber piles and partial piers where the previous two Long Bridge alignments were constructed. For additional information, the DC Chapter of the National Railway Historical Society (NRHS) provides a complete history of the Long Bridge (reference: www.dcnrhs.org/learn/washington-d-c-railroad-history/history-of-the-long-bridge).

Relationship to Other Studies

A number of previous studies provided context for the importance of studying improvements for the Long Bridge, as well as investigating other modal options for crossing the Potomac River. A review of these reports and information that was relevant to the Long Bridge is detailed below.

Southeast High-Speed Rail Market and Demand Study, August 1997

This study examined the market demand for intercity and SEHSR service improvements in the Southeastern US and analyzed service as far north as Union Station in the District. The study involved development of new travel forecasting models that were responsive to different market segments, travel time, fares, and other variables. The model estimated current demand and projected future travel between cities along the SEHSR, as well as along the entire Atlantic Coast for auto, air, and train modes. In total, six different SEHSR service options were established in addition to the existing service along the SEHSR. Relevant to projections for high-speed rail for the Long Bridge, if Virginia and North Carolina were to decrease the time between Raleigh and the District to approximately three hours, ridership and revenue would increase dramatically along the corridor and into Union Station. The study also showed that a majority of the travel on high-speed rail will come from existing rail and air service in the same corridor.

Report to Congress VOLUMES I & II: Potential Improvements to the Washington-Richmond Railroad Corridor

National Railroad Passenger Corporation, May 1999

This report specified on a preliminary basis the infrastructure improvements that would enable the Washington-Richmond Corridor to accommodate 2015 projections of higher speed intercity passenger, commuter, and freight services. Inclusive of all the stakeholders on the Long Bridge Study, this study also included multi-agency inputs from Amtrak, FRA, the Commonwealth of Virginia, Virginia Railway Express, and the freight railroad right-of-way owners: CSX Transportation, Inc. (CSX) and Norfolk Southern (NS). The study was based on the following comprehensive analytical approach: (1) assess current facilities, services, and operating conditions on the route (including across Long Bridge); (2) characterize service needs for the planning year 2015; (3) conduct operational analyses simulating the performance of 2015 services over various configurations of infrastructure; and (4) identify the infrastructure investments that would allow the Corridor's operators to achieve their intended 2015 service quality and train volumes with satisfactory reliability. This analysis of current and projected railroad operations and facilities on the Washington-RIchmond Corridor led to the following conclusions: (1) protection of all freight and passenger services including the identification of a number of specific infrastructure changes that would provide the capacity to reliably handle all existing and projected services. Even with these changes, close scheduling and dispatching coordination among operators will be necessary to optimize the use of the improved facility. (2) The study recommended further engineering with the development of detailed construction plans for the various improvements. The report specifically identified the area in the vicinity of L'Enfant Station to be particularly challenging. (3) Confirmed Amtrak's and FRA's commitments to moving these improvements forward with involved agencies and railroads to obtain funding for the recommended improvements, to progress the necessary engineering work on a timely basis, and to arrange for any needed environmental/historic documentation. (4) Identified high-speed rail service as a feasible goal on this corridor provided that requisite infrastructure improvements are constructed.

The Northeast Corridor Infrastructure Master Plan, NEC Master Plan Working Group, May 2010

This study identified a baseline of infrastructure investments needed in the near term to maintain the current NEC system in a state of good repair, integrate service plans, and meet future performance goals for the corridor. Relevant as an input to the Long Bridge, this plan forecasted a 59 percent increase in passenger rail ridership through 2030 and a 40 percent increase in train movements for the NEC. The plan described the current conditions of the Long Bridge as substandard, which affects trip times and operating capacity for passenger trains traveling south of the District. The Master Plan recommended a new bridge over the Potomac River to increase the throughput in and out of Union Station. The plan also recommended new platforms, expanded tracks, siding, and high-speed interlocking and signal improvements to permit 90 mph service between Richmond and Washington.

Note that there is also a Northeast Corridor FUTURE Rail Investment Plan that is currently being conducted. This will provide operations detail for future high-speed rail growth across the Long Bridge.

National Rail Freight Infrastructure Capacity and Investment Study, Association of American Railroads, September 2007

This study assessed the long-term capacity expansion needs of freight railroads and provided a first approximation of the improvements and investments needed to meet future rail freight demand at the national level. The study estimated freight movements to increase 88 percent by 2035. The study described a methodology to forecast rail freight traffic growth by type of train service using the US DOT's Freight Analysis Framework (FAF) data. This methodology was used for the Long Bridge freight forecasting and operational analysis. The study also defined the level of service (LOS) for grading rail corridors' performance based on the throughput of train traffic. These LOS grades were used to assess the capacity of the different rail options for the Long Bridge.

National Capital Region Freight Plan, Metropolitan Washington Council of Governments, July 2010

This plan provided an analysis of the current and future freight conditions in the National Capital Region (NCR). Trucks carry approximately 76 percent of freight traffic in the region; rail carries the remainder. Ninety-five percent of the rail freight in the NCR is through trips. The report also contained a NCR Freight Project Database that included projects beneficial to freight movement in the region. Relevant to the Long Bridge, this database included a recommendation for a new rail bridge over the Potomac River, interlocking options to eliminate train conflicts, and third and fourth track configurations in the District that would feed a new CSX rail bridge to improve train operations.

The SW Ecodistrict Initiative Plan, National Capital Planning Commission, January 2013

The SW *Ecodistrict Plan* provided guidance for revitalizing the community by incorporating residential, commercial, and cultural uses with existing federal uses. Through the rehabilitation, repurposing, and redevelopment of buildings within the community, high energy efficiency, along with low environmental impact, would provide long-term sustainability. These goals would be realized in part through coordination and advocacy of economic partnerships between the federal government, the District, property owners, tenants, and residents.

14th Street Bridge Corridor – Draft Environmental Impact Statement (DEIS), Federal Highway Administration, January 2012

The 14th Street Bridge DEIS assessed improvements needed to reduce congestion, enhance safety, and improve traffic operation along the 14th Street Bridge Corridor. The DEIS analyzed several alternatives for vehicular, pedestrian, bicycle, and transit improvements. The project is ongoing.

M Street/Southeast-Southwest Transportation Planning Study, District Department of Transportation, December 2012

The goal of this study was to promote livable communities and reinvestment within the Southwest study area by developing transportation improvement recommendations to accommodate future land use plans while eliminating the deficiencies of the existing transportation infrastructure. Relevant to the Long Bridge Study, there were recommendations to promote improved multimodal transit connectivity within The Wharf and Southwest waterfront areas along 7th Street, SW, and Maine Avenue, SW.

The Comprehensive Plan for the National Capital: District Elements, District of Columbia Office of Planning, December 2006

The comprehensive plan was a policy document that provided overall guidance for the future planning and development of the city. In addition to the physical development of the city, social and economic issues that impact the city and its citizens were also addressed. Due to the District’s distinction as the nation’s capital, the comprehensive plan included elements specific to the federal lands and facilities, as well as elements that encompass the District. The comprehensive Plan included the following 13 citywide elements: framework which sets the Plan’s guiding principles and vision: land use; transportation; housing; economic development; parks, recreation, and open space; educational facilities; environmental protection; infrastructure; urban design; historic preservation; community services and facilities; arts and culture; and implementation. All other physical plans that the District Government adopts are to be guided by the goals and assumptions about the future that are included in the elements of this comprehensive plan. As such, elements of the Long Bridge Study related to transportation, land use, environment, and design must also be consistent with the comprehensive plan.

VRE System Plan 2040, January 2014

The VRE System Plan incorporated information garnered from the VRE Strategic Plan (May 2004), which established an overall direction in which VRE should head; providing a directive VRE could take to improve existing infrasturcture to meet expected future demand. The System Plan provides a framework for VRE system investments and actions VRE should pursue through 2040 to best meet regional travel needs. The system investments and service expansion recommended in the System Plan will enable VRE to carry over 40,000 new weekday trips by 2040, more than double the 19,000 daily trips carried today. The second phase of the system plan dated from 2021-2030 includes major investment in relieving the key capacity bottlenecks on the VRE system, including the Long Bridge crossing of the Potomac River; to acheive the desired capacity benchmarks established in the System Plan.

Marc Growth and Investment Plan, September 2007

The MARC Growth and Investment Plan is a multi-phased, multi-year plan to triple the capacity of MARC, Maryland's commuter rail system. MARC is a key component of Maryland's commuter network providing rail service for more than 30,000 commuter a day traveling between Washington's Union Station and northern, central, and western MAryland. The MARC Growth and Investment plan establishes a series of improvement milestones for 2008, 2010, 2015, 2020, and 2035. The improvements to the Long Bridge are ciritical to MARC's 2020 desired expansion of the Penn Line, which would cross the Potomac and terminate in Alexandria; which would require an increase in capacity and improvements in operations along the Long Bridge to accomplish.

CHAPTER 2: PURPOSE AND NEED

CHAPTER 2: PURPOSE AND NEED

The purpose of the study was to complete a comprehensive study of the Long Bridge to identify short- and long-term structural needs, identify long-term capacity improvements, identify and analyze alternatives to enhance multimodal connectivity, and make a recommendation for the National Environment Policy Act (NEPA) class of action level required to move forward with project development.

The study purpose was based on a number of needs identified by previous studies and analyses as they related to growth in the District and Virginia areas immediately adjacent to the Long Bridge, as well as the needs of the Long Bridge freight and passenger movements. See Table 2.1 for a list of the project needs.

Table 2.1: Project Needs

Transportation Demand	Long-term capacity
Operational improvements	Multimodal access
Structural conditions	Intermodal connectivity

Several of the needs were interrelated. Each is addressed in this chapter and establishes the foundation for conducting this study.

Transportation Demand

The Long Bridge is an important connection in the local, regional, and national transportation system. The origins and destinations of freight and passenger travel across the Long Bridge come from all over the Eastern Seaboard. The Long Bridge is the only rail link across the Potomac River. Passenger and freight rail are forecasted to increase in the future, so it is important that options to accommodate the demand be developed and planned for before the bottleneck occurs. Currently, rail activity during peak periods is only one train below peak period capacity. Demand projections to 2040 indicate that there will be an additional 71 percent demand during the peak with an increase of 29 new trains. Demand for the Long Bridge will be even greater during the off-peak with a projected increase of 152 percent from 58 new trains. The daily demand will require meeting the needs of 166 freight and passenger trains on an existing two-track bridge that can currently carry a maximum of 96 trains daily.

The movement of vehicles, transit, and non-motorized activity was also important to understanding the demand needs of the crossing. Daily vehicular trips across the I-395/14th Street bridges in 2010 was approximately 185,000 trips per day, with peak hour crossings experiencing extensive delays that often added 20 minutes of travel time just to cross the Potomac River into the District. Current plans for streetcar in the District may include routes along 7th Street, SW, that could expand to include crossing of the Potomac River and create a connection to Virginia's proposed Arlington streetcar and stations at Pen Place along Jefferson Davis Highway or at Pentagon City. The 14th Street Bridge currently experiences hundreds of pedestrian and 1,500 to 2,000 bicycle crossings on a daily basis. The Long Bridge study presented the opportunity to look at both rail and multimodal demand issues to meet future demand.

Operational Improvements

Freight and passenger trains share the two-track Long Bridge for daily activity. Analysis of the current activity showed passenger rail having a priority over freight rail during peak periods. Future demand will exceed current available track operations, so prioritization of the future is unknown. The current two-track system can carry an estimated maximum of 96 trains per day. Future projections indicate there will be a 110 percent increase in train operations by 2040.

With no expansion of the two-track Long Bridge, operations approaching the Long Bridge would require extensive sidetracking of trains, creating delays by forcing them to wait to make the crossing.

There is also a need to assess passenger rail operations at the L'Enfant rail station. Current operations of VRE and Amtrak only allow for one-rail operations along one side of the station. MARC service from Maryland ends at Union Station before reaching the L'Enfant station. The current operational constraints at L'Enfant station provide the opportunity to consider various solutions such as studying the implications of adding an additional platform or extending the existing platform in order to enhance passenger services at this location.

Rail operations in Virginia have not been fully assessed to meet the potential needs of passenger rail. Meeting the demand of future passengers will require a coordinated operational analysis between activity at the Alexandria and L'Enfant stations.

Image 2.1: L'Enfant Station

Structural Conditions

The current bridge was constructed in 1904 with improvements in 1942 to add new girder spans and additional support piers. A preliminary visual bridge assessment rated the overall condition of the bridge. The superstructure bridge spans were rated “fair” and the substructure piers were rated “good” based on established national rating standards established by the American Railway Engineering and Maintenance-of-Way Association (AREMA). The two-span Tidal Basin Bridge was rated as “fair” for the spans and “satisfactory” for the piers. The Long Bridge is in need of further assessment, including a full inspection to establish the serviceable life of the structure. The weight of freight trains and the continuous repetition of these heavy loads contribute to accelerated deterioration and reduce the bridge’s expected life. The current bridge is maintained to provide safe transport across the Potomac River for both freight and passenger trains. At its current age and condition, there is a need to identify recommendations and options to ensure that the Long Bridge structure and future options continue to provide the necessary infrastructure for freight and passenger service on this important rail segment connecting freight and passenger travel north and south of the current bridge.

Long Term Capacity

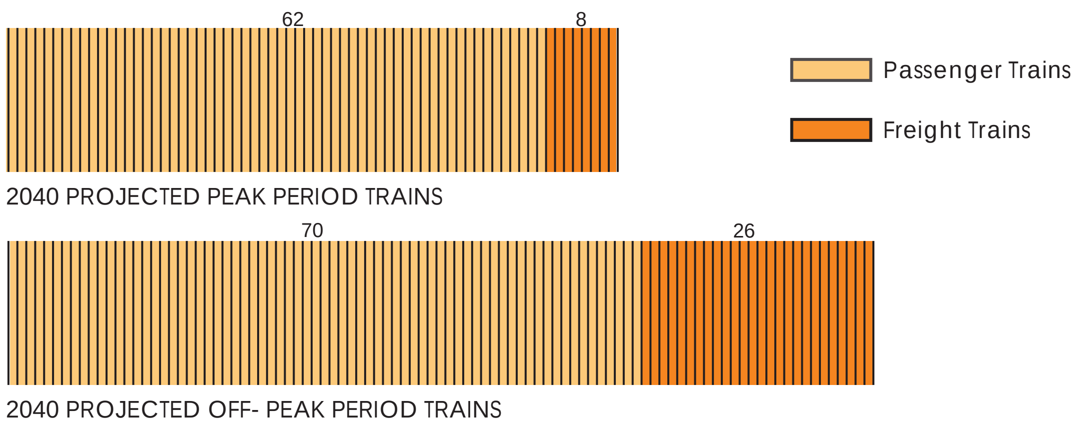
The Long Bridge is a vital link on the Eastern Seaboard for freight and passenger travel. Future demand for moving goods and new passenger services, including passenger high-speed rail, are limited due to the current capacity of the Long Bridge. The current two-track system is near capacity for accommodating freight and passenger service in the peak passenger travel periods of the day. Future demand for use of the Long Bridge exceeds the bridge’s current capacity. Future forecasts developed from the Federal Highway Administration Freight Analysis Framework dataset and passenger train projections from VRE and Amtrak (including high-speed rail) indicated that the current daily 96-train capacity will be exceed by 41 trains in the year 2020 and an additional 29 trains by the year 2040.

Multimodal Access

The study focused on the current and future needs of passenger and freight rail crossing the Potomac River. The Long Bridge currently carries 79 daily trains, of which 71 percent are passenger trains and 29 percent freight. Passenger service is comprised of approximately 12,000 VRE passengers and 5,600 Amtrak passengers per day. Freight tonnage over the Long Bridge is approximately 60,000 tons per day. CSX, which owns the Long Bridge, provides an agreement with passenger carriers that gives them priority during morning and evening rush hours (6:00 am – 9:00 am and 4:00 pm – 7:00 pm). During these rush hours only five freight trains use the bridge, compared to 36 passenger trains. The capacity during rush hours only allows for the addition of one more passenger or freight train.

The 2040 passenger service projections in Figure 2.1 show as many as 62 passenger trains in the future peak hours. Freight service is projected to be at eight trains.

Figure 2.1: 2040 Projected Peak and Off-Peak period trains



The opportunity to assess multimodal options for the Long Bridge does not end with passenger and freight rail. Any possible expansion also assesses the needs of other modal activities adjacent to the Long Bridge to ensure provision of a multimodal transportation system including vehicular, transit (bus, streetcar, Metro), and pedestrian/bicycle pathways.

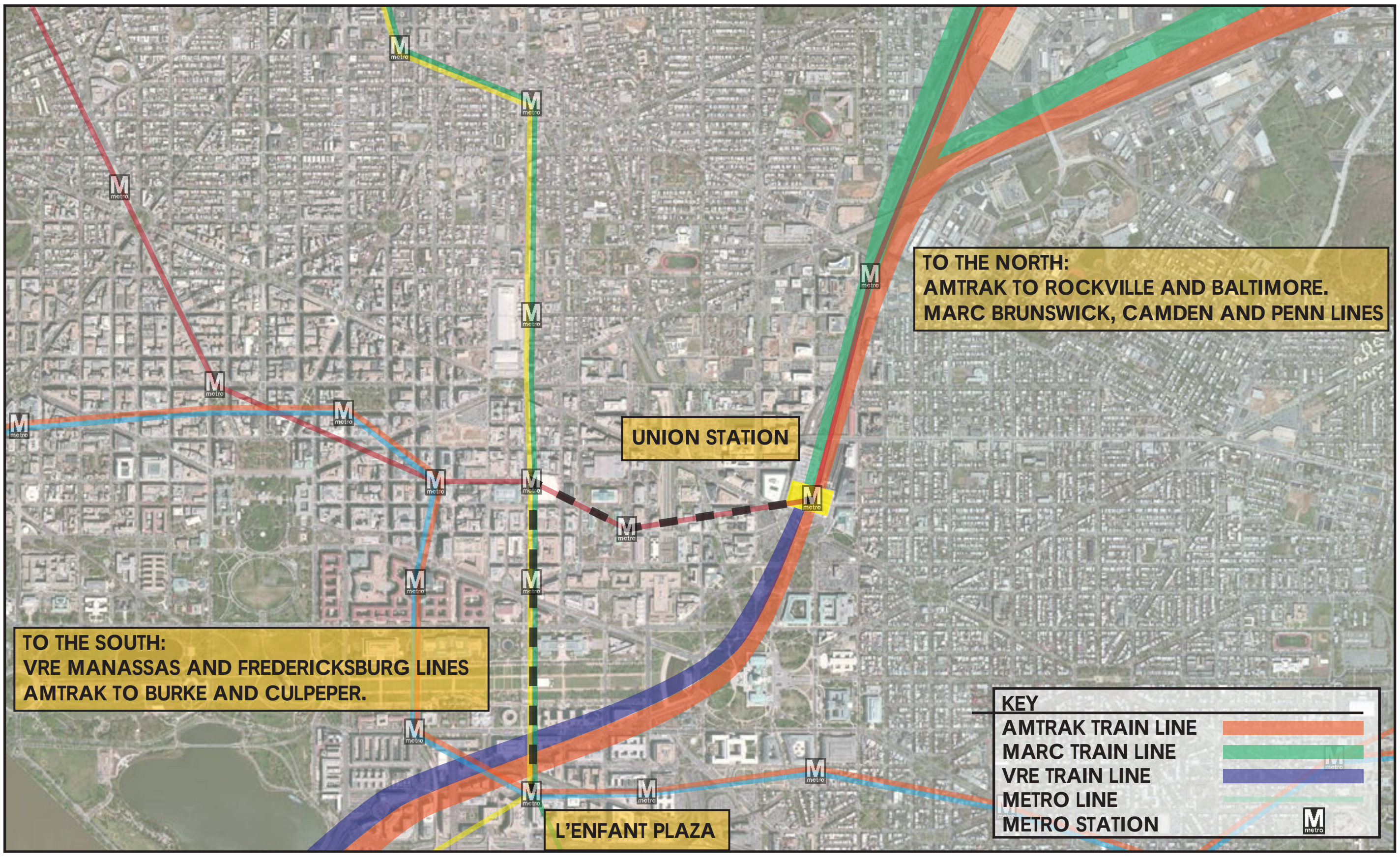


Figure 2.2: Connectivity and system linkages for passenger and commuter rail

Intermodal Connectivity/System Linkages

The connection between modes drives people's choices on how they will travel for work and leisure activities. Maintaining an easy connection and providing users with options to use multiple modes of travel is central to daily activity in the District. The L'Enfant area is a hub for many commuters using Amtrak, VRE, and/or MARC trains as shown in Figure 2.2. VRE and Amtrak trains stop at the L'Enfant train station in the peak travel direction throughout the day. VRE and Amtrak trains stop at the L'Enfant train station in the peak travel direction thoughout the day. The tracks in the vicinity of L'Enfanct station are bidirectional without a fixed current of traffic, but due to present operational constraints the vast majority of passenger trains travel from Virginia to the District and in the evening from the District to Virginia. MARC train service from Maryland currently only stops at Union Station, requiring a trasfer to either Metrorail or a VRE passenger train to reach the L'Enfant Plaza area. Per a joint fare agreement between MARC and VRE, passengers are able to transfer seamlessly betweent the two services. Yet, there is a need to imporve existing operations that will allow for MARC to expand its passenger train service range and VRE to increase its passenger train service in either direction.

Figure 2.3: Connectivity and system linkages for trails and parks

Future plans for streetcar and the District's bus service also provide coverage and connectivity to move to and from the District. To provide efficient transit service, modal options other than rail will need to coordinate across the current and future modal improvements. Expanding the District's streetcar plan to include a connection to the proposed Arlington streetcar plan will greatly enhance inter-regional transit mobility.

The bicycle/pedestrian pathway network on both sides of the river is extensive within the Long Bridge study area as shown in Figure 2.3. Currently, the only connection across the Potomac River for pedestrians and bicycles is on the 14th Street Bridge, with ramp systems in both the District and Virginia. Providing additional connections between the District and Virginia would allow users access from the pathway network along the Southwest waterfront and East Potomac Park in the District to the Mount Vernon Trail and pathways planned in Long Bridge Park in Virginia. An additional bicycle/pedestrian pathway will also allow for a more direct connection to the mixed use wharf development; connecting a residential/commerical area to an abdunant selection of parks and trails. Moreover, any planned bicycle/pedestrian pathway will be designed for the sole purpose of use for cyclist or pedestrians compared to the present 14th Street Bridge connection that runs parralel to an interstate, which may be daunting for some cyclists and pedestrians.

CHAPTER 3: EXISTING CONDITIONS

CHAPTER 3: EXISTING CONDITIONS

Image 3.1: The Long Bridge over the Potomac River

The Long Bridge is a two-track railroad bridge located in the District over the Potomac River. There are several other bridges in close proximity to the Long Bridge. The WMATA Metrorail bridge for the yellow line is the first bridge located northwest of the Long Bridge, followed by the 14th Street Bridges complex that includes George Mason Memorial Bridge, Rochambeau Bridge, and the I-395/Route 1 Bridge.

Bridge Conditions

The current Long Bridge is comprised of 22 through girder spans and a double span swivel swing truss for a total of 24 spans over the Potomac River. It contains elements from the original 1904 structure (the swing span and 12 piers) and from the 1942 structural updates (the girder spans and 11 piers). The Long Bridge features two tracks with a width of 36 feet 6 inches, measured between the centerline of the girders and narrowing down to 28 feet at the swing trusses. There is no existing reserve width to add additional tracks on the structure. Figure 3.1 shows the through girder approach spans in relation to the main span, as well as the main swivel swing span truss over the Potomac River navigation channel. The through girder spans vary from 85 to 113 feet in length, while the truss span measures 280 feet in total length and provides two 110 foot-wide navigation channels. There is an additional two-span bridge that crosses the Washington Channel at the Tidal Basin between Potomac Park and Maine Avenue, SW, in the District. These additional two spans are a continuation of the Long Bridge into the Southwest waterfront in the District. This additional two-span bridge is included in the existing conditions assessment. The elevation of the Long Bridge over the Potomac River is shown in Figure 3.2.

Image 3.2: Tidal spans over the Washington Channel

Image 3.3: Existing through girder and truss swing span

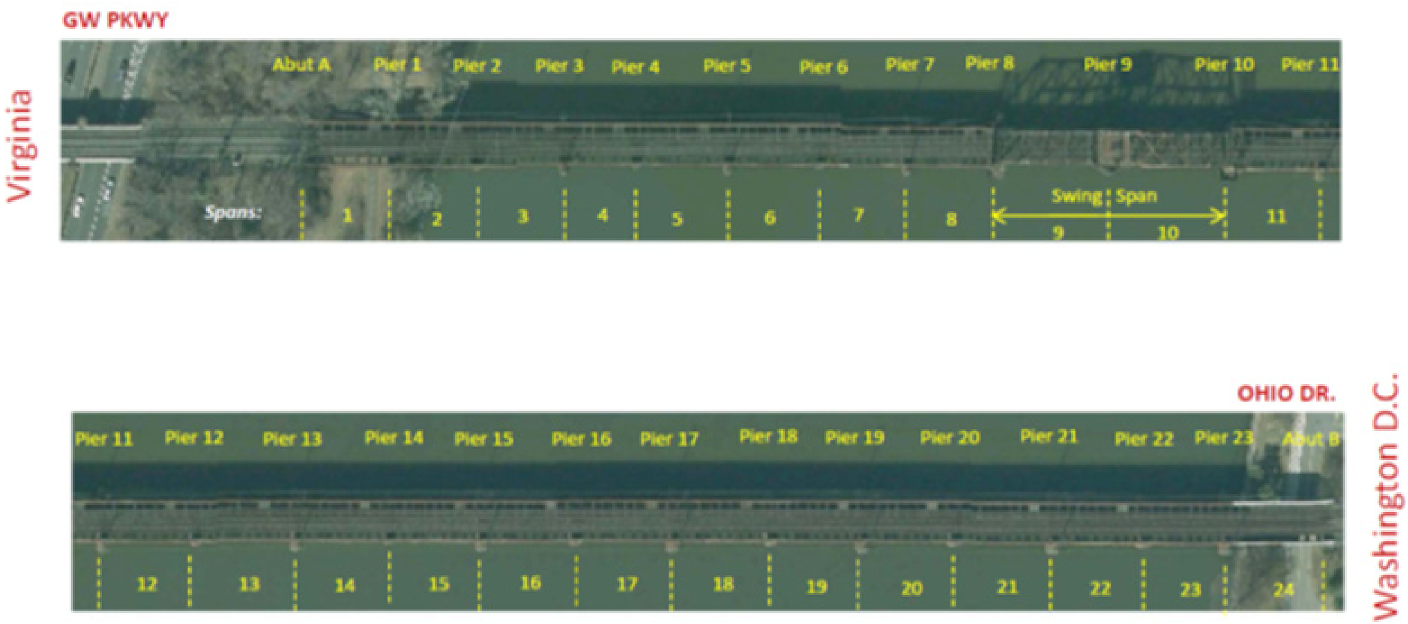


Figure 3.1: Long Bridge Pier and Span Layout

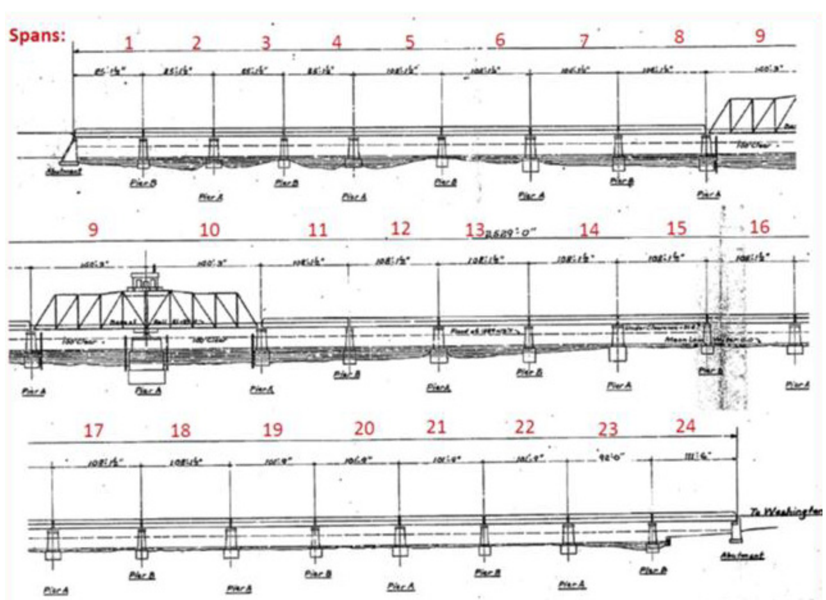


Figure 3.2: Long Bridge Elevation (1942)

Bridge Configuration

Through Girder Spans

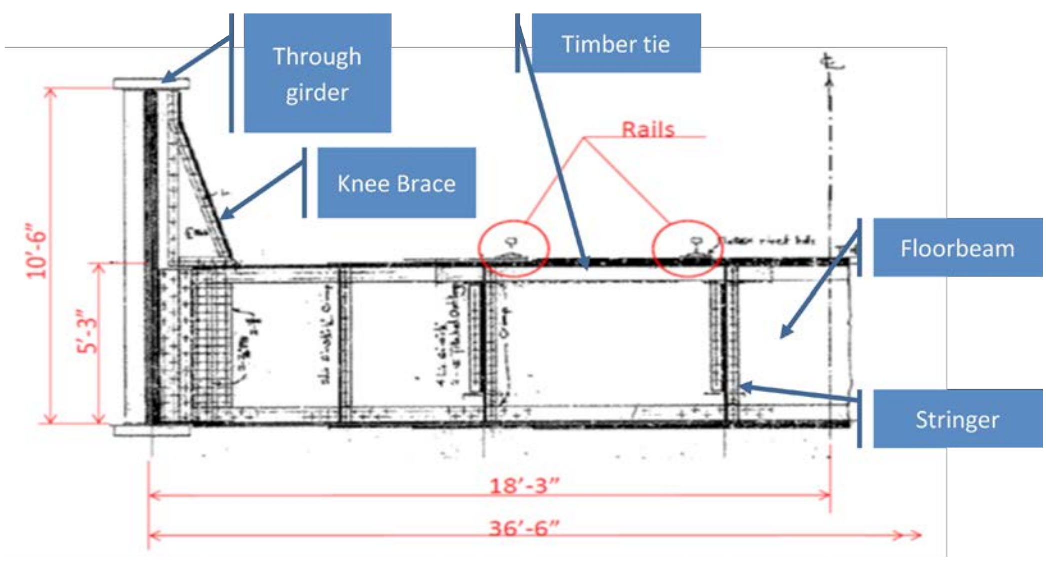
Through girder spans are typically used for railroad bridge construction. For the Long Bridge, the main supporting elements extend above the riding surface. The deck is supported at the lowest level of the girder structure by additional framing tying the main girders together.

The through girder spans consist of two large steel plate girders fabricated by riveting together plates and angle steel components. Web stiffeners reinforce the girders, and a system of lateral and cross braces ties the girders together and provides stability.

Timber ties are located transverse to the railroad track on the bridge. No floor, other than the timber ties, is provided; the bridge is an open deck. The open deck framing exposes the steel elements to weather conditions such as rain or snow, allowing corrosion to occur more rapidly. The tracks and timber ties are immediately supported by a floor system that is located in the bottom half of the girders' flanges beneath the railroad tracks. The floor system is comprised of stringers and floor beams. The timber ties rest on and directly transfer the load to the stringers, which in turn are supported by the floor beams that span in the transverse direction of the stringers. The floor beams are attached to the girders, thus completing the transfer of load from the ties, to the stringers, to the floor beams, to the girders, and finally to the piers.

The type and grade of the steel are not known. According to the 2011 AASHTO *Manual for Bridge Evaluation and Load Ratings – 2nd Edition*, which is used by the FRA, the yield strength of the steel, based on the year of construction for a typical through girder span, is 33 ksi. Figure 3.3 shows the cross section view of a typical through plate girder span.

Figure 3.3: Through Girder Span Profile, Soffit and Cross Section



Swing Truss Spans

The swing spans utilize two through trusses as the primary members of the superstructure. The through trusses are constructed of steel. The individual components of the trusses are sections built from plates and angled steel. Rivets connect the truss components. The truss is an assembly of triangular steel panels connected together at the intersection of the members and sized according to the span and loading demands. The perimeter members of the truss consist of a top chord, bottom chord, and end posts. The interior members of the truss that complete the triangular construction consist of diagonals, intermediate posts, and hangers. These members are connected to each other with gusset plates at the panel points of the truss. Like the through girder spans, the track in the swing truss is supported by a floor system made up of stringers and floor beams. The track rests on ties, which rest on the stringers. The stringers are framed into the floor beams that span laterally and are attached to the trusses at panel points. The truss is laterally braced with sway bracing, top laterals, and bottom laterals.

Like the through girder spans, the type and grade of the steel of the swing truss spans is not known. Again, according to the 2011 AASHTO *Manual for Bridge Evaluation and Load Ratings – 2nd Edition*, the yield strength of the steel, based on the year of construction for a typical truss span, is 26 ksi.

The double span swing truss is designed to be supported solely on the pier at its center swivel when the end supports have been released. It can be thought of as a balanced seesaw as it is opening and closing. It is equipped to be turned in a horizontal plane once it is released from the end supports in order to open the navigable waterway. When closed in the normal rail operating position, lifts are inserted under the tips of the cantilevers, supporting the span at the center pier and resting on the two end piers.

Image 3.4: Double swing truss spans (left)

Image 3.5: Swing Truss Span Soffit (right)

Piers of Through Girder Spans

In 1942, the 1904 truss spans, except for the swing span, were each replaced with two shallower through girder spans by adding a new pier in the middle of the original spans. Both types of piers were constructed of concrete with a facing of cut stone. Stone masonry facing presents a pleasing appearance and offers good resistance to the abrasion of the flowing river and protection against impact from floating debris. The stone facing is tied to the concrete by the use of steel anchor rods. The piers are supported on piles that are below mud-level of the riverbed. Steel bearing piles are used in the 1942 piers and timber piles in the 1904 piers.

Image 3.6: 1904 through girder span pier

Image 3.7: 1942 through girder span pier

Piers of Swing Truss Spans

The piers of the two swing truss spans built in 1904 were also constructed of concrete with stone masonry facing. The piers are supported on a solid concrete filled caisson, a deep foundation type common to river construction when high load carrying capacity is required. The actual concrete strength is unknown, but the concrete is designated as "Portland Cement Concrete" in the original design plans with 1-2-5 mix ratios. For this type of mix ratio, the strength is approximately 3,000 psi. The caisson extends to a hard layer that rests approximately 40 feet below the water surface.

Image 3.8: 1904 swing truss middle pier

Image 3.9: 1904 swing truss end pier

Bridge Structural Conditions Assessment

A visual survey was completed by boat to superficially assess the individual elements of each span and pier. Each span of the bridge was observed in the following order:

(1) Northeastern elevation,
(2) Soffit or underside view,
(3) Right pier,
(4) Left pier, and
(5) Southwestern elevation.

Due to the nature of the observation, certain areas of the bridge, such as the deck, interior faces of the girders or truss members, and the underwater piers and foundations, were not observed. The visual assessment was a precursor to a formal inspection that would include a hands-on inspection of each component of the bridge to gather information needed for a condition and load rating evaluation. The objectives of the visual survey were to evaluate the condition and repair needs of the bridge and to establish a preliminary rating of the condition of the bridge and its individual components.

Bridge condition rating is defined on a scale from 0 (failed) to 9 (excellent) as detailed in Appendix D. The visual survey resulted in an overall rating of 5 (fair) for the superstructure and 7 (good) for the substructure. Ratings of the individual structure portions and the condition ratings are shown in Table 3.1. However, a full, formal inspection of the bridge is recommended.

Table 3.1: Overall Condition of the Long Bridge and the Tidal Basin Bridge

Structure	Overall Superstructure Condition Rating	Overall Substructure Condition Rating
Long Bridge (22 Through Girder Spans)	5 FAIR	7 GOOD
Long Bridge (2 Swing Truss Spans)	5 FAIR	7 GOOD
Tidal Basin Bridge (2 Multi-Girder Spans)	5 FAIR	6 SATISFACTORY

The visual survey also included an assessment of the Tidal Basin Bridge, located between East Potomac Park and the Southwest waterfront on the same alignment. The overall condition was determined to be 5 (fair) for superstructure and 6 (Satisfactory) for substructure. Specific recommendations that were derived from the visual survey can be found in Appendix D.

A visual inspection is the first step in determining the life and serviceability of a bridge. Many railroad bridges of this age (70- to 110-year range) continue to provide reliable service to their owners. This is due to a number of factors, including the conservative nature of railroad bridge design, the high loads they were designed for when steam locomotives were common, and the ability to make repairs as needed to continue to extend the bridge's life. However, it must be noted that train weights and the high number of repeated loadings on the bridge have an increasing effect on deterioration and remaining life. The Long Bridge is no exception. It has some short-term and long-term rehabilitation needs, some of which are defined herein and others of which can only be determined following a formal inspection.

Load Capacity Analysis

To assess the load capacity of the Long Bridge, a technical analysis was conducted to rate the loading for a representative through girder span and the two swing truss spans on the bridge. The span selected for the through girder load rating was the longest span, measuring 113 feet in length. The two truss spans measure 280 feet in total length.

Physical characteristics of the structure, such as the member dimensions and thickness, were based on the original 1904 and 1942 design plans, which were inputs for the process of analyzing the structure and computing the load rating. All ratings were determined in accordance with accepted methods in the 2012 American Railway Engineering and Maintenance-of-Way Association *Manual for Railway Engineering*.

The service life of the bridge was analyzed by determining the current load capacities and load demands and provided a measure of the service life of the bridge. The load demand of a bridge refers to the vehicle load that the structure will be subjected to while the bridge is in service. The load capacity of a bridge is the overall ability of the bridge to carry the imposed demand. For a satisfactory performance, the capacity must be greater than the demand, meaning that the capacity-to-demand ratio (C/D) is greater than 1 (C/D > 1). The analysis follows a process of 10- and 20-year evaluation cycles for the capacity-to-demand ratio. Table 3.2 shows the options that are taken depending upon the outcome of the C/D rating.

Depending upon the year and ratio, it can be determined if replacement of the bridge is necessary. Complete details of inputs, methodology, and results of the load capacity analysis for each of the elements discussed below can be found in Appendix C.

Swing Truss Superstructure

The swing truss superstructure is from the original 1904 bridge construction. The rating results for the structure showed that the swing truss superstructure does not meet the current industry rating (Cooper E-80). The structure does not have sufficient capacity for an estimated long-term service life beyond 30 years under the current loads. It is recommended that the controlling members (3 gusset plates, 2 diagonals, and 2 top chords), as detailed in Appendix C, be strengthened. More frequent and detailed inspection of all members is recommended. Currently, trains cross the Long Bridge at reduced speeds from their typical running speeds. Observed running speeds are 20 to 30 mph where typical running speeds are in excess of 50 mph. Reduced train speeds are recommended to reduce fatigue effects.

Swing Truss Substructure

The substructure of the swing truss consists of solid concrete caissons under the center pier and the two end piers. These concrete caissons in their original condition have capacity for the Cooper E-80 load but do not have sufficient capacity for the combined Cooper E-80 and longitudinal braking loads. The controlling stress mode is the soil bearing capacity under the caissons. The caissons in their original condition provide adequate capacity for the vertical loads under the Cooper E-80 loading, which represents normal train operations without any braking/traction activity. However, their capacity was not sufficient under combined Cooper E-80 load and longitudinal braking loads, as required per current design standards. Underwater inspection of the substructure is recommended to determine the existing condition in order to confirm the reported rating or modify the rating if the condition is different from the assumed condition. It is also recommended that an enforceable rule be implemented that prevents trains from braking or accelerating on the bridge, or at least reduces operating speeds when crossing the bridge.

Through Girder Span Superstructure

The superstructure of the through girder span is from the original 1942 bridge construction. The rating results for the structure showed that the through girder span superstructure does not meet the current Cooper E-80 industry rating. The structure does not have sufficient capacity for long-term service under the current loads. It is recommended that the controlling members and stringers be strengthened. Floor beams also need to be strengthened, but stringers have priority due to the lower rating.

Through Girder Span Substructure

The substructure of a typical through girder span consists of a pier with 1904 timber piles and a pier with 1942 steel piles. Both timber and steel piles in their original as-built condition and under gravity loads had sufficient capacity for Cooper E-80 loading. The governing stress mode in this case is the stress in the pile. These piles lack sufficient capacity under longitudinal braking loads, especially the timber piles. Underwater inspection of both steel and timber piles is recommended to determine the existing condition in order to confirm the reported rating or to modify the rating if the condition is different from the assumed condition.

Load capacity rating provides an estimate of the service life of a given structure. The Long Bridge is currently considered a safe structure for freight and passenger operations. Continued inspection and load analysis will ensure safe operations and help plan for future options for bridge rehabilitation or replacement.

Current Operations

The Long Bridge is a two-track rail bridge that is part of the CSX main line of operations serving the Eastern Seaboard. Currently, the Long Bridge serves three different users: CSX for freight, VRE for weekday commuting, and Amtrak for intercity passengers. The bridge is a two-way operating stretch of rail between two diverging points; one point is two miles south of the Virginia Interlocking, the other point is past L'Enfant Plaza where passenger trains continue to the District's Union Station and freight rail continues toward the Virginia Avenue Tunnel. From both directions there is a three-track system connecting to the Long Bridge that narrows down to a two-track system on the bridge, creating a bottleneck for freight and passenger rail users crossing the Potomac River. Additionally, the bridge and track approaches exhibit speed reductions due to the current condition of the bridge. The combination of speed restrictions and the bottleneck limits the operational capacity through the area.

Beyond the physical limitations of a two-track bridge, the current operation of one platform servicingt two tracks at L'Enfant Station limits passenger operations to a single track. Although three tracks are present at the L'Enfant Station, only the track next to the passenger platform can be used for passenger rail use. A detailed explanation of rail operations is provided in Chapter 4.

Table 3.3 shows the current level of daily train activity across the Long Bridge for freight and passenger trains. Freight train activity is provided by four commodity types: intermodal that transports shipping containers and truck trailers; merchandise that typically carries finished retail goods; bulk goods, also known as unit trains, that carry one product at a time; and open container coal cars.

During the peak hours for passenger rail travel, freight traffic is limited to goods that are time sensitive for delivery. The 2013 daily freight train activity included five trains during the peak and 18 trains during the off-peak for a total of 23 daily freight trains. The peak hours are defined as 6:00 am to 9:00 am and 4:00 pm to 7:00 pm.

VRE and Amtrak provide current passenger service. Passenger service for the two carriers includes 36 trains in the peak periods. VRE trains run more often during the peak timeframe with a ratio of three-to-one over Amtrak trains. Service for the two carriers in the off-peak periods includes 20 trains. During off-peak, Amtrak runs more trains with a three-to-one train ratio over VRE. Freight and passenger rail traffic total 79 daily trains, of which 23 are freight trains.

Table 3.2: Current Daily Freight and Passenger Train Volumes

2013 Freight Train Volumes					
Period	**Intermodal**	**Merchandise**	**Bulk**	**Coal**	**Total Freight**
Peak	0	3	2	0	5
Off-peak	5	9	3	1	18
Daily Total	**5**	**12**	**5**	**1**	**23**

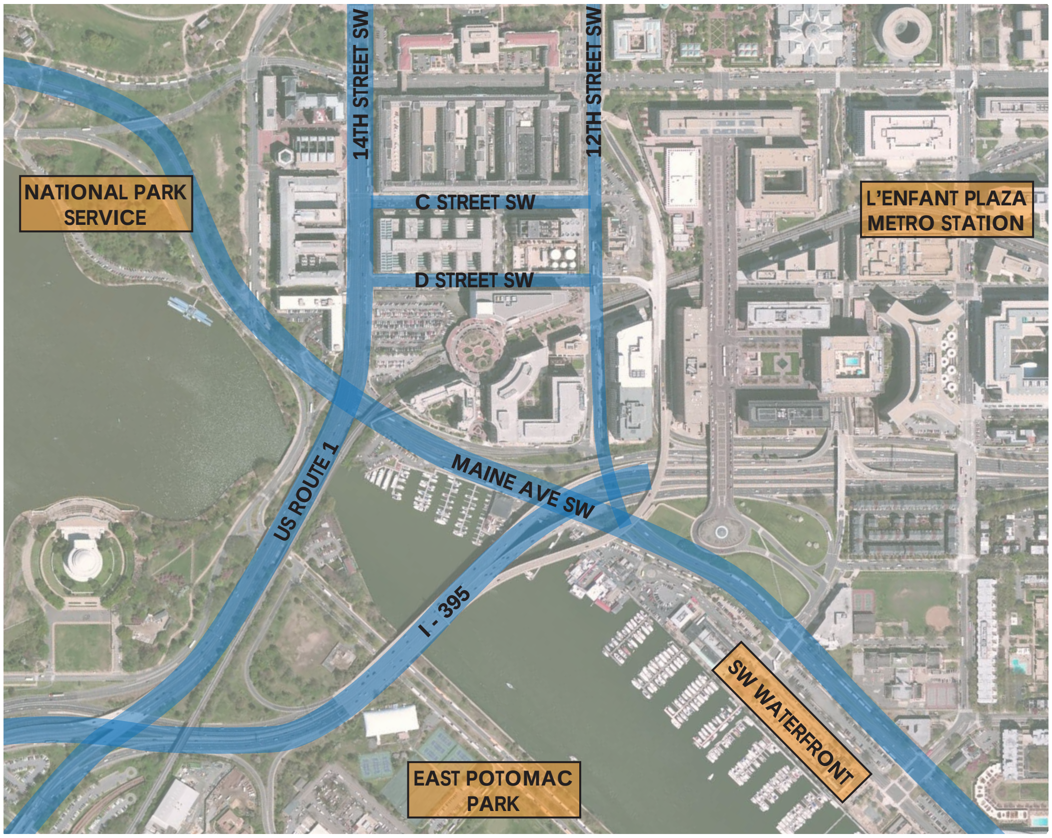
2013 Daily Passenger Train Volumes			
Period	**VRE**	**AMTRAK**	**Total Passenger**
Peak	27	9	36
Off-peak	5	15	20
Daily Total	**32**	**24**	**56**
Numbers based on information provided by: CSX, VRE and Amtrak			

Existing Non-Railroad Transportation System

Surrounding the rail corridor defined by the Long Bridge is a multimodal transportation network used for vehicular travel, transit, and non-motorized pedestrian/bicycle activity. As shown in Figure 3.4, the District roadway system adjacent to the Long Bridge consists of the Southwest waterfront, L'Enfant Plaza, and NPS land comprised of the East Potomac Park and Tidal Basin. Roadway facilities include interstates, regional freeways, principal and minor arterials, and local streets. Major roadways in this area include: Maine Avenue, SW; 12th Street, SW; C and D Streets, SW; 14th Street, SW; and the access and egress from I-395 and 14th Street, SW. The most congested location in this area during peak hours can be found around the intersection of 12th and C Streets, SW.

Figure 3.5 shows the Virginia side of the study area with Long Bridge Park, the NPS land of the George Washington (GW) Memorial Parkway, and the Mount Vernon Trail. The study area is bordered on the northwest side by I-395 and the ramp system between I-395 and the GW Memorial Parkway. Long Bridge Park is currently under construction and provides local roadway access via Long Bridge Park Drive to Jefferson Davis Highway and close destinations such as Crystal City and the Pentagon.

Figure 3.4: District Transportation System



The WMATA Metrorail yellow line across the Potomac River is immediately upriver (southeast) of the Long Bridge. Currently, the yellow line carries 13 peak hour trains across the Potomac River. This represents 50 percent of the capacity of the yellow line crossing, which can handle 26 trains per hour. The Metrorail tracks are on an elevated structure crossing the river and go into underground tunnels on both the District and Virginia sides of the river. The District side tunnel is on East Potomac Park.

In the District, the Metrorail yellow line connects to the Metrorail green line at L'Enfant Plaza. At this point, the two lines provide north-south service in the District, and Metrorail has very little capacity for additional service in the peak hour. The 13 peak hour trains from the yellow line share track with 11 peak hour green line trains, making for a total of 24, which is only two trains short of hourly capacity at the L'Enfant Plaza Metrorail station. WMATA's 2013-2025 Strategic Plan introduced an additional north-south tunnel under L'Enfant Plaza and 10th Street, NW, then west to Thomas Circle. This would enable the green and yellow lines to operate in separate tunnels, allowing more trains to cross the Potomac River on the yellow line bridge, as there would not be a bottleneck at the L'Enfant Plaza Station with green line service. Additionally, WMATA's Regional Transit System Plan (RTSP) introduced a proposed Metrorail loop for 2040. This loop circulates through the DC core and Arlington, providing new connections between the Pentagon, East Potomac Park, and the Federal District, and enhancing transfer points between the yellow, blue, and green lines.

WMATA Metrobus service operates along various routes in the Long Bridge Study area. The majority of these routes use 7th Street, SW, as the north-south connection and Independence Avenue as the east-west connection through the study area. There are twelve WMATA bus routes (5A, 52, 54, 74, A9, A42, A46, A48, V5, V7, V9, and W9) that stop within a five-minute walk of the L'Enfant Plaza Metro station. Most of these routes also serve the Southwest waterfront area along Maine Avenue, SW, and M Street, SW. The intersection of Maryland Avenue and 12th Street, SW, is served by four Metrobus routes (V7, V9, 52 and 5A). WMATA operates five regional bus routes (5A, 13F, 13G, 11Y, and 16X) across the Potomac River using the 14th Street Bridge. WMATA also operates a MetroExtra Route that provides limited stop service between the District and Virginia over the 14th Street Bridge.

The Long Bridge Study area is also served by commuter bus services from Virginia and Maryland. These include the Potomac and Rappahannock Transit Commission (PRTC), Loudoun County Transit (LCT), and Maryland Transit Administration (MTA). The commuter buses generally operate during morning and evening rush hours with limited stops. PRTC's commuter service is called OmniRide. It operates five routes across the 14th Street Bridge into the District from Prince William County, Virginia. Three of these routes serve the L'Enfant Plaza station (MC-R, R1-R, and LR-R) and one route (DC-R) serves the Navy Yard along Maine Avenue, SW, and M Street, SW. Maryland's MTA commuter buses operate six routes (901, 902, 903, 904, 905, and 906) along 7th Street, SW, and M Street, SW, and serve the L'Enfant Plaza and Waterfront Metro stations. There are six additional MTA routes (907, 909, 915, 922, 929, and 995) that operate along Independence Avenue and stop at the intersection of 7th Street, SW. LCT operates three routes from Loudoun County, Virginia, into the District over the Potomac River on the 14th Street Bridge.

Figure 3.5: Virginia Transportation System

Users can find pedestrian/bicycle pathways on the parkland on both the District and Virginia sides of the Long Bridge. In the District, pedestrian/bicycle paths line the Southwest waterfront. A pedestrian staircase behind the Mandarin Oriental Hotel provides access across Maine Avenue from the waterfront. The pedestrian plaza along Maryland Avenue, located above the railway tracks, also features pedestrian walkways that provide access to Maine Avenue, 12 Street, SW, and the District's sidewalk system.

East Potomac Park features shared bike lanes and pedestrian walkways that provide views of the Potomac River and District monuments. The Long Bridge structure continues across East Potomac Park on a raised structure with all pedestrian/bicycle activity passing beneath the tracks along Ohio Drive and the waterfront areas of the park.

The Mount Vernon Trail along the Virginia side of the Potomac River is an 18-mile bicycle/pedestrian trail that runs parallel to the GW Memorial Parkway from Rosslyn to George Washington's estate at Mount Vernon. The Mount Vernon Trail provides views of the Potomac River and monuments on the Mall in the District. As part of the Mount Vernon Trail, the George Mason Bridge (as part of the 14th Street Bridges complex) also features a barrier-separated pedestrian/bicycle route that connects the Tidal Basin area to Virginia at the Mount Vernon Trail.



Image 3.10: Land Use East Potomac Park Pedestrian Path (left), Hotel Plaza at 12th Street,SW (middle), and Walkway next to rail tracks behind Hotel (right)

Land Use

The Long Bridge crosses into the District in the Southwest waterfront area alongside the existing historic Fish Market. The waterfront includes several marinas, including the Gangplank and Washington Marinas, theaters, restaurants such as the Phillips Flagship Restaurant, hotels, and other attractions. While located in a prime location along the Potomac River, the Southwest District area is bordered by I-395 to the north and South Capitol Street to the east. These neighborhoods are connected to the highway network through I-395; Maine Avenue, SW; 7th Street, SW; 3rd and 6th Streets, SW; and South Capitol Street, SW. At present the Southwest Waterfront neighborhood is mostly comprised of medium- to high-density residential land use. Development has started in the area surrounding the Waterfront Metro station that will shift the area to more mixed land use. The Southwest waterfront area will undergo new growth with the development of The Wharf, bringing new restaurants and attractions to the waterfront.

As a result of these proposed developments, a growth in population of over 4,100 people along the immediate waterfront area is expected, with an additional 2,400 people in the Southwest Waterfront area over the next 25 years. Along with this growth, approximately 2,800 new jobs are expected in these neighborhoods.

In the vicinity of the study area, there are several destinations that produce travel patterns on the interstates and local streets, as well as transit. These include retail, industrial, or office employment centers such as the major federal center at L'Enfant Plaza. Figure 3.6 lists a number of these destinations, such as The Wharf area along the waterfront and the federal museum attractions immediately to the north in the District's monumental core.

Long Bridge Park is the major land use development on the Virginia side of the study area. Bordered by I-395 to the north and the GW Memorial Parkway to the east, the area will be redeveloped as a recreational destination that will include basketball and tennis courts, ball play fields, and an aquatics center. Current plans are for pathways connecting towards Long Bridge Park Drive and pedestrian/bicycle circulation to Crystal City and the Pentagon. There are currently no plans for pathways to connect over the parkway to the Mount Vernon Trail.

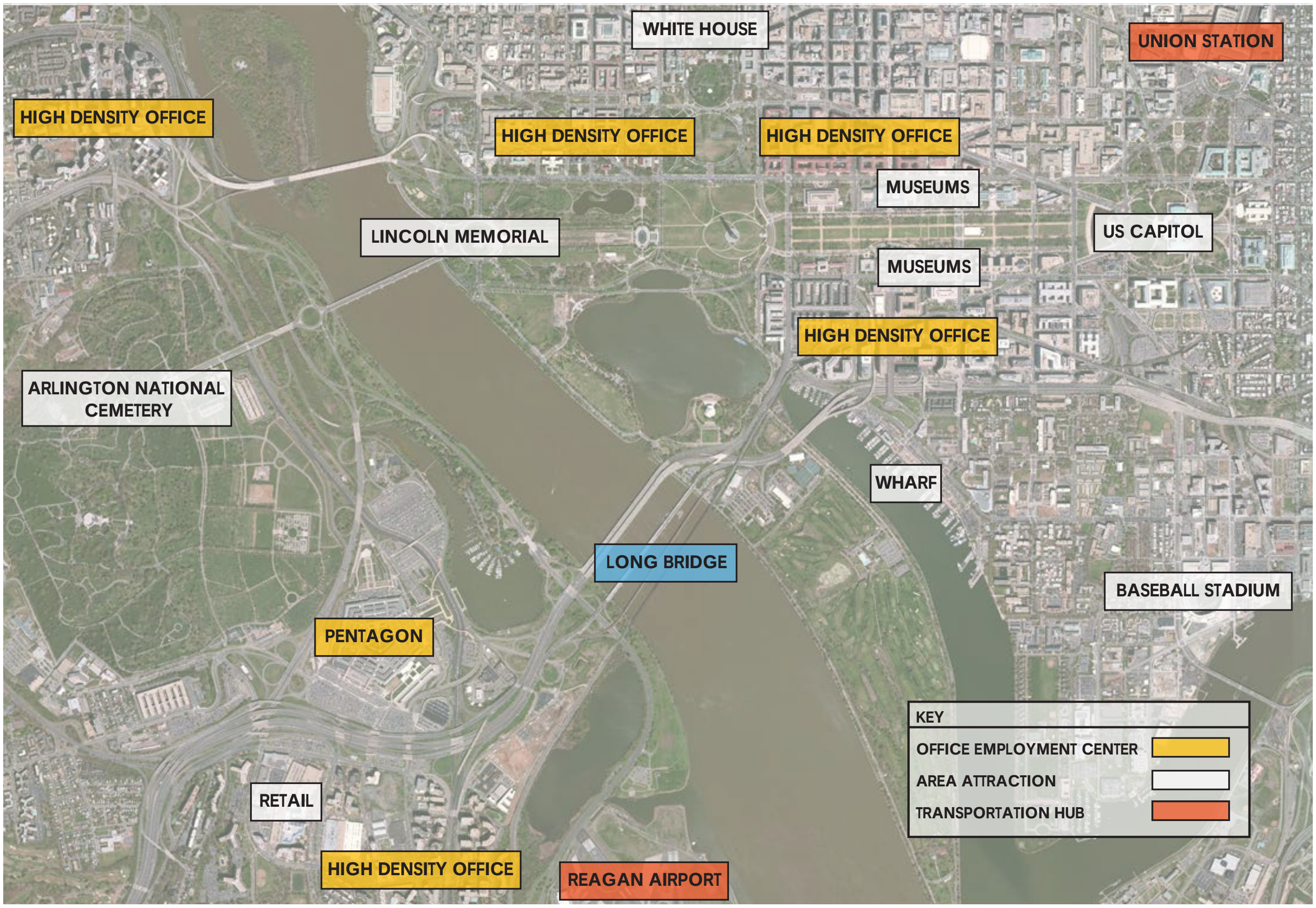


Figure 3.6: Area Attractions

Page left blank intentionally.