# The Economic Impact of the Proposed Long Bridge Expansion and Associated Corridor Projects and the Role of Rail Commuting in the Economy

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## Executive Summary

The Long Bridge is a two-track railroad bridge crossing the Potomac River between Arlington County, VA and Washington, D.C. The Bridge is owned and operated by CSX Transportation (CSXT) and is currently also used by Amtrak and Virginia Railway Express (VRE). The limitations of existing structure are that 1) it is at 98 percent capacity during peak hours and is not projected to be able to accommodate the new demand for passenger rail on Amtrak and VRE, 2) the two-track bridge creates a bottleneck as it connects to the three-track systems on each side, and 3) the overall system lacks resiliency and redundancy, with the next closest rail crossing of the Potomac River being 75 miles away at Harpers Ferry, WV.

Because of these limitations, a new two-track rail bridge, a fourth track addition in Alexandria and station improvements to L'Enfant, Crystal City, and Alexandria are being examined (the Long Bridge projects). These improvements would allow an increase of the total number of daily trains crossing the Long Bridge to 192, an increase of 80 trains compared to a no-build scenario. This increase would include 54 VRE passenger trains, 18 Amtrak passenger trains and eight Maryland Area Regional Commuter (MARC) trains.

The addition of 80 daily trains crossing the Long Bridge will benefit the national economy and the economies of Virginia, Maryland and the District. The long-term economic benefits include 1) the economic impacts of the increased operational expenditures, 2) the economic growth that is accommodated by the new commuter rail services, 3) the decreased cost of turn-over for firms in the Washington region, 4) the value of time savings for rail passengers and road users, and 5) the cost savings and value added to existing infrastructure and services. These benefits are annual and cumulative over the lifespan of the Long Bridge projects infrastructure and the services that the projects accommodate.

1) The long-term economic impact of the operational expenditures from expanded Amtrak, VRE and MARC train services generates an annual impact of

- $205.9 million annually to the benefit of the Commonwealth of Virginia economy including
  - $119.7 million for the economy in Northern Virginia,
  - $16.6 million for the economy in Spotsylvania County and Fredericksburg City, VA,
  - $10.6 million for the economy in Prince William County and the cities of Manassas and Manassas Park, VA, and
  - $9.4 million for the economy in Alexandria City, VA,
- $111.3 million annually to the benefit of the Maryland economy,
- $6.6 million annually to the benefit of the D.C. economy,

- $150.7 million annually to the benefit of the Washington region's economy and
- $1.1 billion annually for the national economy.

These benefits are new and in addition to the economic benefits from existing services. These benefits begin after the completion of the projects and after the expanded services are implemented. These benefits recur for each year that the expanded services are in operation and can be multiplied by the years of service to estimate the cumulative benefit to these economies.

2) Commuter rail services provide an efficient means to accommodate employment and residential growth. Employment growth patterns by industry and location suggest that the demand for rail in 2040 would increase by 14,810 workers. These workers would contribute $5.9 billion (in 2018 dollars) to the Washington region's economy. The Long Bridge pedestrian and bicycle crossing could also help accommodate the increase of 1,300 new pedestrian and bicycle commuters travelling between D.C. and Virginia by 2040. These workers contribute $590 million to the regional economy. Altogether, the Long Bridge projects could facilitate the commutes of 16,110 new commuters, including rail, pedestrian and bicycle commuters that contribute $6.5 billion (in 2018 dollars) to the Washington region's economy annually by 2040.

The Number and Economic Contribution of Commuters Crossing the Long Bridge

| | 2019 | 2040 | Increase |
|---|---|---|---|
| Rail Commuters | | | |
| Commuters | 31,590 | 46,400 | 14,810 |
| Annual GRP Contribution (billions of 2018 $s) | $6.2 | $12.2 | $5.9 |
| | | | |
| Pedestrian/Bicycle Commuters[1] | | | |
| Commuters | 5,790 | 7,090 | 1,300 |
| Annual GRP Contribution (millions of 2018 $s) | $970 | $1,560 | $590 |
| | | | |
| Total | | | |
| Commuters | 37,380 | 53,490 | 16,110 |
| Annual GRP Contribution (billions of 2018 $s) | $7.2 | $13.7 | $6.5 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

[1]includes all commuters crossing the Potomac River between D.C. and Virginia and represents the maximum for Long Bridge.

3) The quality of life improvements that the increased rail services provide for future rail commuters is likely to reduce the turn-over rates for firms that have a larger concentration of rail commuters. As are result, turn-over costs for these firms would decrease compared to a no-build scenario. The total turn-over costs of all Professional & Business Service firms would decrease by between $48.5 and $96.9 million including

- $30.3 to $60.5 million per year for firms located in D.C.,
- $13.1 to $26.1 million per year for firms in Arlington County, VA, and
- $5.1 to $10.3 million per year for firms in Alexandria City, VA.

4) Rail passengers and road users will have time savings in the form of improved on-time performance for rail passengers and smaller congestion effects for road users. The time savings benefit that accrues to rail passengers boarding in Virginia, the District, and Maryland is valued at $16.9 million per year in 2018 dollars and includes

- $8.9 million accruing to passengers boarding in D.C.,
- $4.9 million accruing to passengers boarding in Maryland, and
- $3.1 million accruing to passengers boarding in Virginia, $1.6 million of which accrues to passengers boarding in Northern Virginia.

The value of time savings for road users in Northern Virginia because of the expanded peak-hour VRE services is between $24.3 and $58.8 million in 2018 dollars. This is a conservative estimate, and excludes the time savings that would result from MARC trains crossing into Virginia, as those service levels have not yet been determined.

5) Lastly, the additional capacity provided by the Long Bridge projects will provide benefits to existing infrastructure, service operators and users along and near the Long Bridge Corridor. Existing infrastructure will have maintenance savings, improved efficiencies and reductions in the growth in demand for additional capacity. Service operators will benefit from increased flexibility, improved reliability and reduced risk that results from the added network redundancy. Users of existing services affected by the Long Bridge corridor will benefit from increased flexibility, improved reliability, as well as improved multi-modal connectivity and increased options with respect to transportation options.

Overall, the Long Bridge Corridor and Expansion Projects will provide long-term economic benefits in to the economies of Virginia, D.C., and Maryland, their residents and their businesses. The Washington region currently has low levels of rail commuting relative to other large, dense employment metros. As the Washington grows, its ability to accommodate the new commuters will depend upon the transportation infrastructure, the home and work locations of the new workers, and their preferences. Based on the patterns of other U.S. metros, the current preferences of rail commuters and the forecasted industry and geographic patterns of growth in the Washington region, rail commuting is well-position to accommodate and facilitate growth. In absence of additional rail commuting services, the likely commuting patterns and modes would be less efficient for the region, overall, and the quality of life for the region's workers would be diminished. The resulting secondary economic benefits of rail commuting would include reducing the cost of employee turn-over for firms in the region, improving the travel times of both rail and road users, and improved efficiencies for the existing infrastructure, service operators and users along and near the Long Bridge Corridor.

# 1. Introduction

The Long Bridge is a two-track railroad bridge crossing the Potomac River between Arlington County, VA and Washington, D.C. The existing structure of the Long Bridge was constructed in 1904 and improvements were made to the trusses, girders and piers in 1942 to increase its weight-bearing capacity. The Bridge is owned and operated by CSX Transportation (CSXT) and is currently also used by Amtrak and Virginia Railway Express (VRE). Norfolk Southern has trackage and haulage rights on the Bridge but does not currently operate trains across it. The Bridge currently carries 76 trains per weekday, including 34 VRE trains,[1] 24 Amtrak passenger trains, and approximately 18 CSXT trains. An estimated 3.3 million VRE passenger trips and 1.1 million Amtrak passenger trips[2] travel across the Bridge annually. As of 2012, the value of goods carried by freight rail traversing the Bridge was $26.6 billion (in 2018 dollars).[3]

Table 1. Annual Passenger Trips on the Long Bridge Corridor

| | Current Estimate | 2040: No-Build Capacity | 2040: Growth Potential |
|---|---|---|---|
| Virginia Railway Express | | | |
| Average Weekday Trips (a) | 19,000 | 25,000 | 41,100 |
| Share of Passengers Crossing Long Bridge (b) | 66.6% | 66.6% | 66.6% |
| Trips Crossing the Long Bridge | 12,700 | 16,700 | 27,400 |
| | | | |
| Amtrak | | | |
| Annual Trips (millions) (c) | 10.91 | 14.69 | 15.81 |
| Share of Passengers Crossing Long Bridge (c) | 10.3% | 11.1% | 15.5% |
| Trips Crossing the Long Bridge (million) (c) | 1.13 | 1.63 | 2.45 |

(a) Current estimate is for 2017 from the Federal Transit Administration's National Transportation Database; Forecast estimates are from the Virginia Railway Express System Plan 2040 Study and use the mid-point of the low and high estimates.
(b) Share estimated using a VRE-administered October 2017 passenger survey.
(c) Current estimate is for 2015 and includes trips with origins or destinations between North Carolina and Boston, MA; Forecast covers the same geography and is estimated using data provided by RGS as part of the Washington, D.C. to Richmond, VA High Speed Rail Draft Service Development Plan.

The limitations of the current structure are threefold. First, the Bridge is currently at 98 percent capacity during peak hours and has a limited capacity for additional passenger trains; by 2040, the existing structure would allow for only two additional Amtrak weekday passenger trains and four weekday VRE trains. As shown in Table 1, both VRE and Amtrak project that demand will exceed the capacity of the current infrastructure in 2040. VRE is expected to be able to accommodate 25,000 average weekday trips in 2040 without major infrastructure changes. VRE demand is forecasted to exceed that by 64 percent for a total of 41,100 average weekday trips. Similarly, Amtrak is projected to be able to accommodate

[1] Including non-passenger trains.
[2] Includes trips with origins or destinations between North Carolina and Boston, MA
[3] 2012 is the most current year available for this estimate.

1.6 million annual trips across the Long Bridge and 14.7 million trips with origins or destinations between North Carolina and Boston, MA in 2040 assuming no major changes to the current infrastructure. Amtrak demand has the potential to generate 51 percent more trips across the Long Bridge and 8 percent more trips in between North Carolina and Boston, MA in 2040. In total, the forecasted demand in 2040 exceeds the existing VRE and Amtrak systems capacity by more than five million annual trips. [4]

The second limitation of the current infrastructure is that three-track systems connect to the two-track Long Bridge on both sides, creating a bottleneck that reduces the overall network efficiency and connectivity of the systems that operate across the Bridge. The third limitation is that the current network lacks redundancy and resiliency. An unplanned disruption to the operations of either one or both tracks would create residual delays throughout the system. The Bridge is the only rail crossing between Virginia and Washington, D.C. and the next closest rail crossing of the Potomac River is 75 miles away at Harpers Ferry, WV.

As a result of these limitations, the Federal Railroad Administration (FRA) and the District Department of Transportation (DDOT) completed a feasibility study (Phase I) for the expansion of the Long Bridge in 2015. A Phase II study was conducted from 2015-2017 and, in spring 2017, DDOT and FRA undertook an Environmental Impact Study (EIS) to study options and select a preferred alternative to expand the Long Bridge; the EIS is anticipated to conclude in summer 2020 with a Record of Decision from FRA.

Three alternatives were carried through the alternatives analysis process and will be presented in the Draft EIS released September 5, 2019. Action Alternative A, which was identified as the Preferred Alternative in late 2018, consists of a new, two-track bridge upstream (west) of the existing crossing with no changes to the existing two-track bridge. Action Alternative B consists of both a new, two-track bridge upstream from the existing bridge and the replacement of the existing two-track bridge. A No Action (No Build) Alternative is also being evaluated.

This analysis examines the economic impact of Action Alternative A: the addition of a new, two-track bridge with no alterations to the existing bridge. As part of the Long Bridge expansion, a pedestrian and bicycle crossing is included in this analysis, although the exact location and connections of this crossing are still under consideration. This economic impact analysis includes the projects detailed below and shown in Figure 1. Collectively, these projects are referred to as the Long Bridge projects hereinafter. Each of the improvements listed below is necessary for the expanded operations forecasted for 2040.

- Long Bridge Expansion: the addition of a new, two-track railroad bridge upstream from the existing Bridge and a pedestrian and bicycle crossing- consists of the main span across the Potomac and five smaller spans over roads and waterways

[4] All service capacity forecasts were produced in coordination with CSXT as part of the DC2RVA Service Development Plan process. The Amtrak forecasts were produced by RGS and the VRE forecasts are from the Virginia Railway Express System Plan 2040 Study.

- Alexandria Fourth Track Project: the addition of a fourth track to the south of the Long Bridge between the Alexandria Station at the AF Interlocking to the Bridge at the RO Interlocking[5]
- VRE Station Improvements
    - L'Enfant Station: the construction of an island platform to accommodate the fourth track, eight-car trains and simultaneous boarding on two tracks and the addition of a fourth track between the Bridge at the LE Interlocking and east of L'Enfant station at the VA Interlocking[6]
    - Crystal City Station: the construction of an island platform to accommodate the fourth track, eight-car trains and simultaneous boarding on two tracks
    - Alexandria Station: the extension and modification of platforms to accommodate eight-car trains and two-platform simultaneous boarding, as well as additional station and platform improvements

Figure 1: Long Bridge Projects


[5] "AF" and "RO" are not acronyms and are the identifiers for these interlockings.
[6] "LE" and "VA" are not acronyms and are the identifiers for these interlockings.

By 2040, the Long Bridge projects will allow 80 additional trains per day to cross the Potomac River compared to a no-build scenario (Table 2). VRE has the largest increase in service capacity as the result of these projects and will be able to run an additional 54 daily trains compared to the no-build scenario. Amtrak will be able to run an additional 18 passenger trains per day as a result of these projects. Maryland Area Regional Commuter (MARC) will also be able to run eight trains from Maryland into Virginia, a service that does not currently exist and will not be feasible unless the Long Bridge projects are completed. Neither CSXT nor Norfolk Southern will have added daily train volume as a result of these projects. While an expanded Long Bridge will provide additional capacity for all rail traffic, freight traffic will continue to increase in response to market conditions independently of an expanded Long Bridge.

Table 2. Average Daily Train Volumes on the Long Bridge Corridor

| Operator | Current Trains Per Day | 2040 | | |
|---|---|---|---|---|
| | | No-Build Scenario | Long Bridge Projects | Project-Related Increase |
| Virginia Railway Express | 34 | 38 | 92 | 54 |
| Amtrak | 24 | 26 | 44 | 18 |
| Maryland Area Regional Commuter | 0 | 0 | 8 | 8 |
| CSX Transportation | 18(1) | 42 | 42 | 0 |
| Norfolk Southern | 0 | 6 | 6 | 0 |
| Total | 76 | 112 | 192 | 80 |

Source: Long Bridge Project Environmental Impact Statement: Alternative Developments Report, June 19, 2018 NOTE: VRE train counts include non-passenger "dead-head" trains (1)Approximate

The economic impacts of the Long Bridge projects will be the result of direct construction outlays related to the projects and the increased operational and maintenance expenditures of the operators along the corridor due to increased services. These are shown in Tables 3 and 4.

Table 3. Total Construction Outlays (Millions of 2018 Dollars)

| Project | Construction Cost |
|---|---|
| Long Bridge Expansion | $1,570.3 |
| 4th Track Project | $176.9 |
| VRE Station Improvements[1] | $134.4 |
| Total | $1,881.6 |

Source: Long Bridge Project Environmental Impact Statement: Conceptual Engineering Cost Estimate, Basis of Estimate, June 17, 2019; Virginia Department of Rail and Public Transportation; Virginia Railway Express FY2020 Annual Budget [1]Includes the 4th track project in D.C. between the LE and VA Interlockings

Table 4. Increase in Operating Expenditures Along the Long Bridge Corridor Resulting from Expanded Service Capacity in 2040 (Millions of 2018 Dollars)

| | Annual Operating Expenditures |
|---|---|
| Amtrak | $ 361.3 |
| Virginia Railway Express | $ 65.1 |
| Virginia Railway Express / Maryland Area Regional Commuter Run-Through[1] | $ 12.9 |
| Total | $ 439.3 |

Sources: Washington, D.C. to Richmond, VA Southeast High Speed Rail Corridor Service Development Plan, Administrative Draft (November 2018); Virginia Railway Express System Plan 2040 Study; Amtrak General and Legislative Annual Report & Fiscal Year 2020 Grant Request; Virginia Railway Express Recommended Budget for Fiscal Year 2020, Amended Budget for Fiscal Year 2019, and Capital Improvement Program & Six-Year Financial Forecast; Virginia Railway Express 2018 Transit Asset Management Plan; Federal Transit Authority's National Transit Database; The Stephen S. Fuller Institute at the Schar School, GMU
[1]Describes service area, not service operator(s)

In addition to these economic impacts, this analysis examines the role that rail commuting plays in the broader economy and how the Long Bridge projects could affect it. These effects are described through 1) examining rail commuting in the Washington region and its peer metropolitan areas, 2) examining current and future rail commuters and their contributions to the regional economy, 3) estimating the savings accruing to employers resulting from reduced turn-over rates attributable to the expanded rail services 4) detailing the value of time savings for both rail and road users resulting from the projects, and 5) describing the impacts of the expansion on existing infrastructure, including the costs associated with the failure of the existing Long Bridge.

The Long Bridge projects will also include a new bicycling and pedestrian crossing over the Potomac River between D.C. and Virginia. This analysis also describes the current and potential future states of bicycling and pedestrian commuting between these jurisdictions and their contributions to the regional economy.

The report is structured as follows. Section 2 describes the economic impacts of the Long Bridge projects in three parts: 2.1 details the current economic impacts of the Amtrak and VRE services crossing the bridge; 2.2 describes the short-term economic impacts resulting from the planning and construction of the projects; and 2.3 describes the long-term economic impacts of the operational and maintenance expenditures of the expanded passenger services. Section 3 examines the secondary effects of rail on the economy: 3.1 details the characteristics and patterns of current rail commuters in the region and their economic contribution; 3.2 compares current rail commuting patterns in the Washington region and its peer metros; 3.3 forecasts rail commuting trends in 2040 and the economic contributions of rail commuters; 3.4 estimates the decreased cost of turn-over for regional businesses resulting from expanded rail services; 3.5 estimates the value of time savings for rail and road users because of the expanded rail services; and 3.6 describes the effects of the Long Bridge projects on existing infrastructure, including the costs that would result from the failure of the existing structure. Section 4 describes the current and future of bicycling and pedestrian commuting between D.C. and Virginia. Section 5 concludes.

## 2. The Economic Impacts of the Proposed Long Bridge Expansion and Associated Corridor Projects

The economic impacts of the proposed Long Bridge Expansion and Associated Corridor Projects are composed of: 1) short-term and 2) continuing, long-term effects that recur annually. For both categories of economic impacts, the economic benefits identified and measured are unique to the proposed Long Bridge projects; that is, these economic benefits would not occur in the absence of the outlays required for its construction and to support increased rail services operations. These impacts are measured at their place of origin and to the benefit of the host jurisdictions and those receiving the benefit of these enhanced services. The economies or beneficiaries affected by these economic impacts are defined by the location of the beneficiaries and the principal geographic boundaries of the jurisdictions of analysis.

The economic impacts are described by four metrics.

1. The **direct outlays** is the total expenditure associated with the component being analyzed. For the short-term economic impacts, the direct outlays are the development (planning, design and engineering) and construction costs of the Long Bridge projects. For the long-term economic impacts, the direct outlays are the annual operational expenditures associated with the expanded passenger rail services accommodated by the Long Bridge. The long-term outlays and impacts will occur following the completion of construction and recur annually over the lifetime of the expanded rail services. The long-term outlays are shown as the annual expenditures in 2040 and can be multiplied by the years of services for a cumulative, lifetime estimate.

2. The **total output** is the outlay's overall contribution to the economy of the jurisdiction of analysis, as measured by the Gross State Product for states, Gross County Product for counties, Gross Regional Product for the Washington region, or the Gross Domestic Product for the U.S. The total output includes the direct outlays and the secondary impacts of these expenditures, inclusive of their indirect and induced effects.[7] These secondary impacts result from the spending and re-spending of the initial expenditures within the respective economies; that is, the spending of payroll and purchases by suppliers and vendors and their employees. As a result of the re-spending and recycling of the initial expenditures by workers employed on the construction of the projects or by rail service providers and their sub-contractors and suppliers, the initial economic impacts of these outlays increase beyond their initial value; they are multiplied. Larger geographies and more complex economies will have larger multipliers and, accordingly, will capture a greater share of the indirect and induced inputs and of the benefits resulting from the construction and operations of the proposed Long Bridge projects. The short-term impacts are

[7] Indirect effects are those that result from business-to-business expenditures resulting from the direct expenditures. Induced effects are those that result from households spending wages and other earnings from the direct and indirect business activities. These effects are not examined separately in this analysis.

temporary and exist during the planning and construction period, while the long-term impacts recur annually during the operations of the expanded services. The long-term total output is shown as the annual effect on economic activity in 2040 and can be multiplied by the years of services for a cumulative, lifetime estimate.

3. The **personal earnings** is the income that accrues to residents living in the jurisdiction of analysis as the result of wages and other earnings associated with both the direct outlays and their secondary effects. These earnings are taxable and allocated by the place of residence. For the short-term impacts, these earnings are temporary and occur during the planning and construction period. For the long-term impacts, these earnings recur for each year of expanded services across the Long Bridge. The long-term personal earnings are shown as the annual amount accruing to residents in 2040 and can be multiplied by the years of services for a cumulative, lifetime estimate.

4. The **jobs supported** is the total number of jobs that are associated with the direct outlays and secondary impacts. These jobs can be located within the jurisdiction of analysis, the U.S. or internationally. For the short-term impacts, these jobs are temporary and occur during the planning and construction period. For the long-term impacts, these jobs are permanent during the lifetime expanded services across the Long Bridge; the tables below describe these jobs in 2040.

The total output, personal earnings and jobs supported by the direct outlays are calculated by using multipliers provided by the U.S. Department of Commerce's Bureau of Economic Analysis, from its RIMS II Model. These multipliers are calculated specifically for the affected jurisdictions (i.e., The Washington region, the District of Columbia, Northern Virginia, the Commonwealth of Virginia and the U.S. and the counties described below). These multipliers reflect the most recent regional data available (2016) for all county jurisdictions in the U.S. and for the structure of the U.S. economy (2007) from which the inter-industry sales transactions matrix and related personal earnings and employment multipliers have been calculated.

This inter-industrial transactions matrix enables the initial direct outlays in any one industry in a specific jurisdiction to be linked to all directly affected suppliers and to their suppliers, locally and throughout the U.S., until all of the re-spending effects have been accounted for. The result of these inter-industry analyses is the sum of their accumulated economic contributions at each successive geographic level across all industries; that is, the sum of all economic impacts captured directly and indirectly within the economies of the Washington region inclusive of Northern Virginia and the District of Columbia, the Commonwealth of Virginia inclusive of Northern Virginia, and the U.S. inclusive of the Commonwealth.

For the short-term economic impacts, the jurisdictions of analysis are 1) the District of Columbia and suburban Maryland (combined), 2) Northern Virginia, 3) the Commonwealth of Virginia, and 4) the U.S. While these short-term economic benefits may accrue to the individual jurisdictions comprising Northern Virginia, the interdependencies of the

Northern Virginia jurisdictions' economies with their relatively small geographic and economic scales, inter-jurisdictional commuting patterns, and the geographically dispersed distribution of businesses make the measurement of benefits at the Northern Virginia geographic scale meaningful both unto itself and in comparison to the Commonwealth.

The economic impacts flowing from the construction of the Long Bridge projects will be largely captured within the jurisdictions directly affected by the locations of the construction projects. However, there will be economic impacts that are unassignable to a specific local jurisdiction and other impacts that will spill over to jurisdictions not directly benefiting from the proposed construction activities. These economic impacts will result from the inter-regional distribution of the labor force and supply network supporting these construction and related activities. Additionally, the distribution of the indirect and induced effects generated by this direct spending will generate economic benefits for the affected jurisdictions as the re-spending of these outlays spread out across the region. Where these economic impacts are measurable, they will be identified and quantified.

For the long-term economic impacts, the jurisdictions of analysis are 1) the Commonwealth of Virginia, 2) Northern Virginia, 3) Alexandria City, Virginia, 4) Prince William County, Manassas City and Manassas Park City, Virginia (combined), 5) Spotsylvania County and Fredericksburg City, Virginia (combined), 6) the District of Columbia, 7) the state of Maryland and 8) the U.S. Similar to the short-term impacts, the long-term impacts will also benefit other counties in Northern Virginia; however, these benefits are not definable because of economic cross-dependencies of these jurisdictions and because all direct outlays cannot be assigned to a county-level geography. Prior to analyzing the long-term benefits, the existing benefits are detailed to provide the base-level of economic impacts for the same jurisdictions of analysis.

The direct outlays for construction and operations of the Long Bridge projects will generate indirect and induced impacts within the economies of the Washington region including the District of Columbia, Northern Virginia and Suburban Maryland, the Commonwealth of Virginia and the U.S. The sum of these economic impacts constitutes the total contribution to the Washington region, including the District of Columbia, Northern Virginia, and Suburban Maryland, the Commonwealth of Virginia and the U.S. economies. The resulting direct and indirect (and induced) outlays also will generate new (taxable) personal earnings for workers residing in the jurisdictions impacted by this new spending. These short- and long-term outlays also support jobs, indirect and induced, beyond the direct workforce employed in the construction and operation of the Long Bridge projects.

## 2.1 The Economic Impact of the Existing Passenger Rail Operations Over Long Bridge

The long-term economic impacts associated with the Long Bridge Expansion and Associated Corridor Projects will occur following the completion of construction and recur annually over the lifetime of the expanded passenger rail service operations across the

corridor. The economic benefits resulting from the Long Bridge projects will be new and in addition to the benefits resulting from the existing operations along the corridor. The economic impacts of the existing services are detailed in this section and are the result of the operating expenditures associated with the passenger rail services that operate over the Long Bridge. The current benefits accrue to the U.S. and are estimated separately for the Commonwealth of Virginia, the District of Columbia, and the state of Maryland. Four sub-state geographies are also shown for the Commonwealth of Virginia: 1) Northern Virginia, 2) Alexandria City, Virginia, 3) Prince William County, Manassas City and Manassas Park City, Virginia (combined), and 4) Spotsylvania County and Fredericksburg City, Virginia (combined).

Figure 2. Passenger Rail Network Operating Over Long Bridge


As shown in Figure 2, two passenger rail services currently have routes that operate over the Long Bridge. The Virginia Railway Express operates two routes; one that runs between Spotsylvania County, VA and Washington, D.C. and one that runs between Manassas City, VA and Washington, D.C. These services and their associated operational expenditures are geographically compact and originate within the Commonwealth of Virginia. The point of expenditure for more than two-fifths of VRE operations (41.6%) can be identified based on the locations of the VRE administrative and maintenance facilities.

Amtrak operates 31 routes across the Long Bridge that run primarily between Boston, MA, Miami, FL, New Orleans, LA and Chicago, IL although many routes originate or terminate elsewhere in the network. The operational expenditures associated with these routes are geographically dispersed and assumed to occur proportionally along the specific route being operated at the state-level and for Northern Virginia.

Table 5 shows the FY 2018 operational and maintenance expenditures associated with the VRE and Amtrak routes that operate over Long Bridge. Only VRE expenditures are estimated by county. Altogether, VRE operational and maintenance expenditures were $54.3 million in FY 2018, after excluding track access fees, liability, and debt service, which are either transfers to other rail operators in the region or are likely not to be spent in the local economy. VRE professional and administrative expenditures are assumed to occur in the jurisdictions of the two administrative buildings in either Alexandria City, VA or Spotsylvania County and Fredericksburg City, VA (combined).[8] The maintenance expenditures are assumed to occur in the jurisdictions where the maintenance buildings and the maintenance and storage facilities are located, either in Spotsylvania County, VA or in Manassas City and Prince William County, VA (combined). All other expenditures are assumed to occur in Northern Virginia, except finance, utilities and fuel, which are assumed to occur in parts of Virginia that cannot be geographically identified, potentially inclusive of Northern Virginia.

Amtrak operational and maintenance expenditures associated with the routes that travel over Long Bridge totaled $691.1 million in FY 2018. These expenditures were allocated based on the share of route-miles for long distance routes or train-miles for state-supported and northeast corridor routes. About 18 percent (17.8%) of operations occur in the Commonwealth of Virginia, including 6.2 percent in Northern Virginia. Of the states in which these routes operate, the Commonwealth accounts for the largest share of services. Another 10.8 percent occur in Maryland and 1.1 percent occur in the District. All other expenditures occur in one of the other 21 states that are served by the routes or in the U.S., more broadly.

The economic impacts generated by these expenditures are shown in Tables 6-12 for the Commonwealth of Virginia, Northern Virginia, select jurisdictions within the Commonwealth, Maryland, D.C., the Washington region and the U.S., respectively. These impacts are annual and recur during each year of operations. These impacts reflect the baseline benefit that accrues to the affected geographies in absence of the expanded services that can be achieved through the Long Bridge projects.

[8] The administrative building is in the City of Fredericksburg, VA.

Table 5. FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge

| | Virginia Railway Express[1] | Amtrak[2] | Total |
|---|---|---|---|
| Alexandria City, VA | $6,284,071 | N/A | $6,284,071 |
| Prince William County & cities of Manassas & Manassas Park, VA | $6,317,426 | N/A | $6,317,426 |
| Spotsylvania County & Fredericksburg City, VA | $9,979,816 | N/A | $9,979,816 |
| Northern Virginia, Not Geographically Identifiable | $26,402,536 | N/A | $69,196,194 |
| Northern Virginia, Total | $48,983,850 | $42,793,658 | $91,777,508 |
| | | | |
| Virginia, Not Geographically Identifiable | $5,309,476 | $80,351,722 | $85,661,198 |
| Virginia, Total | $54,293,326 | $123,145,380 | $177,438,706 |
| | | | |
| D.C. | $0 | $7,588,497 | $7,588,497 |
| Suburban Maryland | $0 | $11,179,525 | $11,179,525 |
| | | | |
| Washington Region[3] | $48,983,850 | $61,561,680 | $110,545,530 |
| | | | |
| Elsewhere in Maryland | $0 | $63,163,109 | $63,163,109 |
| | | | |
| Elsewhere in the U.S. | $0 | $567,947,157 | $567,947,157 |
| | | | |
| U.S. | $54,293,326 | $691,092,537 | $745,385,863 |

Sources: Amtrak General and Legislative Annual Report & Fiscal Year 2020 Grant Request; Virginia Railway Express Recommended Budget for Fiscal Year 2020, Amended Budget for Fiscal Year 2019, and Capital Improvement Program & Six-Year Financial Forecast; Virginia Railway Express 2018 Transit Asset Management Plan; The Stephen S. Fuller Institute at the Schar School, GMU

[1]Excludes access fees, liability, and debt service; [2]Excludes transfers to capital & ancillary; NOTE: VRE expenditures exclude access fees; [3]Includes D.C., Northern Virginia, and Suburban Maryland.

## 2.1.1 Impacts of Existing Long Bridge Operations on the Commonwealth of Virginia Economy

### *2.1.1.1 Commonwealth of Virginia*

The Commonwealth of Virginia economy captures the largest identifiable state-level economic benefit resulting from the current passenger rail operations over Long Bridge. The direct outlays of $177.4 million in FY 2018 accounted for 23.8 percent of the combined expenditures of VRE and Amtrak routes operating across Long Bridge, including all of VRE

expenditures and 17.8 percent of Amtrak expenditures. The majority of the expenditures were the result of Amtrak operations, which accounted for 69.4 percent of the total outlays that occurred in Virginia.

The rail transportation multipliers reflect the composition of the Virginia economy, its sectoral interdependence, and the degree to which these outlays and indirect and induced effects are captured by the Commonwealth. The rail transportation multiplier for the Commonwealth is 1.7252, nearly 50 percent smaller than that for the U.S., indicating the degree to which the impacts associated with these expenditures spill over to other geographies in the U.S. The annual operations of passenger rail services across the Long Bridge contributed $306.1 million in FY 2018 to the Commonwealth's economy, as measured by its Gross State Product (GSP), or about one-third of the direct GSP associated with the rail transportation industry in the Commonwealth.

Table 6. The Impact of FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge on the Commonwealth of Virginia Economy

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $123,145,380 | $212,450,409 | $51,462,454 | 830 |
| VRE | $54,293,326 | $93,666,846 | $22,689,181 | 366 |
| Total | $177,438,706 | $306,117,255 | $74,151,635 | 1,197 |

Sources: See Table 5

[1]total impact on the Virginia economy; [2]new labor income of workers residing in Virginia; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

These direct outlays generated $74.2 million in personal earnings to workers residing in the Commonwealth. For every dollar in operational expenditures, $0.42 cents accrued to the workers living Commonwealth; that is, these annual personal earnings would support the equivalent of 1,075 full-time workers living in the Commonwealth. In total, these operational outlays supported 1,197 jobs, including those located in Virginia and elsewhere.

*2.1.1.2 Northern Virginia*

A significant share of the benefits that accrue to the Commonwealth of Virginia are to the benefit of the Northern Virginia economy. Northern Virginia captured $91.8 million in direct expenditures in FY 2018 that were associated with the operations of the Long Bridge routes, or 51.7 percent of the total expenditures that occurred in the Commonwealth. The majority of direct outlays in Northern Virginia were from VRE services and VRE accounted for 53.4 percent of the FY 2018 expenditures.

The multiplier in Northern Virginia is 1.4776 and is smaller than that for the Commonwealth as the result of larger economic leakage and smaller recycling effects inside the Northern Virginia economy. As shown in Table 7, the contribution of these operations to the Northern Virginia economy, its Gross Regional Product (GRP), in FY 2018 was $135.6 million.

Table 7. The Impact of FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge on Northern Virginia Economy

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $42,793,658 | $63,231,910 | $12,983,596 | 198 |
| VRE | $48,983,850 | $72,378,537 | $14,861,700 | 227 |
| Total | $91,777,508 | $135,610,446 | $27,845,296 | 425 |

Sources: See Table 5

[1]total impact on the Northern Virginia economy; [2]new labor income of workers residing in Northern Virginia [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

The direct expenditures associated with operating the Long Bridge passenger services generated $27.8 million in personal earnings in FY 2018. For every dollar of direct outlays, $0.30 cents accrued to workers living in Northern Virginia and these earnings supported the equivalent of 317 full-time workers in the region. Overall, $1 million in operating expenditures supported 4.6 jobs, a total of 425 jobs, both in Northern Virginia and elsewhere.

*2.1.1.3 Select Jurisdictions in Virginia*

A portion of the operating expenditures of the VRE system occurred in one of three sub-state geographies: Alexandria City, Virginia, Spotsylvania County & Fredericksburg City, Virginia (combined, abbreviated as the Spotsylvania area), or Prince William County, Manassas City & Manassas Park City, Virginia (combined, hereinafter referred to as the Prince William area). These three geographies captured 41.6 percent of VRE operating expenses in FY 2018 based on the type of expenditure and the location of the VRE facilities. The remaining expenditures cannot be identified by sub-state geography, although some are likely to also occur in the jurisdictions detailed below. For this reason, the impacts presented here are conservative.

The multipliers of rail transportation expenditures for these sub-state geographies are smaller than those of the larger geographies, reflecting larger economic leakage and smaller economic recycling effects within these sub-state areas. The multipliers are 1.2472, 1.4007, and 1.3831 for Alexandria City, VA, the Prince William area and the Spotsylvania area, respectively. The total contribution to the areas' economies (Gross County Product) was $7.8 million for the City of Alexandria, $8.8 million for the Prince William area, and $13.8 million for the Spotsylvania area. In both Alexandria City and the Prince William area, the total contribution of the Long Bridge passenger rail operations equaled 0.05 percent of the total economic activity in the respective geographies. For the Spotsylvania area, these operations accounted for about 0.3 percent of the local economy.

The VRE expenditures contributed to the personal earnings in each of these three areas: $0.4 million in the City of Alexandria, $1.4 million in the Prince William area, and $2.2 million in the Spotsylvania area. These personal earnings accrued to workers living in these

jurisdictions and supported the equivalent of 54 full-time workers living in these jurisdictions, combined. A total of 59 jobs, located anywhere, were supported by these expenditures in FY 2018.

Table 8. The Impact of FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge on Select Jurisdictions in Virginia

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Alexandria City, VA | | | | |
| Amtrak | N/A | N/A | N/A | N/A |
| VRE | $6,284,071 | $7,837,494 | $443,655 | 6 |
| Total | $6,284,071 | $7,837,494 | $443,655 | 6 |
| | | | | |
| Prince William County & the cities of, Manassas & Manassas Park, VA (combined) | | | | |
| Amtrak | N/A | N/A | N/A | N/A |
| VRE | $6,317,426 | $8,848,819 | $1,423,316 | 22 |
| Total | $6,317,426 | $8,848,819 | $1,423,316 | 22 |
| | | | | |
| Spotsylvania County & Fredericksburg City, VA (combined)[4] | | | | |
| Amtrak | N/A | N/A | N/A | N/A |
| VRE | $9,979,816 | $13,803,084 | $2,230,489 | 32 |
| Total | $9,979,816 | $13,803,084 | $2,230,489 | 32 |

Sources: See Table 5
[1]total impact on the jurisdiction's economy; [2]new labor income of workers residing in the jurisdiction of analysis; [3]jobs supported anywhere as a result of new direct spending; [4]uses the 2006/2015 RIMS II model
Totals many not sum due to rounding.

### 2.1.2 Impacts of Existing Long Bridge Operations on the District of Columbia Economy

The operating expenditures that occur in the District of Columbia as the result of passenger rail services crossing the Long Bridge are modest and account for 1.0 percent of the system-wide expenditures, or $7.6 million in FY 2018. All of these expenditures are from Amtrak service operating over Long Bridge. No VRE administrative or maintenance facilities are located in the District so no expenditures are directly associated with VRE operations. Union Station is a major hub for Amtrak operations but the District accounts for a small share of the route- and train-miles travelled. No additional geographic-specific data are available to adjust for any potential hub-effect so the economic benefits presented here are conservative.

The rail transportation multiplier for the District is 1.2070, the smallest multiplier of the geographies examined in this section, indicating that D.C. captures the smallest share of the economic recycling associated with these operations as the result of its economic structure and small geography. The overall economic impact of the operational outlays was $9.2

million in FY 2018, or about ten percent of direct Gross State Product associated with the rail transportation industry in the District.

Table 9. The Impact of FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge on the District of Columbia Economy

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $7,588,497 | $9,159,316 | $466,693 | 6 |
| VRE | $0 | $0 | $0 | 0 |
| Total | $7,588,497 | $9,159,316 | $466,693 | 6 |

Sources: See Table 5
[1]total impact on the D.C. economy; [2]new labor income of workers residing in D.C.; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

These outlays contributed $0.5 million in personal earnings to the District of Columbia, supporting the equivalent of five full-time workers residing in D.C. The outlays supported a total of six jobs located in the District and elsewhere in FY 2018.

2.1.3 Impacts of Existing Long Bridge Operations on the Maryland Economy

VRE does not operate in Maryland so no direct operating expenditures occurred in the state in FY 2018. Maryland captured 10.8 percent of all Amtrak operating expenditures associated with the Long Bridge routes in FY 2018, for a total of $74.3 million in direct outlays.

Table 10. The Impact of FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge on the State of Maryland Economy

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $74,342,634 | $127,534,788 | $31,023,181 | 465 |
| VRE | $0 | $0 | $0 | 0 |
| Total | $74,342,634 | $127,534,788 | $31,023,181 | 465 |

Sources: See Table 5
[1]total impact on the Maryland economy; [2]new labor income of workers residing in the Maryland; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

The multiplier of rail transportation in Maryland is 1.7155, similar to that in Virginia. The overall contribution of these operations to Maryland's economy, its GSP, was $127.5 million in FY 2018, or the equivalent of about thirty percent of the total GSP from the rail transportation industry in the state. The GSP contribution of the Long Bridge rail operations in Maryland was about 94 percent of the size of the contribution to the Northern Virginia economy, despite smaller levels of direct outlays.

The Amtrak operations of the Long Bridge routes contributed $31.0 million in personal earnings to Maryland residents. That is, for every $1.0 in direct outlays, $0.42 cents accrued to a worker living in the state, supporting the equivalent of 425 full-time workers living in

the state. Overall, these operating outlays supported 465 jobs located in Maryland and elsewhere.

### 2.1.4 Impacts of Existing Long Bridge Operations on the Washington Region's Economy

The Washington region's economy captured the 14.8 percent of the combined expenditures of VRE and Amtrak routes operating across Long Bridge, including 90.2 of VRE expenditures and 8.9 percent of Amtrak expenditures. These annual direct outlays of $110.5 million, in turn, generated $166.1 million to the regional economy, reflecting a multiplier of 1.5029. This economic impact represents about 0.03 percent of the regional economy, as measured by its Gross Regional Product.[9] This multiplier is larger than both that of the District (1.2070) and Northern Virginia (1.4776), reflecting the interdependence of the economies of the District and Northern Virginia. Combined, these sub-state areas capture a larger share of the recycling effects than they do separately as the benefits of the expenditures that occur in the District spill over into Northern Virginia and *vice versa*.

Table 11. The Impact of FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge on the State of Maryland Economy

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $61,561,680 | $92,521,049 | $22,014,457 | 329 |
| VRE | $48,983,850 | $73,617,828 | $17,516,625 | 262 |
| Total | $110,545,530 | $166,138,879 | $39,531,082 | 596 |

Sources: See Table 5
[1]total impact on the Maryland economy; [2]new labor income of workers residing in the Maryland; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

For every dollar in direct expenditures, $0.36 cents accrues to workers that live in the Washington region, a total of $39.5 million in FY 2018. These personal earnings support the equivalent of 471 full-time workers. Overall, these operating outlays supported 596 jobs located in Washington region and elsewhere.

### 2.1.5 Impacts of Existing Long Bridge Operations on the U.S. Economy

The full economic effects of the operations of passenger rail services across Long Bridge are national and reflected annually in the U.S.'s Gross Domestic Product (GDP). The total operational outlays associated with the full network of passenger rail using Long Bridge was $745.4 million in FY 2018 (Table 12), inclusive of $691.1 million in Amtrak expenditures and $54.3 million in VRE expenditures.

The national multiplier for rail transportation is 2.5547 and these operation expenditures contributed a total of $1,904.2 million in FY 2018 to GDP. Even though 34.8 percent of the total direct outlays occur in D.C., Maryland and Virginia (combined), these states only

[9] As measured in 2017, inflated to 2018 dollars.

capture 23.3 percent of the total economic effect of these operations. The difference in share reflects the spill-over effects that accrue to other parts of the U.S. and to the national economy, more broadly.

Table 12. The Impact of FY 2018 Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge on the U.S. Economy

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $691,092,537 | $1,765,534,104 | $466,902,118 | 7,997 |
| VRE | $54,293,326 | $138,703,160 | $36,680,571 | 628 |
| Total | $745,385,863 | $1,904,237,264 | $503,582,689 | 8,625 |

Sources: See Table 5

[1]total impact on the U.S. economy; [2]new labor income of workers residing in the U.S.; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

Rail operations over Long Bridge generated $503.6 million in personal earnings in FY 2018, supporting the equivalent of 7,681 full-time workers living in the U.S. Overall, these operations supported 8,625 jobs, including the estimated 7,681 living in the U.S. and an additional 944 jobs internationally.

### 2.1.6 Summary of Impacts of Existing Long Bridge Operations

In FY 2018, the operational expenditures associated with the existing Amtrak and VRE train services across the Long Bridge generated an impact of

- $306.1 million annually to the benefit of the Commonwealth of Virginia economy including
  - $135.6 million for the economy in Northern Virginia,
  - $13.8 million for the economy in Spotsylvania County and Fredericksburg City, VA,
  - $8.8 million for the economy in Prince William County and the cities of Manassas and Manassas Park, VA, and
  - $7.8 million for the economy in Alexandria City, VA,
- $127.5 million annually to the benefit of the Maryland economy,
- $9.2 million annually to the benefit of the D.C. economy,
- $166.1 million annually to the benefit of the Washington region's economy and
- $1.9 billion annually for the national economy.

These economic impacts associated with current operations, as presented in this section, establish the framework for projecting the economic impacts that will be generated by the proposed Long Bridge projects described in Sections 2.2 and 2.3. The existing impacts will continue to occur annually and the short-term and long-term benefits are in addition to these existing impacts.

## 2.2 The Short-Term Economic Impact of the Proposed Long Bridge Expansion and Associated Corridor Projects

The construction outlays projected for the development and construction of the proposed Long Bridge Expansion and Associated Corridor Projects are presented in Table 13. These outlays occur over the pre-construction (including planning, design, and engineering) and construction periods and will culminate in a completed structure with a fourth track and improvements at three stations ready for use as designed. The direct outlays projected for soft and hard costs over the full construction period will total $1.9 billion expressed in 2018 dollars. For the economic impact analysis, several cost items have been excluded—insurance premiums from soft costs and land acquisition costs from hard costs—as these outlays will not contribute to the affected economies in the short-term period.

These construction outlays have been assigned to the jurisdictions where these projects or their staging areas and access points will be located. This division of construction costs is also presented in Table 13.

Table 13. Long Bridge Expansion and Associated Corridor Projects: Construction Costs (in millions of 2018 dollars)

| | Total Costs | Outlays Analyzed for Economic Impacts | | |
|---|---|---|---|---|
| | | Washington Region | Northern Virginia | District[1] |
| Long Bridge | $1,570.3 | $1,525.7 | $1,297.8 | $227.9 |
| 4th Track | $176.9 | $176.9 | $176.9 | [2] |
| Station Improvements | $134.4 | $134.2 | $73.0 | $61.2 |
| Totals | $1,881.6 | $1,836.8 | $1,547.7 | $289.1 [2] |

Sources: Long Bridge Expansion Project Environment Impact Statement Conceptual Engineering Cost Estimate (6/17/19); VRE 2020 CIP; Virginia Department of Rail and Public Transportation; The Stephen S. Fuller Institute at the Schar School, GMU

[1]District of Columbia; [2]Outlays for 4th track construction within the District are included in the Station Improvements project and total.

The economic impacts that will be generated by these direct construction outlays presented in Table 13 are shown in Table 14 for the Washington region and its sub-state portions and in Tables 15-17, respectively, for Northern Virginia, the Commonwealth of Virginia, and the U.S. These impacts are cumulative within and limited to the construction period; that is, they reflect the total outlays over this period and, with the completion of the construction phase including testing with the new rail and bridge crossing ready for daily use, these economic impacts will have been captured locally, statewide and nationally.

### 2.2.1 Impacts from Construction of the Long Bridge Projects on the District of Columbia and Suburban Maryland Economies

The Long Bridge projects' construction activities will be located within the District of Columbia and Northern Virginia, as shown in Table 13, with the direct economic impacts originating in those to sub-state areas. However, the economic impacts of these outlays will

have indirect and induced effects throughout the entire Washington region due to the interdependencies within the regional economy. The interstate mobility of the region's workforce and the transportability of professional and related construction services account for a major share of these spill-over effects but these economic interdependencies also make assigning some indirect and induced benefits impossible. These spill-over effects within the Washington region allow a portion of these benefits to flow into Suburban Maryland even though none of the Long Bridge projects' construction activity will be based in its local jurisdictions.

Table 14. The Impact of Construction of the Proposed Long Bridge Expansion and Associated Corridor Projects on the Washington Region's Economy
(Millions of 2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Washington Region[4] | $1,836.8 | $2,845.0 | $787.4 | 14,592 |
| Northern Virginia | $1,547.7 | $2,390.3 | $604.2 | 11,303 |
| D.C. | $289.1 | $319.4 | $17.3 | 293 |
| Long Bridge | $227.9 | $250.2 | $12.1 | 203 |
| L'Enfant Station[5] | $61.2 | $69.2 | $5.1 | 90 |
| Regional Spill-Over[6] | $0.0 | $135.3 | $165.9 | 2,996 |

Sources: Virginia Department of Rail and Public Transportation; The Stephen S. Fuller Institute at the Schar School, GMU

[1]total impact on the Northern Virginia economy; [2]new labor income of workers residing in Northern Virginia; [3]jobs supported anywhere as a result of new direct spending; [4]Totals many not sum due to rounding; [5]includes outlays for rail improvements; [6]Includes impacts benefiting Suburban Maryland as well as occurring at the regional level that are not assignable to its sub-state areas.

The construction outlays totaling $1,836.8 million over the full pre-construction and construction periods for the Long Bridge projects are shown to generate a total contribution of $2,845.0 million to the Washington region's economy, reflecting an aggregate multiplier of 1.5489. This total contribution to the Washington region's economy (GRP), based on the distribution of direct construction outlays and the region's economic structure (as reflected in their respective RIMS II multipliers) is divided among its sub-state portions as follows: Northern Virginia's economy will capture 84.0 percent, the District of Columbia's economy will capture 11.2 percent, and the remaining 4.8 percent or $135.3 million, consisting of indirect and induced impacts, will accrue to Suburban Maryland's jurisdictions' economies or cannot be assigned to any specific local jurisdiction and consist of regional benefits.

The District of Columbia's economic impacts resulting from the direct outlays of $289.1 million involving improvements to L'Enfant Plaza's VRE Station, fourth track construction connecting the Long Bridge to L'Enfant Station and eastward connecting to the existing rail network serving Union Station, and the construction that will be required to connect the Long Bridge's two new rails to existing structures in the District. These direct outlays will generate a total of $319.4 million to the Districts economy, reflecting a multiplier of 1.1049. Additionally, this direct construction spending will generate $17.3 million in new personal

earnings that well accrue to workers residing in the District; these new earnings would equate to 192 full-time, year-round jobs. These relatively small total output and personal earnings multipliers reflect the District's small geographic size and the specialized nature of the District's economy that results in significant magnitudes of direct outlays that occur in the District leaking out to adjacent jurisdictions.

### 2.2.2 Impacts from Construction of the Long Bridge Projects on the Northern Virginia Economy

The Northern Virginia economy is positioned to be the principal beneficiary of the impacts flowing from the expenditures related to planning, design and engineering, and construction of the proposed Long Bridge projects. These direct expenditures will contribute to Northern Virginia's economy, its Gross Regional Product (GRP), by expanding the demand of professional and related services in combination with construction and related services. While these outlays will be focused within the Northern Virginia economy, the workforce and suppliers that will be supporting the Long Bridge projects during the construction phase will be drawn from a broad laborshed extending across the Washington region, including Maryland and the District of Columbia, elsewhere within the Commonwealth of Virginia, and nationally. The same will be true for the distribution of suppliers of the materials utilized in the construction activities.

Typically, those jurisdictions in more convenient proximity to the construction site will supply more of the project's labor requirements and capture more of the subsequent payroll spending—and the resulting indirect and induced effects—than jurisdictions farther removed from the construction site. For labor resources, proximity is a major consideration as it would be for suppliers of more common construction materials such as concrete and lumber. The more specialized materials are likely to be supplied by vendors outside of the Northern Virginia economy, but even for these, the distributors may be local.

The multipliers used to calculate the economic benefits flowing from the Long Bridge projects' construction outlays reflect the Northern Virginia economy's sectoral composition and scale, and its ability to capture and re-cycle the direct spending associated with these outlays. At larger jurisdictional scales, in this case the Commonwealth of Virginia and the United States, these larger economies have greater capacities to capture, retain and re-cycle these direct outlays thereby achieving even greater economic impacts, as will be shown in Tables 16 and 17.

The impacts of the direct construction outlays for the Long Bridge projects on the Northern Virginia economy are presented in Table 15.

With an aggregate multiplier (combining soft and hard costs) of 1.5444, the direct expenditure of $1,547.7 million will contribute a total of $2,390.3 million to the Northern Virginia economy, its GRP, over the construction period. This increase to the region's GRP represents new economic activity that would not have occurred in the absence of these construction outlays for the Long Bridge projects.

Table 15. The Impact of Construction of the Proposed Long Bridge Expansion and Corridor Projects on the Northern Virginia Economy (Millions of 2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Long Bridge | $1,297.8 | $2,010.9 | $505.2 | 9,353 |
| Soft Costs[4] | $353.5 | $598.0 | $176.9 | 2,842 |
| Hard Costs | $944.3 | $1,412.9 | $328.3 | 6,511 |
| Fourth Track | $176.9 | $264.7 | $61.5 | 1,220 |
| Station Improvements | $73.0 | $114.7 | $37.5 | 730 |
| Soft Costs[4] | $18.4 | $31.1 | $9.2 | 148 |
| Hard Costs | $54.6 | $83.6 | $28.3 | 582 |
| Totals[5] | $1,547.7 | $2,390.3 | $604.2 | 11,303 |

Sources: Virginia Department of Rail and Public Transportation; The Stephen S. Fuller Institute at the Schar School, GMU

[1]total impact on the Northern Virginia economy; [2]new labor income of workers residing in Northern Virginia; [3]jobs supported anywhere as a result of new direct spending; [4]architecture & engineering, legal, management and other professional costs; insurance and land acquisition costs have been excluded; [5]unallocated contingency costs have been assigned to other cost categories on a proportional basis. Totals many not sum due to rounding.

These direct development and construction expenditures will also generate new personal earnings totaling $604.2 million to the benefit of workers residing within Northern Virginia; that is, each dollar of new direct construction outlay will generate $0.39 cents of new personal earnings that will accrue to workers residing in Northern Virginia. This new personal earnings will result from the spending and re-spending of payroll and suppliers' earnings within the Northern Virginia economy. The jobs associated with these new personal earnings are in addition to those supported directly by the Long Bridge projects' construction and will span the breadth of the region's workforce.

It is estimated that this $604.2 million in new personal earnings generated by the construction of the Long Bridge projects would support 6,878 full-time, year-round equivalent jobs held by Northern Virginia residents during the construction period. Inclusive of these Northern Virginia-based workers, this direct construction spending would support directly and indirectly 7.3 jobs per $1 million in new construction and related outlays and total 11,303 full-time, year-round equivalent jobs over the full construction period in the Commonwealth, nationally and globally.

### 2.2.3 Impacts from Construction of the Long Bridge Projects on the Commonwealth of Virginia Economy

The impacts generated by the Long Bridge projects' construction outlays on the Commonwealth of Virginia's economy are shown in Table 16. With geographic and economic scale advantages compared to Northern Virginia and its economy, its economic multipliers are greater than those for Northern Virginia. With the direct construction outlays for the Long Bridge projects of $1,547.7 million and a multiplier of 1.8674, these GSP impacts will total $2,890.1 million over the full construction period.

These direct construction outlays will generate $871.4 million in new taxable personal income for workers residing within the Commonwealth (including Northern Virginia); this magnitude of new earnings would support 12,637 full-time, year-round equivalent jobs held by Virginians. For each dollar of direct construction outlays, $0.56 in new personal earnings would be generated within the Commonwealth's economy. Overall, these direct construction outlays would support 11.5 jobs per $1 million in new construction outlays for a total of 17,761 full-time, year-round equivalent jobs in the Commonwealth, elsewhere in the U.S., and globally.

Table 16. The Impact of Construction of the Proposed Long Bridge Expansion and Corridor Projects on the Commonwealth of Virginia Economy (Millions of 2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Long Bridge | $1,297.8 | $2,424.8 | $698.2 | 14,930 |
| Soft Costs[4] | $353.5 | $707.7 | $243.7 | 5,723 |
| Hard Costs | $944.3 | $1,717.1 | $454.5 | 9,207 |
| Fourth Track | $176.9 | $321.7 | $121.9 | 1,725 |
| Station Improvements | $73.0 | $143.6 | $51.3 | 1,107 |
| Soft Costs[4] | $18.4 | $36.8 | $12.7 | 298 |
| Hard Costs | $54.6 | $106.8 | $38.6 | 809 |
| Totals[5] | $1,547.7 | $2,890.1 | $871.4 | 17,761 |

Sources: Virginia Department of Rail and Public Transportation; The Stephen S. Fuller Institute at the Schar School, GMU

[1]total impact on the Commonwealth of Virginia economy; [2]new labor income of workers residing in the Commonwealth; [3]jobs supported anywhere as a result of new direct spending; [4]architecture & engineering, legal, management and other professional costs; insurance and land acquisition costs have been excluded; [5]unallocated contingency costs have been assigned to other cost categories on a proportional basis. Totals many not sum due to rounding.

2.2.4 Impacts from Construction of the Long Bridge Projects on the U.S. Economy

The full economic effects of the construction outlays for the Long Bridge projects are captured within the national economy and would be reflected in its GDP growth during the construction period. These impacts are presented in Table 17.

The GDP contribution of the direct construction outlays of $1,836.8 million for the Long Bridge projects, reflecting a multiplier of 2.8028, will total $5,148.1 million. This GDP effect is 78.1 percent greater than the Long Bridge projects' construction outlay's GSP impact on the Commonwealth of Virginia economy as it accounts for GSP impacts that are captured by other state economies, including the District of Columbia, as well as inter-state transactions not assignable to any particular state's economy.

In addition to this GDP-effect generated by the Long Bridge projects' construction outlays, these direct outlays support the generation of new labor income—personal earnings—totaling $1,520.1 million accruing to workers residing in the U.S. The estimated 23,186 full-time, year-round equivalent jobs that are supported by these new earnings span the breadth of the economy reflecting the re-spending of direct and indirect payroll disbursements and the purchases of contractors and their suppliers during the construction period.

Table 17. The Impact of Construction of the Proposed Long Bridge Expansion and Corridor Projects on the U.S. Economy (Millions of 2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Long Bridge | $1,525.7 | $4,212.5 | $1,227.4 | 23,883 |
| Soft Costs[4] | $353.5 | $969.6 | $323.0 | 5,839 |
| Hard Costs | $1,172.2 | $3,242.8 | $904.4 | 18,044 |
| Fourth Track | $176.9 | $489.4 | $136.5 | 2,723 |
| Station Improvements | $134.2 | $446.2 | $156.3 | 3,154 |
| Soft Costs[4] | $18.4 | $50.5 | $16.8 | 304 |
| Hard Costs | $115.8 | $395.8 | $139.5 | 2,850 |
| Totals[5] | $1,836.8 | $5,148.1 | $1,520.1 | 29,769 |

Sources: Virginia Department of Rail and Public Transportation; The Stephen S. Fuller Institute at the Schar School, GMU.[1]total impact on the U.S. economy; [2]new labor income of workers residing in the U.S.; [3]jobs supported anywhere as a result of new direct spending; [4]architecture & engineering, legal, management and other professional costs; insurance and land acquisition costs have been excluded; [5]unallocated contingency costs have been assigned to other cost categories on a proportional basis. Totals many not sum due to rounding.

These direct construction outlays were also found to support a total of 29,769 full-time, year-round equivalent jobs in the global economy, including those in the U.S. The difference between those jobs held by residents of the U.S. and total jobs supported illustrates the

leakage of economic benefits beyond the U.S. economy; in this instance, this leakage is to the global economy and accounts for 22.1 percent of the total jobs supported.

2.2.5 Impacts from Construction of the Long Bridge Projects: Spill-Over Effects

The economic impacts generated by the construction outlays occurring during the development and construction phase of the Long Bridge projects, as presented in Table 14 for the Washington region, in Tables 15 and 16 for Northern Virginia and the Commonwealth of Virginia, and in Table 17 for the U.S. are cumulative and increase in magnitude with increases in the geographic and economic scales being analyzed. The differences in the economic impacts among geographic areas are the "spill over" of economic benefits beyond the initial impact area reflecting the spread effects as measured by their indirect and induced impacts. These economic impacts and their spill-over effects at each larger geographic scale is presented in Table 18.

Table 18. Economic Impact Spill-Over Effects from Construction of Long Bridge Projects: The District of Columbia, Northern Virginia, the Commonwealth of Virginia and the U.S. (Millions of 2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| District of Columbia | $289.1 | $319.4 | $17.3 | 293 |
| Washington Region | $1,836.8 | $2,845.0 | $787.4 | 14,592 |
| Spill-Over Impact | | $2,525.6 | $770.1 | 14,299 |
| Percent | | 88.8% | 97.8% | 98.0% |
| | | | | |
| Northern Virginia | $1,547.7 | $2,390.3 | $604.2 | 11,303 |
| Washington Region Spill-Over[4] | | $135.3 | $165.9 | 2,996 |
| Percent | | 4.8% | 21.1% | 20.5% |
| | | | | |
| The Commonwealth | $1,547.7 | $2,890.1 | $871.4 | 17,761 |
| Spill-Over Impact | | $499.8 | $267.2 | 6,458 |
| Percent | | 17.3% | 30.7% | 36.4% |
| | | | | |
| U.S. | $1,836.8 | $5,448.1 | $1,520.1 | 29,76+ |
| Spill-Over Impact | | $2,558.0 | $648.7 | 12,008 |
| Percent | | 47.0% | 42.7% | 40.3% |

Sources: Table 15-17; see Table 15 for footnote 1-3 definitions

[4]Indirect and induced impacts spilling over into Suburban Maryland or unassignable to a local jurisdiction.

2.2.6 Summary of Impacts of Existing Long Bridge Operations

The direct outlays for the construction of the Long Bridge projects will generate indirect and induced impacts within the economies of the Washington region including the District of Columbia, Northern Virginia, the Washington region, the Commonwealth of Virginia and the U.S. These impacts are temporary and occur while the projects are being planned, designed and built. These impacts are summarized below.

- The Washington region's economy will capture 52.2% of the national economic benefits (GDP) resulting from the Long Bridge projects' construction outlays with Northern Virginia's economy accounting for 84.0% of these regional economic benefits, the District of Columbia capturing 11.2% of these economic benefits, and the remaining 4.8% accruing to Suburban Maryland's economy or constituting unassignable regional benefits.

- The Northern Virginia economic impacts that result from the Long Bridge project's construction outlays will constitute 82.7% of the benefits accruing to the Commonwealth of Virginia's economy as result of these construction outlays with spill-over benefits comprising the remaining 17.3 percent.

- The Commonwealth's economic impacts resulting from the Long Bridge project's construction outlays, inclusive of Northern Virginia, will account for 53.1% of the total national economic benefits generated by these construction outlays.

- These direct outlays over the construction period will generate $604.2 million in new personal earnings accruing to workers residing in Northern Virginia, accounting for 69.3% of all new personal earnings generated to the benefit of workers residing within the Commonwealth of Virginia and 39.7% of all new personal earnings generated by these direct construction outlays within the U.S. economy.

- New personal earnings generated to the benefit of workers residing in Virginia, including Northern Virginia, will account for 57.3% of all new personal earnings attributable nationally to the Long Bridge projects' construction outlays.

The construction outlays associated with the Long Bridge projects will contribute $2,845.0 million to the Washington region's economy accounting for 52.2 percent of the national (GDP) effects of these outlays over the construction period. The share of these GDP effects not captured by the regional economy will spill over to other state economies, including the Commonwealth of Virginia (excluding Northern Virginia), reflect interstate transfers or be unassignable to any specific state economy, and leak into the global economy.

The share of the indirect and induced economic impacts generated by the direct outlays in Northern Virginia that spills over to the Commonwealth's economy (GSP) and from the Commonwealth's economy to the U.S. economy, reflects the interdependences of these

economies, the mobility of the workforce, and the distribution of benefits through subcontractors and suppliers beyond the immediate impact area. The spill-over benefits totaling $499.8 million that will accrue to the Commonwealth's economy beyond the Long Bridge projects' construction-related impacts of $2,390.3 million captured by the Northern Virginia' economy reflects economic growth spreading beyond Northern Virginia to other portions of the Commonwealth. For workers residing beyond Northern Virginia within the Commonwealth, these economic impacts will generate new personal earnings totaling $267.2 million over the construction period, or the equivalent of 3,875 full-time, year-round jobs.

In total the Commonwealth of Virginia, inclusive of Northern Virginia, will capture 53.1 percent of the Long Bridge project's total national (GDP) economic benefits. Additionally, the Commonwealth will capture 57.3 percent of the nationwide personal earnings generated during the construction period and the estimated 12,637 full-time, year-round equivalent jobs held by Virginians that these new personal earnings will support.

## 2.3. The Long-Term Economic Impact of the Long Bridge Expansion

The Long Bridge projects will increase the capacity for rail passenger services, allowing for an additional 80 trains per day compared to a no-build scenario. The operational expenditures associated with the increase in services will generate economic benefits that are measured by 1) the increase in economic activity, inclusive of the direct, indirect and induced effects, 2) the gain in personal earnings that accrue to local workers and households as the result of the increased economic activity, and 3) the number of jobs that the increase in economic activity supports globally. These benefits occur after the completion of construction and once the additional passenger services are in operation, assumed to be 2040 in this analysis. These benefits occur annually during each year of operations of expanded services. The increased operational expenditures benefit the national economy and are estimated separately for the Commonwealth of Virginia, the District of Columbia, and the state of Maryland. Four sub-state geographies are also shown for the Commonwealth of Virginia: 1) Northern Virginia, 2) Alexandria City, Virginia, 3) Prince William County, Manassas City and Manassas Park City, Virginia (combined), and 4) Spotsylvania County and Fredericksburg City, Virginia (combined).

As a result of increased services, annual operational expenditures would increase by $439.3 million nationally once all 80 daily trains are in service (Table 19). Each train is assumed to be a single route that has service patterns that reflect the current level of services depending upon the operator and type of route. The type of route is based on existing plans from Virginia Railway Express and Amtrak and estimated for Maryland Area Regional Commuter services using current MARC and VRE routes.

Amtrak is assumed to add 18 daily trains as a result of expanded capacity provided by the Long Bridge projects. The expected routes of these trains are detailed in the Washington, D.C. to Richmond, VA Southeast High Speed Rail Corridor Service Development Plan, Administrative Draft (November 2018). Four routes run both North and South between

North Carolina and New York and five routes run both North and South between Virginia and elsewhere on the Northeast Corridor. The operational expenditures of the routes between North Carolina and New York are assumed to be the same as the current cost per train of the Carolinian route, which has the same origins and destinations. The cost per route for the Virginia-Northeast Corridor routes is assumed to reflect the average cost per train-mile of the state-sponsored routes in Virginia and the average cost of the Northeast Regional routes and reflects the current mix of trains terminating in both New York, NY and Boston, MA. The share of route-miles is used to estimate the share of expenditures that occur in each state and in Northern Virginia (see page 13 in Section 2.1 for more detail).

Table 19. Increase in Annual Operational & Maintenance Expenditures of Passenger Rail Services Over Long Bridge Resulting from Expanded Services, 2040 (2018 Dollars)

| | Amtrak[1] | Virginia Railway Express[2] | VRE/ MARC Run-Through Service[3] | Total |
|---|---|---|---|---|
| Alexandria City, VA | N/A | $7,535,545 | N/A | 7,535,545 |
| Prince William Area[4] | N/A | $11,967,298 | N/A | $11,967,298 |
| Spotsylvania Area[5] | N/A | $7,575,542 | N/A | $7,575,542 |
| Northern Virginia, Not Geographically Identifiable | $16,301,847 | $31,660,604 | $5,975,710 | $53,938,161 |
| Northern Virginia, Total | $16,301,847 | $58,738,988 | $5,975,710 | $81,016,546 |
| | | | | |
| Virginia, Not Geographically Identifiable | $31,342,108 | $6,366,859 | $647,721 | $38,356,688 |
| Virginia, Total | $47,643,955 | $65,105,847 | $6,623,432 | $119,373,234 |
| | | | | |
| D.C. | $5,457,156 | $0 | $0 | $5,457,156 |
| Suburban Maryland | $8,832,137 | $0 | $4,957,502 | $13,789,639 |
| | | | | |
| Washington Region[6] | $30,591,139 | $58,738,988 | $10,933,340 | $100,263,340 |
| | | | | |
| Elsewhere in Maryland | $49,900,619 | $0 | $1,179,801 | $51,080,420 |
| | | | | |
| Elsewhere in the U.S. | $249,437,317 | $0 | $204,198 | $249,641,515 |
| | | | | |
| U.S. | $361,271,183 | $65,105,847 | $12,964,933 | $439,341,963 |

Sources: Washington, D.C. to Richmond, VA Southeast High Speed Rail Corridor Service Development Plan, Administrative Draft (November 2018); Virginia Railway Express System Plan 2040 Study; Amtrak General and Legislative Annual Report & Fiscal Year 2020 Grant Request; Virginia Railway Express Recommended Budget for Fiscal Year 2020, Amended Budget for Fiscal Year 2019, and Capital Improvement Program & Six-Year Financial Forecast; Virginia Railway Express 2018 Transit Asset Management Plan; Federal Transit Authority's National Transit Database; The Stephen S. Fuller Institute at the Schar School, GMU
[1]Excludes transfers to capital & ancillary; [2]Excludes access fees; [3]See page 31 for service assumptions; [4]Includes the cities of Manassas & Manassas Park, VA; [5]Includes the city of Fredericksburg; [6]Includes D.C., Northern Virginia and Suburban Maryland.

The addition of 18 daily Amtrak trains crossing the Long Bridge results in an increase of $361.3 million per year in operational expenditures nationwide in 2018 dollars. These expenditures are in addition to the existing base operations across the Long Bridge, estimated to be $745.4 million in FY 2018, and the addition of two daily trains that can be accommodated in absence of the expansion projects. The majority of the new expenditures (69.0%) are expected to occur outside of Virginia, D.C., or Maryland, reflecting the share of services that occur in North Carolina and farther north in the Northeast Corridor. Maryland would capture 16.3 percent of the operational expenditures for an additional 58.7 million of expenditures. The Commonwealth would capture 13.2 percent of these expenditures, or $47.6 million annually, including $16.3 million in Northern Virginia. The District would capture an additional $5.5 million, accounting for 1.5 percent of the increased expenditures.

The added capacity provided by the Long Bridge projects will allow VRE to run an additional 54 trains in 2040. While the specific routes will be determined based on market conditions, this analysis assumes that equal increases in service will occur for both the Manassas Line and the Fredericksburg Line. The operational expenditures are estimated based on the VRE System Plan 2040 Study and allocated geographically based on the current locations of facilities (see page 13 in Section 2.1 for more detail). VRE's annual increase in operational expenditures is projected to be $65.1 million in 2018 dollars excluding access fees, which are transfers to other rail operators and do not have a net economic effect. These new expenditures would not occur without the Long Bridge projects and are in addition to the base expenditures, estimated to be $54.3 million in FY 2018, and the increase in expenditures that results from adding four trains which is likely to occur in absence of the Long Bridge projects. All of these new expenditures would occur in Virginia. Northern Virginia would capture 90.2 percent of these new expenditures including 18.4 percent in the Spotsylvania area, 11.6 percent in the Prince William area and 11.6 percent in the city of Alexandria. The remaining expenditures captured by Northern Virginia cannot be allocated to a specific jurisdiction.

The MARC train service is administered by the Maryland Transit Administration and operated by Amtrak. Currently, three lines operate between Washington, D.C. and either Martinsburg, WV, Perryville, MD, or Camden Station in Baltimore, MD and include several routes that originate or terminate at stations along these lines. The increased capacity resulting from the Long Bridge projects is projected to allow eight MARC trains to cross the Long Bridge into Virginia. These run-through routes and services levels have not been determined. For this analysis, the average route and level of the run-through service is assumed to mirror existing VRE and MARC services, combined. Because the specific operational details about these routes are not yet known, a blended cost structure is used to estimate the operational expenditures. The VRE expenditures per train-mile is used to estimate the operational expenditures resulting from trains running on the portion of the route that occurs in Virginia. The MARC expenditures per train-mile is used to estimate the operational expenditures resulting from trains running on the Maryland portion of the route. Estimates from the Federal Transit Authority's National Transit Database were used for both systems for consistency and operational expenditures exclude casualty and liability costs, which do not have a local economic impact.

However, the addition of the run-through portion of the route is assumed to be an extension of an existing route, not a net new train running the full length of both systems. To account for this, the operational expenditures are halved.[10] The resulting estimate reflects one-half of the cost of running an average route for the both the VRE and MARC systems. These routes are referred to hereinafter as a VRE/MARC run-through service to best describe the geography and cost structure, not which agency operates or funds the routes. Each of the additional eight trains is assumed to cost the same as this one-half average route.

The location of VRE/MARC run-through service expenditures are distributed based on train-miles for Virginia, Maryland and the portion of Suburban Maryland in the Washington region, and West Virginia. Because the routes do not terminate or originate in the District, no expenditures are allocated to that geography. For the Virginia portion, the share occurring in Northern Virginia is estimated using the distribution of expenditures for VRE. No other sub-state jurisdictions are estimated because of the uncertainty of the specific operations. The annual increase in operational expenditures resulting from run-through services is estimated to be $13.0 million in 2018 dollars. About one-half (51.1%) of the expenditures occur in Virginia and 47.3 percent occur in Maryland. The remaining 1.6 percent occur in West Virginia as a result of the share of operations that currently extend into the state.

In total, the Commonwealth of Virginia would gain $119.4 million of additional operational expenditures, measured in 2018 dollars, as the result of expanded Long Bridge passenger operations per year. Of this, $81.0 million (67.9%) occurs in Northern Virginia. The additional expenditures in both the Commonwealth, overall, and Northern Virginia result in a 27.9 percent increase compared to the Long Bridge-related passenger services in FY 2018. Maryland would gain $64.9 million in operational expenditures resulting from expanded Long Bridge operations, an increase of 44.1 percent compared to FY 2018 and the largest percentage increase of the states examined. Maryland's relatively large percentage gain is the result of the addition of commuter rail running between Maryland and Virginia. The District would gain an additional $5.5 million in operational expenditures annually, an increase of 41.8 percent compared to FY 2018 services associated with the Long Bridge.

### 2.3.1 Impacts of Increased Operational Expenditures on the Commonwealth of Virginia Economy

#### *2.3.1.1 Commonwealth of Virginia*

The Commonwealth of Virginia has the largest economic benefit of the geographies examined in this analysis as a result of the expanded passenger operations across the Long Bridge. The Commonwealth captures 27.2 percent of the direct operational expenditures

[10] The share of net new train-miles is not known and this assumption is based on the total length of the VRE and MARC systems, which are about equal. The VRE system spans 45.4 miles and the MARC system spans 43.5 miles for all lines.

associated with the expanded services. These direct outlays of $119.4 million, in turn, generate a total of $205.9 million in economic activity in the Commonwealth each year, as measured by its Gross State Product (GSP) in 2018 dollars; that is, every dollar of direct outlays in the Commonwealth results in 1.7252 dollars for the Commonwealth's economy, reflecting the industrial composition and the degree to which the indirect and induced effects are captured by the local economy.

If these rail passenger services existed in 2018, the Commonwealth's economy would be 0.04 percent larger. Similarly, the GSP resulting from the entire rail transportation industry in the Commonwealth would be 21.2 percent larger.[11] Because these benefits recur annually, during an 80-year period of operations, the total GSP effect would total nearly $16.5 billion in 2018 dollars.

Table 20. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the Commonwealth of Virginia Economy in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| VRE | $65,105,847 | $112,320,607 | $27,207,733 | 439 |
| Amtrak | $47,643,955 | $82,195,351 | $19,910,409 | 321 |
| MARC/VRE Run-Through Services | $6,623,432 | $11,426,745 | $2,767,932 | 45 |
| Total | $119,373,234 | $205,942,703 | $49,886,074 | 805 |

Sources: See Table 19

[1]total impact on the Virginia economy; [2]new labor income of workers residing in Virginia; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

For every dollar of additional operational expenditures that results from the expanded passenger services across the Long Bridge, $0.42 cents accrues to workers residing in the Commonwealth. A total of $49.9 million in personal earnings would be generated for Virginia residents as a result of the expanded services every year, the equivalent of 723 full-time workers. If these operations existed in 2018, personal earnings in the Commonwealth would be 0.01 percent larger. Overall, the expanded operations support 805 jobs globally. The personal earnings and the jobs supported represent continuing gains that would exist for the duration of the expanded operations.

*2.3.1.2 The Impacts of Increased Operational Expenditures on the Northern Virginia Economy*

The economic benefits that accrue to the Commonwealth are concentrated in Northern Virginia, which captures more than two-thirds (67.9%) of the direct outlays associated with expanded Long Bridge passenger operations in the Commonwealth and 18.4 percent of the nationwide expenditures. The increase of $81.0 million in direct outlays generates a total economic effect, measured by the Gross Regional Economy (GRP), that is 1.4776 times larger as these direct outlays are spent and re-spent in the Northern Virginia economy. The

[11] Estimated using GSP data for 2017, which is the most recent estimate available.

total economic effect of expanded services is $119.7 million in 2018 dollars. If these services existed in 2018, the economy in Northern Virginia would be 0.03 percent larger.[12] Because this GRP effect will exist for every year of expanded operations, the economic impact would total nearly $9.6 billion over an 80 year period.

Table 21. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the Northern Virginia Economy in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| VRE | $58,738,988 | $86,792,729 | $17,821,409 | 272 |
| Amtrak | $16,301,847 | $24,087,609 | $4,945,980 | 75 |
| MARC/VRE Run-Through Services | $5,975,710 | $8,829,710 | $1,813,031 | 28 |
| Total | $81,016,546 | $119,710,048 | $24,580,420 | 375 |

Sources: See Table 19

[1]total impact on the Northern Virginia economy; [2]new labor income of workers residing in Northern Virginia [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

The direct outlays would generate $24.6 billion in personal earnings for workers residing in Northern Virginia, as $0.30 cents of each dollar of direct outlays accrues to workers living in the region. If these earnings existed in the region in 2018, the total personal income in the region would be 0.005 percent larger.[13] These personal earnings would support the equivalent of 280 full-time workers living in Northern Virginia in every year that the expanded services are in operations. Globally, the increased rail operations would support a total of 375 jobs during every year of operations.

*2.3.1.3 The Impacts of Increased Operational Expenditures on the Economy of Select Virginia Jurisdictions*

The VRE operations associated with the expanded services can be partially allocated to one of three sub-state areas: Alexandria City, Virginia, the Spotsylvania area (Spotsylvania County & Fredericksburg City, Virginia), or the Prince William area (Prince William County, Manassas City & Manassas Park City). Overall, only one-third (33.4%) of operational expenditures of the expanded services in Northern Virginia can be allocated to a specific jurisdiction so the identifiable impacts on these jurisdictions under-estimate the overall effects for these jurisdictions.

Of these sub-state areas, the Spotsylvania area gains the largest identifiable economic benefit as a result of the expanded operations. The $12.0 million in direct outlays generate a total of $16.6 million in economic activity, as measured through its GRP in 2018 dollars

[12] Based on Gross County Product data from 2015, which is the most recent data produced by the U.S. Bureau of Economic Analysis.
[13] Based on county-level personal income in 2017, which is the most recent data produced by the U.S. Bureau of Economic Analysis.

during each year of operations. If these operations existed in 2018, the economy in the Spotsylvania area would have been 0.04 percent larger.[14] As these benefits recur annually, the GRP effect of 80 years of operations would total $1,324.2 million in 2018 dollars. During a single year of operations, personal earnings in the Spotsylvania area would increase by $2.7 million in 2018 dollars because of the economic impact of the increased rail services, the equivalent of an increase of 35 full-time resident-workers. If these operations existed in 2018, personal earnings in the area would have been 0.03 percent larger, an increase nearly proportional to the total GRP effect.[15]

Table 22. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the Economies of Select Jurisdictions in Virginia in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Spotsylvania County & Fredericksburg City, VA (combined)[4] | | | | |
| VRE | $11,967,298 | $16,551,970 | $2,674,691 | 3 |
| Amtrak | N/A | N/A | N/A | N/A |
| MARC/VRE Run-Through Services | N/A | N/A | N/A | N/A |
| Total | $11,967,298 | $16,551,970 | $2,674,691 | 3 |
| Prince William County & the cities of, Manassas & Manassas Park, VA (combined) | | | | |
| VRE | $7,575,542 | $10,611,062 | $1,706,770 | 38 |
| Amtrak | N/A | N/A | N/A | N/A |
| MARC/VRE Run-Through Services | N/A | N/A | N/A | N/A |
| Total | $7,575,542 | $10,611,062 | $1,706,770 | 38 |
| Alexandria City, VA | | | | |
| VRE | $7,535,545 | $9,398,332 | $532,009 | 7 |
| Amtrak | N/A | N/A | N/A | N/A |
| MARC/VRE Run-Through Services | N/A | N/A | N/A | N/A |
| Total | $7,535,545 | $9,398,332 | $532,009 | 7 |

Sources: See Table 19

[1]total impact on the jurisdiction's economy; [2]new labor income of workers residing in the jurisdiction of analysis; [3]jobs supported anywhere as a result of new direct spending; [4]uses the 2006/2015 RIMS II model; Totals many not sum due to rounding.

The Prince William area captures $7.6 million of the operational expenditures resulting from the expanded VRE services during each year of operations. These annual direct outlays generate a total of $10.6 million of economic activity, measured through its GRP in 2018 dollars, reflecting a multiplier of 1.4007. If these operations existed in 2018, the

[14] Based on Gross County Product data from 2015, which is the most recent data produced by the U.S. Bureau of Economic Analysis.

[15] Based on county-level personal income in 2017, which is the most recent data produced by the U.S. Bureau of Economic Analysis.

economy in the Prince William area would have been 0.01 percent larger.[16] The GRP effect of 80 years of expanded operations would result in a total economic gain of $848.9 million in 2018 dollars. This economic increase is also to the benefit of Prince William area residents. For every dollar of direct outlays, $0.23 cents accrues to workers living in the area and the outlays of the expanded services would generate $1.7 million dollars of personal earnings each year. This increase in personal earnings would support the equivalent of 24 full-time workers living in the area. If these operations existed in 2018, personal earnings in the area would have been 0.01 percent larger.[17]

The city of Alexandria, VA gains $7.5 million in operational expenditures as the result of expanded VRE operations annually. These direct outlays generate a total of $9.4 million per year in economic activity, as measured by its Gross County Product (GCP) in 2018 dollars, an effect that is 1.2472 times larger than the direct expenditure. If these operations existed in 2018, the Alexandria economy would have been 0.03 percent larger.[18] After 80 years of expanded operations, the total GRP effect would be $281.9 million in 2018 dollars. In addition to the GRP effect, the expanded operations would increase the personal earnings of residents living the in city of Alexandria. For every dollar of direct outlays, $0.07 cents accrues to workers living in the city and the outlays of the expanded services would generate $0.5 million dollars of personal earnings each year, after accounting for regional commuting patterns. This increase in personal earnings would support the equivalent of six full-time workers living in the city. If these operations existed in 2018, personal earnings in the area would have been 0.03 percent larger.[19]

### 2.3.2 Impacts of Increased Operational Expenditures on the District of Columbia Economy

The expanded Amtrak passenger service across Long Bridge results in $5.5 million in operational expenditures spent in the District of Columbia. Because these expenditures are apportioned based on the share of either route-miles or train-miles operated in the District, this estimate is conservative and does not account for any increased expenditures that may result from the intensity of activity at Union Station.

As these direct expenditures circulate in the D.C. economy, they generate 1.2070 times the economic activity as a result of the indirect and induced effects that are captured by the District's economy. In total, the annual economic effect of expanded rail services is $6.6 million as measured by the GSP in 2018. If these services existed in 2018, the District's economy would have been 0.005 percent larger and the GSP contribution of the rail transportation industry, overall, would have been 8.0 percent larger. These benefits recur

[16] Based on Gross County Product data from 2015, which is the most recent data produced by the U.S. Bureau of Economic Analysis.
[17] Based on county-level personal income in 2017, which is the most recent data produced by the U.S. Bureau of Economic Analysis.
[18] Based on Gross County Product data from 2015, which is the most recent data produced by the U.S. Bureau of Economic Analysis.
[19] Based on county-level personal income in 2017, which is the most recent data produced by the U.S. Bureau of Economic Analysis.

during each year of operations and the total GSP effect during 80 years of operations would be $526.9 million in 2018 dollars.

Table 23. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the District of Columbia Economy in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $5,457,156 | $6,586,787 | $405,087 | 5 |
| VRE | $0 | $0 | $0 | $0 |
| MARC/VRE Run-Through Services | $0 | $0 | $0 | $0 |
| Total | $5,457,156 | $6,586,787 | $405,087 | 5 |

Sources: See Table 19

[1]total impact on the D.C. economy; [2]new labor income of workers residing in D.C.; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

As a result of the overall economic activity generated by expanded passenger services, personal earnings in the District would increase by $0.4 million, the equivalent of 4.5 full-time workers. If these earnings existed in 2018, personal income in the District would have been 0.001 percent larger. Globally, the outlays in the District support five jobs. Both the personal earnings that accrue to District residents and the total number of jobs supported occur in each year of expanded rail service operations and result in a sustained economic benefit locally, nationally and internationally.

### 2.3.3 Impacts of Increased Operational Expenditures on the Maryland Economy

The expanded Amtrak and commuter rail services would result in an additional $64.9 million in operational expenditures in Maryland annually. Overall, Maryland captures 14.8 percent of the nationwide increase in operational expenditures of these expanded services. As these direct outlays are circulated and re-circulated in the Maryland economy, their total economic effect is increased so that every dollar of direct expenditures generates 1.7115 dollars of economic activity. The total economic effect on the Maryland economy, as measured by the Gross State Product, for one year of expanded passenger rail operations is $111.3 million in 2018 dollars. If these services existed in 2018, Maryland's economy would have been 0.03 percent larger and the GSP contribution from the entire rail transportation industry would have been 25.1 percent larger. Because these benefits occur during each year of operations, the cumulative economic effect of operations is even larger; during 80 years of operations, the GSP contribution would total $8.9 billion in 2018 dollars.

For every dollar of direct expenditures for the expanded rail services, $0.42 cents accrues to workers living in Maryland associated with the direct, indirect and induced economic effects. In total, the expanded operations generates $27.1 million of personal earnings for Maryland residents, the equivalent of 370 full-time workers. Had these operations existed in 2018, personal earnings in the state would have been 0.01 percent larger. In total, the expenditures in Maryland support 406 jobs in Maryland and elsewhere in the world. Both

the personal earnings that accrue to Maryland residents and jobs supported by the expenditures continue during the lifetime of the expanded rail operations and are long-term impacts to the benefits of both the local and global economy.

Table 24. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the State of Maryland Economy in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $58,732,755 | $100,756,042 | $24,509,179 | 367 |
| MARC/VRE Run-Through Services | $6,137,303 | $10,528,543 | $2,561,097 | 38 |
| VRE | $0 | $0 | $0 | $0 |
| Total | $64,870,058 | $111,284,585 | $27,070,275 | 406 |

Sources: See Table 19
[1]total impact on the Maryland economy; [2]new labor income of workers residing in the Maryland; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

## 2.3.4 Impacts of Increased Operational Expenditures on the Washington Region's Economy

The additional services from VRE, Amtrak and MARC that are made possible by the Long Bridge projects would result in an additional $100.3 million in annual operating expenditures in the Washington region, which accounts for 23.8 percent of the total increase in expenditure nationwide. These direct outlays generate a total of $150.7 million in economic activity in the region each year, as measured by its Gross Regional Product (GRP) in 2018 dollars; that is, every dollar of direct outlays in the Washington region results in 1.5029 dollars for the regional economy, reflecting the industrial composition and the degree to which the indirect and induced effects are captured locally.

Table 25. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the Washington Region's Economy in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| VRE | 58,738,988 | 88,278,826 | 21,005,062 | 314 |
| Amtrak | 30,591,139 | 45,975,423 | 10,939,391 | 163 |
| MARC/VRE Run-Through Services | 10,933,212 | 16,431,525 | 3,909,717 | 58 |
| Total | 100,263,340 | 150,685,774 | 35,854,170 | 535 |

Sources: See Table 19
[1]total impact on the Washington region's economy; [2]new labor income of workers residing in the region; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

If these rail passenger services existed in 2018, the regional economy would be 0.03 percent larger. Because these benefits recur annually, during an 80-year period of operations, the cumulative GRP effect would total nearly $12.1 billion in 2018 dollars.

For every dollar of additional operational expenditures that results from the expanded passenger services across the Long Bridge, $0.36 cents accrues to workers residing in the region. As a result of the expanded services, a total of $35.9 million in personal earnings would be generated for residents living in the Washington region each year, the equivalent of 427 full-time workers. If these operations existed in 2018, personal earnings in the region would be 0.01 percent larger. Overall, the expanded operations support 535 jobs globally. The personal earnings and the jobs supported represent continuing gains that would exist for the duration of the expanded operations.

### 2.3.5 Impacts of Increased Operational Expenditures on the U.S. Economy

The Long Bridge projects allow for expanded passenger rail operations across the Long Bridge, with additional routes running between North Carolina and Massachusetts and points in between. The nationwide expenditures associated with the operations of the new routes totals $439.3 million in 2018 dollars. The national multiplier effect of these direct outlays is 2.5547 and larger than the sub-national geographies. The total annual economic activity generated by the increased services is $1.1 billion dollars, measured by the Gross Domestic Product (GDP) in 2018. Had these services existed in 2018, the U.S.'s GDP would have been 0.005 percent larger. Over the course of 80 years of operations, the cumulative GDP effect would total $88.8 billion in 2018 dollars.

As a result of the expanded operations, personal earnings in the U.S. would increase by $296.8 million, the equivalent of 4,527 full-time workers living in the U.S. In total, the increased operational expenditures support 5,084 jobs both nationally and internationally. These benefits recur annually during each year of expanded operations and represent long-term benefits.

Table 26. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the U.S. Economy in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] | Jobs Supported[3] |
|---|---|---|---|---|
| Amtrak | $361,271,183 | $922,939,492 | $244,074,812 | 4,180 |
| VRE | $65,105,847 | $166,325,907 | $43,985,510 | 753 |
| MARC/VRE Run-Through Services | $12,964,933 | $33,121,513 | $8,759,108 | 150 |
| Total | $439,341,963 | $1,122,386,913 | $296,819,430 | 5,084 |

Sources: See Table 19

[1]total impact on the U.S. economy; [2]new labor income of workers residing in the U.S.; [3]jobs supported anywhere as a result of new direct spending; Totals many not sum due to rounding.

### 2.3.6 Summary of Impacts of Increased Operational Expenditures

The Long Bridge projects allow for increased passenger rail services across the Potomac River and in the Northeast Corridor to the benefit of the local and national economies. The economic impact of the operational expenditures from expanded Amtrak, VRE and MARC train services generates an annual impact of

- $205.9 million annually to the benefit of the Commonwealth of Virginia economy including
  - $119.7 million for the economy in Northern Virginia,
  - $16.6 million for the economy in Spotsylvania County and Fredericksburg City, VA,
  - $10.6 million for the economy in Prince William County and the cities of Manassas and Manassas Park, VA, and
  - $9.4 million for the economy in Alexandria City, VA,
- $111.3 million annually to the benefit of the Maryland economy,
- $6.6 million annually to the benefit of the D.C. economy,
- $150.7 million annually to the benefit of the Washington region's economy and
- $1.1 billion annually for the national economy.

These benefits are new and in addition to the economic benefits from existing services, detailed in Section 2.1. These benefits begin after the completion of the projects and after the expanded services are implemented. These benefits recur for each year that the expanded services are in operation and can be multiplied by the years of service to estimate the cumulative benefit to these economies.

## 3. The Role of Rail Commuting in the Economy

The majority of the rail commuting in Virginia, D.C. and Maryland is in the Washington region and the rail commuter either lives in the region, works in the region, or both. The Washington region currently has low levels of rail commuting relative to other large, dense employment metros. As the Washington region grows, its ability to accommodate the new commuters will depend upon the transportation infrastructure, the home and work locations of the new workers, and their preferences. Based on the patterns of other U.S. metros, the current preferences of rail commuters and the forecasted industry and geographic patterns of growth in the Washington region, rail commuting is well-positioned to accommodate and facilitate growth. In absence of additional rail commuting services, the likely commuting patterns and modes would be less efficient for the region, overall, and the quality of life for the region's workers would be diminished. The resulting secondary economic benefits of rail commuting would include reducing the cost of employee turn-over for firms in the region, improving the travel times of both rail and road users, and improving efficiencies for the existing infrastructure, service operators and users along and near the Long Bridge Corridor.

## 3.1 Current Rail Commuting Patterns in Virginia, D.C., Maryland and the Washington Region

The potential for rail commuting to facilitate or accommodate economic growth in areas affected by Long Bridge services in the future will depend not only upon the supply of services but also depend upon the underlying demand. This potential can be illustrated based on the existing profile of rail commuters and the future patterns of growth that are forecasted.[20] As shown in Table 27, a total of 38,200 commuters live in Virginia, Maryland or the District and relied on rail as their main mode of commute for a job located anywhere, on average, during the 2015-2017 period.

Table 27. Regular Rail Commuters by Home and Work Location, 2015-2017 Average

| | Live in Virginia | Live in Maryland | Live in D.C. | Total (Work in Area, Live Anywhere) |
|---|---|---|---|---|
| D.C. | 9,520 | 14,400 | 430 | 24,350 |
| Maryland | 480 | 4,990 | 350 | 5,820 |
| Washington Suburbs | 220 | 2,580 | 80 | 2,880 |
| Other Parts of MD | 260 | 2,410 | 270 | 2,950 |
| Virginia | 5,470 | 1,430 | 110 | 7,020 |
| Washington Suburbs | 5,320 | 1,430 | 110 | 6,860 |
| Other Parts of VA | 150 | 0 | 0 | 150 |
| Other States | 390 | 460 | 160 | 1,010 |
| Total (Live in State, Work Anywhere) | 15,860 | 21,280 | 1,060 | 38,200 |

Source: U.S. Census (2015-2017 American Community Survey microdata); The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

The vast majority of these commutes occurred within the Washington region and 97.9 percent of the current rail commuters in the tri-state area either worked or lived in the Washington region. Because of the geographic concentration of rail commuters in the Washington region, the Washington regional economy will be the most affected by rail commuters; the region is defined based on commuter patterns and is designed to reflect the inter-jurisdictional dependencies of the residents and jobs located in the region. The remainder of Sections 3.1-3.4, therefore, analyze the Washington region.

Select characteristics of rail commuters in the Washington region are described in Table 28. Overall, rail commuters had wages that were nearly double (177%) the regional average. Rail commuters were more likely to work in the Federal Government or in Professional, Technical and Scientific industries, which are the specialty industries of the Washington

[20] Detailed estimates of demand exist for specific operators and services and other feasibility studies are being conducted to determine more precise level of demand. This description does not attempt to estimate precise ridership numbers but, instead, provides and overview of the potential role that rail could play in accommodating growth.

region. Rail commuters were also far more likely to have an advanced degree. Altogether, these characteristics suggest that rail commuters are highly specialized workers that have more flexibility than the average worker in selecting their commute mode and home location. Because of the higher-than-average salaries and specialized industries, these workers generate economic benefits both at their home location, through their residential household spending, and at their work location, through their added economic productivity and their daytime spending.

Table 28. Profile of Rail Commuters and Workers in the Washington Region
2015-2017 Average

| | Rail Commuters | All Workers |
|---|---|---|
| Median Wage (2018 $s) | $95,452 | $53,855 |
| Median Commute Time | 70 min. | 30 min. |
| | | |
| Industry Distribution | | |
| Federal Government Workers | 47.3% | 15.1% |
| Professional, Technical & Scientific Workers | 17.3% | 15.4% |
| All Others | 35.4% | 69.5% |
| | | |
| Educational Attainment | | |
| Below B.A. | 24.2% | 47.3% |
| Bachelor's degree | 33.4% | 27.3% |
| Master's degree | 29.6% | 18.0% |
| Doctorate / Advanced Professional | 12.8% | 7.4% |

Source: U.S. Census (2015-2017 American Community Survey microdata); The Stephen S. Fuller Institute at the Schar School, GMU

As of 2019, an estimated 31,590 workers in the Washington region rely on commuter rail as their main form of commute (Table 29). One-quarter (24.6%) of all rail commuters live in Virginia and cross into D.C. via the Long Bridge. Without rail services, these commuters would commute by vehicle, assuming that these households can only make a short-term adjustment to commuting mode. In the long-term, these workers may potentially either relocate closer to their job or be replaced by workers that live closer. As a result, the commuter rail services currently replace the need for an additional 6,500-7,140 parking spaces in D.C., or 4,460-7,140 housing units in D.C.[21]

[21] There are households that have multiple workers commuting by commuter rail. These workers are assumed to commute together and not need separate parking or housing in D.C. The ranges reflect the potential for carpooling or other public transit usage and the distribution of households in D.C., Arlington County, VA, Alexandria City, VA, Fairfax County, VA, Fairfax City, VA, and Falls Church City, VA that live near WMATA MetroRail as a potential alternative for current rail commuters.

Table 29. Rail Commuters in the Washington Region, 2019

| | Live in Virginia | Live in Maryland | Live Elsewhere | Total |
|---|---|---|---|---|
| Work in D.C. | 7,760 | 12,990 | 1,330 | 22,070 |
| Work in Suburban Maryland | 340 | 2,400 | 470 | 3,220 |
| Work in Northern Virginia | 4,800 | 1,190 | 310 | 6,300 |
| Total | 12,900 | 16,570 | 2,110 | 31,590 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

Altogether, these rail commuters contribute $6.2 billion to the regional economy as measured through the region's Gross Regional Product in 2018 dollars, accounting for 1.1 percent of all economic activity in the region. This includes $2.5 billion contributed by workers that live in Maryland and work in the District and $1.6 billion contributed by Virginia residents that work in the District. The economic contribution of these workers is regional and not isolated to either the home or work location; the economic production occurs at the work location but the wages of these workers return to their home location.

Table 30. GRP Value of Rail Commuters in the Washington Region, 2019
(Billions of 2018 $s)

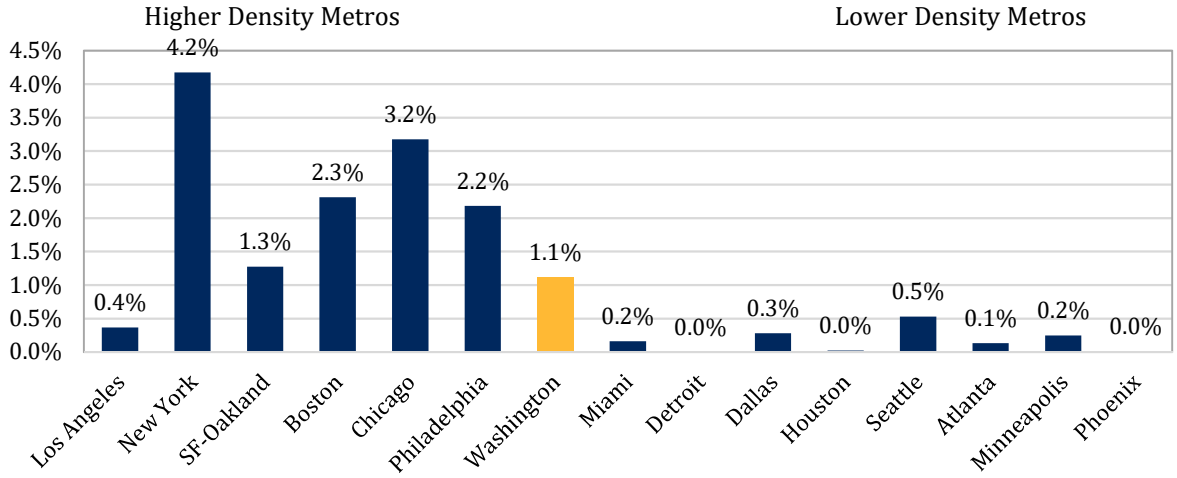
| | Live in Virginia | Live in Maryland | Live Elsewhere | Total |
|---|---|---|---|---|
| Work in D.C. | $1.56 | $2.50 | $0.25 | $4.31 |
| Work in Suburban Maryland | $0.06 | $0.53 | $0.10 | $0.70 |
| Work in Northern Virginia | $0.92 | $0.25 | $0.07 | $1.24 |
| Total | $2.55 | $3.27 | $0.43 | $6.25 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

## 3.2 Rail Commuting in Metropolitan Areas in the U.S.

Rail commuting plays an important role in most of the large, dense metropolitan areas (metros) in the U.S. As shown in Figure 3, of the largest employment metros that are denser than the Washington region, only Los Angeles, CA has a smaller share of commuters that regularly used rail as their main mode of commute to work in 2017. As the Washington region adds jobs and residents in the upcoming decades, it is likely to become more similar to the metros that are currently denser, either following the development and infrastructure patterns of the major metros in Northeast or that in the more car-intense environments in California. The infrastructure investments made in the upcoming years will determine, in part, which path the Washington region follows.

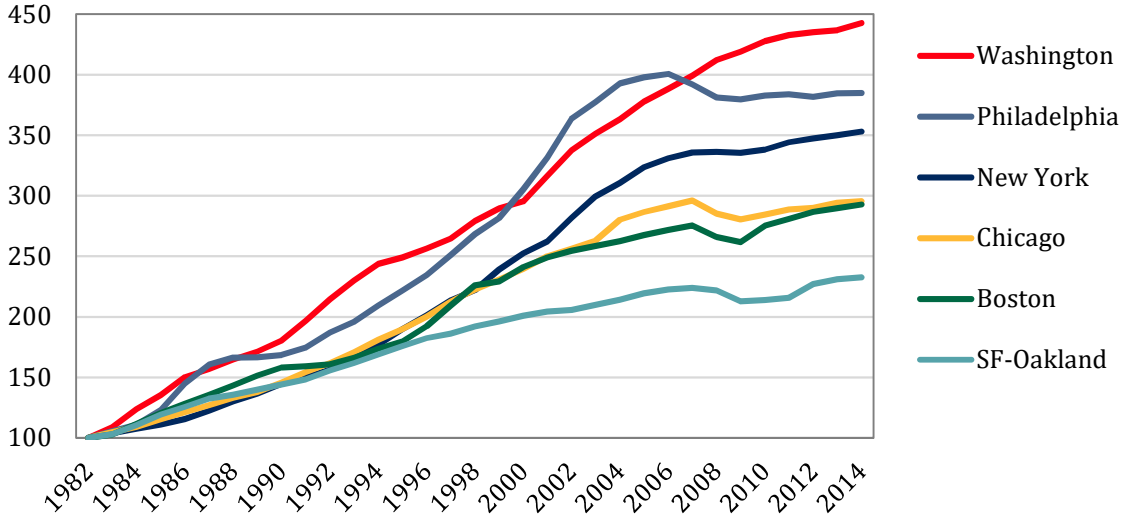
Figure 3. Share of Workers Typically Using Railroad as Main Mode to Commute
Largest 15 Employment Metros, 2017 (Workplace Geography),
Ranked by Jobs Per Square Mile




Source: U.S. Census (2017 American Community Survey); The Stephen S. Fuller Institute at the Schar School, GMU

Of the large employment metros that had a larger share of rail commuters in 2017, the Washington region had faster growth in the total hours of annual traffic delay between 1982 and 2017, as measured by the Texas A&M Transportation Institute. The annual hours of traffic delay increased by 531.6 percent during this period. The Philadelphia metro had the second largest increase, rising 367.2 percent for the entire period, and followed a similar trajectory until the Great Recession, when weaker job growth may have reduced the traffic pressure. The other four metros all had significantly smaller traffic delay growth rates during the 1982-2017 period. While rail commuting was not the only factor in these patterns, the trends suggest that it may play a role.

Figure 4. Growth in Annual Hours of Traffic Delay, 1982-2017 (1982 = 100)



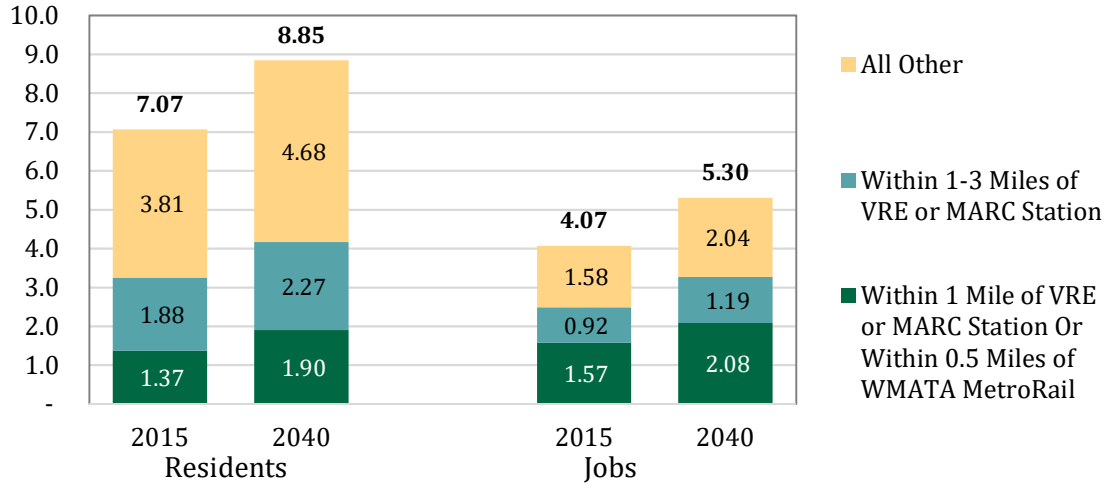

Source: Texas A&M Transportation Institute; The Stephen S. Fuller Institute at the Schar School, GMU

The next section describes the future population and job growth forecasted for the Washington region. As this growth occurs, the region will become denser and require more intense land use, on average. This intensity can be directed, in part, by infrastructure investments and the growth patterns of these peer metros can be used as examples of the potential alternatives for the region.

## 3.3 Future Rail Commuting Patterns in the Washington Region

Between 2015 and 2040, the Washington area is projected to add 1.8 million residents and 1.2 million jobs, including military and self-employment (Figure 5).[22] Of this growth, the areas within one mile of either a Virginia Railway Express or Maryland Area Regional Commuter train station or within 0.5 miles of a Washington Metropolitan Area Transit Authority (WMATA) MetroRail station are forecasted to increase by 0.5 million residents and by 0.5 million jobs, capturing 29.8 percent and 41.3 percent of the respective total gains. Communities that are between one and three miles of a VRE or MARC station are forecasted to add 0.4 million residents and 0.3 million jobs during the 2015-2040 period, accounting for 21.5 percent and 21.7 percent of the gains, respectively.

Figure 5. Residents and Jobs Located Near Rail, Washington Area, 2015 & 2040 (millions)




Source: Metropolitan Washington Council of Governments (9.1 Forecast); The Stephen S. Fuller Institute at the Schar School, GMU

The areas within three miles of a VRE or MARC station or within 0.5 miles of a WMATA metro station are projected to account for 51.3 percent of all residential gains and 63.0 percent of all job growth, for a total of 912,500 residents and 778,200 jobs (Figure 6). The growth in all other parts of the Washington area is smaller, increasing by 866,400 residents and 457,100 jobs. These added residents and workers represent a robust potential source of demand for rail commuting and the geographic pattern of growth further supports rail

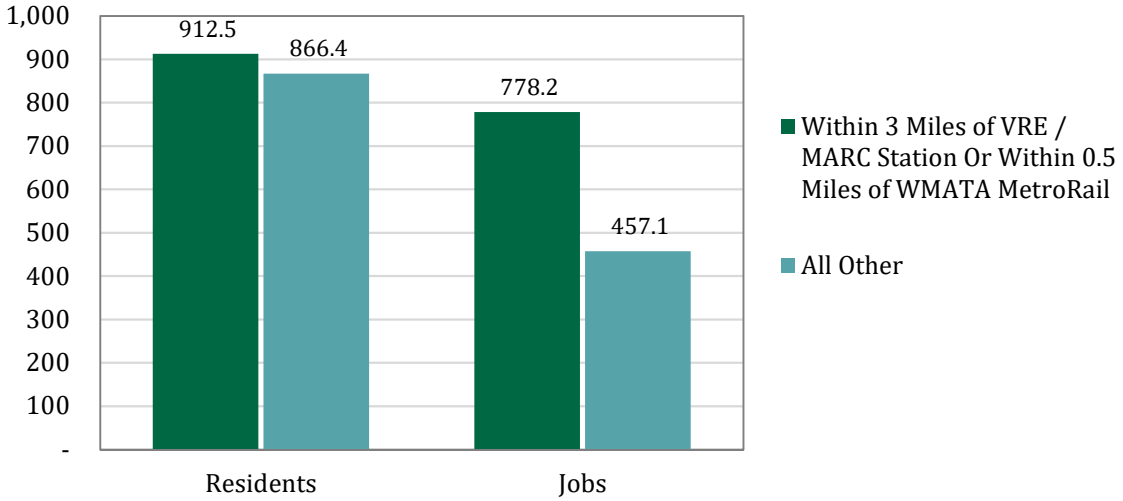
[22] Metropolitan Washington Council of Governments Cooperative Forecast Round 9.1 for the MWCOG region

commuting's potential to accommodate the increase in economic activity forecasted for the region.

These growth projections are based on regional and national factors. While infrastructure limitations could constrain them, it is more likely that the growth would simply occur with larger inefficiencies and congestion effects. The type and location of the growth forecasted and overall density of activity around rail commuter sheds, indicate that rail commuting could play an important role in accommodating and facilitating this growth. In particular, rail commuting could be increasingly important for communities without other high frequency transit like WMATA MetroRail. These areas are more concentrated in the Northern Virginia suburbs outside of the Beltway and additional commuter rail services would increase the access of residents in these communities to jobs and the access of businesses in these communities to workers.

The concentration of employment and residents near the VRE, MARC and Washington Metropolitan Area Transit Authority (WMATA) MetroRail station areas is denser than the region-wide average and is forecasted to grow at a faster rate. By 2040, 61.6 percent of all jobs are forecasted to be within three miles of a commuter rail station or within 0.5 miles of a WMATA MetroRail station and the jobs density will be clustered near these stations (Figure 6).[23] Both the current and future densities in the station areas and the forecasted gains suggest that rail commuting could play an increasing role in transportation in the future.

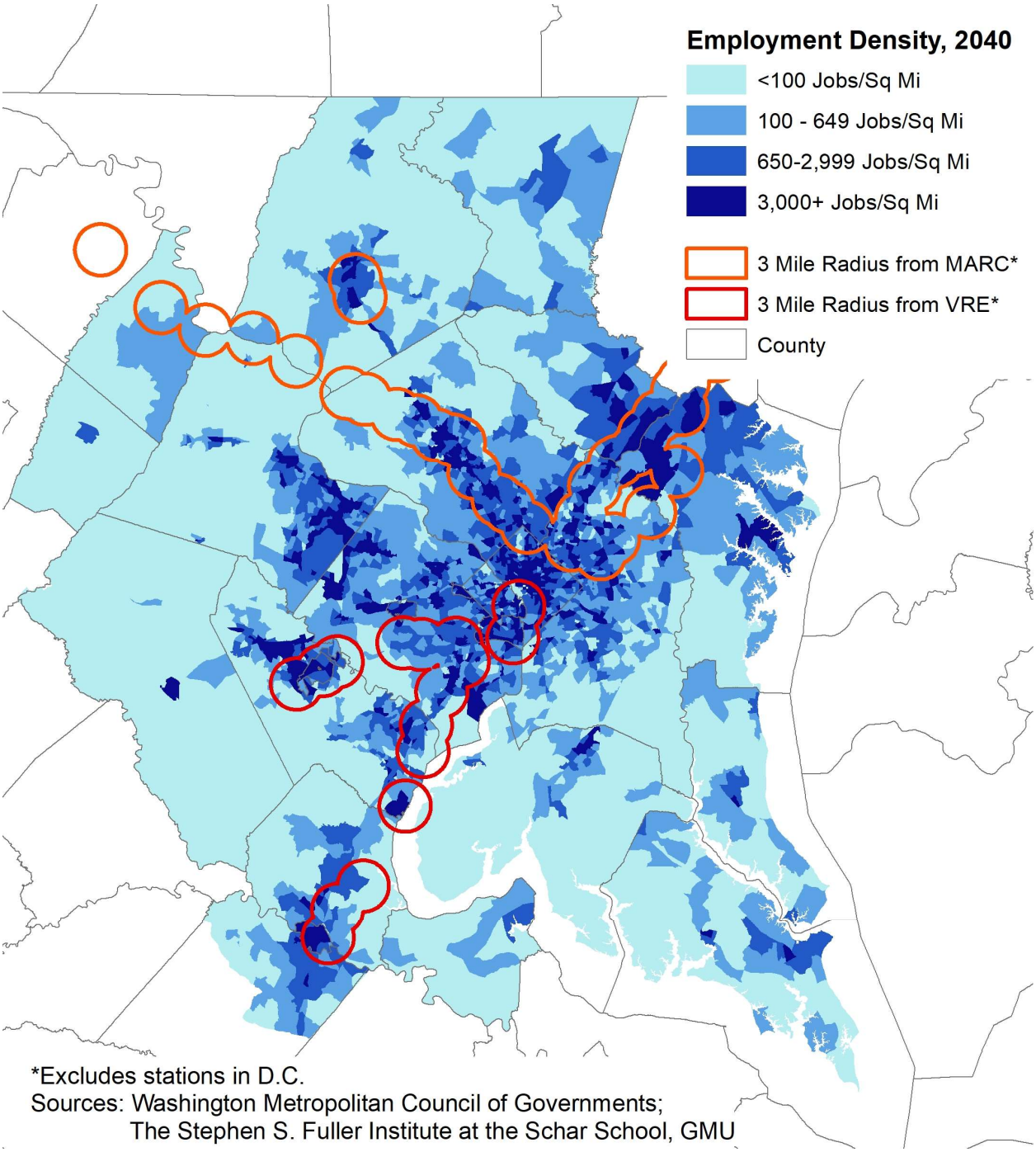
Figure 6. Change in Residents and Jobs in the Washington Area, 2015 - 2040 (thousands)




Source: Metropolitan Washington Council of Governments (9.1 Forecast); The Stephen S. Fuller Institute at the Schar School, GMU

[23] Metropolitan Washington Council of Governments Cooperative Forecast Round 9.1 for the MWCOG region

Figure 7. Employment Density by Traffic Analysis Zone in the Washington Area



Two forecasts of rail commuters are presented in Sections 3.3.1 and 3.3.2. The first assumes that the preferences of rail commuters mirror those of current rail commuters. In this assessment, the industry and job location are the main determinants of demand for rail; this also assumes that the underlying distribution of industry- and location-specific wages and home locations of future jobs mirrors that of the current workforce. In other words, the baseline forecasts assumes that current trends hold and estimates the demand for rail using job growth patterns.

The second forecast (Section 3.3.2) incorporates changes to preferences and commuter patterns that would result from increased rail service levels and additional rail routes. This forecasts assumes that the increased service frequencies for both VRE and Amtrak would increase the share of rail commuters to align more closely with the San Francisco metro, which has rail service levels that are similar to the levels anticipated in the Washington region by 2040.[24] Additionally, the demand for MARC/VRE run-through service is incorporated in this forecast. Current characteristics of workers based on home and work locations, industry, wage, and home-to-DC rail commuter shares for residents living and working in the MARC/VRE suburbs, and job growth patterns are used to estimate these additional, future rail commuters.

### 3.3.1 Rail Commuting in 2040: Assuming No Changes in Demand Resulting from New Services

Based on industry and job location patterns in 2040, 35,750 workers in the Washington region would rely on commuter rail to get to their jobs in 2040, an increase of 4,160 commuters (13.2%) from 2019.[25] The largest absolute increase in rail commuters would be from those that live in Maryland and work in D.C. (+1,440), followed by commuters that both live and work in Virginia (+1,060). The fastest growth, however, would be from residents living Maryland and commuting into Virginia (+29.6%). This increase occurs without adjusting for demand that would arise from MARC/VRE run-through service and only includes workers that would use either Amtrak or commute on MARC to D.C. and then finish their commute to Virginia using another mode.

Of the additional rail commuters, 1,780 are estimated to live in Virginia, an increase that is unlikely to be accommodated without the expanded rail services achieved through the Long Bridge projects. One-quarter (23.6%) of the potential rail commuters in 2040 would live in Virginia and would cross into D.C. via the Long Bridge. Without rail services, these commuters would commute by vehicle or live closer to their place of work. As a result, the

[24] The population and jobs densities, transit usage, overall size and characteristics of the San Francisco metro are a reasonable approximation of the future conditions of the Washington region, albeit not an exact match. Because there is not enough information to estimate the future elasticity of demand from increased services in the Washington region, the current demand characteristics in the San Francisco metro are used in this analysis.

[25] Job forecasts are from IHS Markit

commuter rail services currently replace the need for an additional 7,090-7,790 parking spaces in D.C., or 4,850-7,790 housing units in D.C.[26]

Table 31. Rail Commuters in the Washington Region, 2040 Baseline Forecast

| | Live in Virginia | Live in Maryland | Live Elsewhere | Total |
|---|---|---|---|---|
| Work in D.C. | 8,450 | 14,430 | 1,510 | 24,390 |
| Work in Suburban Maryland | 370 | 2,700 | 510 | 3,580 |
| Work in Northern Virginia | 5,860 | 1,540 | 380 | 7,780 |
| Total | 14,680 | 18,670 | 2,400 | 35,750 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

Overall, these potential rail commuters contribute $9.2 billion to the regional economy as measured through the region's Gross Regional Product in 2018 dollars, an increase of $3.0 billion (47.8%) from 2019. The largest absolute increase compared to 2019 would be from Maryland residents working in D.C. and the contribution of these workers would increase by $1.1 billion in 2018 dollars. The next largest gain would be from Virginia residents commuting to D.C. (+$0.7 billion). The GRP contribution from workers living in Maryland relying on rail to get to their jobs in Northern Virginia would have the largest percentage gain (+66.4%), followed by commuters both living and working in Virginia (+55.3%).

Table 32. Annual GRP Value of Rail Commuters in the Washington Region 2040 Baseline Forecast (Billions of 2018 $s)

| | Live in Virginia | Live in Maryland | Live Elsewhere | Total |
|---|---|---|---|---|
| Work in D.C. | $2.23 | $3.64 | $0.37 | $6.24 |
| Work in Suburban Maryland | $0.09 | $0.79 | $0.16 | $1.03 |
| Work in Northern Virginia | $1.43 | $0.41 | $0.12 | $1.95 |
| Total | $3.75 | $4.83 | $0.64 | $9.23 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

### 3.3.2 Rail Commuting in 2040: Assuming Increase in Demand Resulting from New Services

This forecast assumes that the additional rail services enabled by the Long Bridge projects makes commuting by rail more attractive to the future workforce and allows for new rail commuters between the Northern Virginia and Suburban Maryland Suburbs, because of the MARC/VRE run-through services. The current home and work locations of residents near

[26] There are households that have multiple workers commuting by commuter rail. These workers are assumed to commute together and not need separate parking or housing in D.C. The ranges reflect the potential for carpooling or other public transit usage and the distribution of households in D.C., Arlington County, VA, Alexandria City, VA, Fairfax County, VA, Fairfax City, VA, and Falls Church City, VA that live near WMATA MetroRail as a potential alternative for current rail commuters.

MARC and VRE stations suggest that approximately 66,800 workers live and work near a commuter rail station and commute using another mode.[27] This includes 58,320 commuters that live within three miles of a MARC station and worked within three miles of a VRE station. Conversely, 15,020 workers lived within three miles of a VRE station and worked within three miles of a MARC station. Fewer than 1,500 of these commuters use rail as their main mode of commute. This forecast further identifies future MARC/VRE rail commuters based on industries and wages, as not all workers are equally likely to use rail.

Table 33. Rail Commuters in the Washington Region, 2040 Increase Service Forecast

| | Live in Virginia | Live in Maryland | Live Elsewhere | Total |
|---|---|---|---|---|
| Work in D.C. | 10,110 | 17,430 | 560 | 28,090 |
| Work in Suburban Maryland | 1,470 | 3,260 | 1,360 | 6,080 |
| Work in Northern Virginia | 7,000 | 4,390 | 830 | 12,220 |
| Total | 18,570 | 25,080 | 2,750 | 46,400 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

After accounting for both the service frequency increases and the MARC/VRE run-through services, 46,400 workers are projected to rely on commuter rail to get to their jobs in 2040, an increase of 14,810 commuters (46.9%) from 2019. Of the additional rail commuters, 5,670 are estimated to live in Virginia, an increase that cannot be realized without the expanded rail services achieved through the Long Bridge projects. Compared to 2019, the largest absolute increase would be for workers living in Maryland and commuting to DC (+4,440) followed by Maryland residents commuting to Northern Virginia (+3,210). The largest percentage gains would be from workers living in Virginia and working in Maryland (+326.5%), followed by workers living in Maryland and working in Northern Virginia (+270.5%). This tripling of rail commuters between the Washington suburbs is the likely result of a MARC/VRE run-through services, based on job growth patterns.

One-fifth (21.8%) of the potential rail commuters in 2040 would live in Virginia and would cross into D.C. via the Long Bridge. Without rail services, these commuters would commute by vehicle or live closer to their place of work. As a result, the commuter rail services currently replace the need for an additional 8,470-9,320 parking spaces in D.C., or 5,800-9,310 housing units in D.C.

Overall, these rail commuters would contribute $12.2 billion to the regional economy as measured through the region's Gross Regional Product in 2018 dollars, an increase of $5.9 billion (94.7%) from 2019. The largest gains would be from workers with a job located in D.C. and living in Maryland (+$1.9 billion) or living in Virginia (+$1.1 billion). The MARC/VRE run-through service would result in the largest percentage increases and there would be a four-fold increase in the GRP contribution of rail users living in Virginia and working in Maryland, and a three-fold increase for those living in Maryland and working in Virginia.

[27] Data from LEHD for 2015 and from 2015-2017 from the American Community survey

Table 34. Annual GRP Value of Rail Commuters in the Washington Region 2040 Increased Service Forecast (Billions of 2018 $s)

| | Live in Virginia | Live in Maryland | Live Elsewhere | Total |
|---|---|---|---|---|
| Work in D.C. | $2.67 | $4.39 | $0.13 | $7.19 |
| Work in Suburban Maryland | $0.40 | $0.95 | $0.40 | $1.76 |
| Work in Northern Virginia | $1.71 | $1.24 | $0.26 | $3.21 |
| Total | $4.78 | $6.59 | $0.79 | $12.16 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

## 3.4 The Impact of Expanded Passenger Rail Services Across Long Bridge: Employee Turn-Over Costs

Another secondary benefit of expanded rail services would accrue to firms in the Washington region in the form of reduced employee turn-over. Employee retention and attraction adds to a firm's costs; recruitment, hiring and training require both direct expenditures and time from existing employees. Workers leave their jobs for a variety of reasons and transportation options are a frequently cited reason.[28] Additionally, overall quality of life and the ability to live and work in their desired locations are also likely factor for many workers when determining whether to move to or from a region.[29] This analysis estimates the reduction in turn-over rates and the cost savings that would be associated with increased rail services, based on turn-over rates of the Washington region's peer metros and controlling for other factors that affect turn-over. Because turn-over rates vary by industry and job location, this analysis focuses on those with the largest concentration of rail commuters in 2040: Professional & Business Services firms located in D.C., Alexandria City, VA, or Arlington County, VA.

An average of 9.0 percent Professional & Business Service workers left their job each quarter during the 2011-2017 period. Compared to the six other large employment metros that have significant commuter rail systems, the Washington region's turnover rates were 0.2 percent points larger than predicted based on its unemployment rates, its natural amenity score, and the overall turnover rate of all jobs.[30] While transportation is frequently

[28] For an early example, see Smith, F. J., & Kerr, W. A. (1953). Turnover factors as assessed by the exit interview. *Journal of Applied Psychology*, 37(5), 352-355. http://dx.doi.org/10.1037/h0058432

[29] Generally, movers cite housing as the main reason for relocating and not enough detail is available for the Washington region to determine the exact nature of the housing deficit as it relates to work location and transportation options.

[30] Using a random effects generalized least squares regression and a linear fit prediction model; additional controls that were tested and excluded due to non-significance include average wage of a Professional & Business Service job, regional price parity, metropolitan density, the percentage of rail commuters and the percentage of non-auto commuters

cited as a reason for leaving a job,[31] there are no estimates that measure its magnitude that can be used to estimate what share of this difference is the result of rail or other transportation options.[32] Instead, a range of 25 and 75 percent of this difference is assumed to be the result of a combination of factors (housing, quality of life, commute quality) that could be attributable to lack of commuter rail.

Estimates on the cost of employee turnover range from six percent of the employee's salary to up to five times the employee's salary, depending upon the length of tenure, the employee's expertise and the industry.[33] Generally, higher-wage and specialty occupations and industries, like Professional & Business Service jobs, are more costly to replace, although fewer studies exist to estimate these costs. For this analysis, it is assumed that the cost of turnover is 50 percent of the average wage.

As a result of reducing the turnover rates of this industry so that they are in line with the predicted rates, firms in D.C., Arlington, VA and Alexandria, VA, would reduce hiring and training costs by between $48.5 million and $96.9 million in 2040. These benefits would recur annually. The District has the largest number of Professional & Business Services jobs that could benefit and firms could have cost reductions between $30.3 million and $60.5 million. For Arlington County, VA, the savings range from between 13.1 million and 26.1 million and those in Alexandria City, VA range from 5.1 million to 10.3 million.

Table 35. Annual Reduced Cost of Employee Turnover of Professional & Business Service Workers
2040, by Firm Location (Millions of 2018 dollars)

| | Low Estimate | High Estimate |
|---|---|---|
| D.C. | $30.26 | $60.53 |
| Arlington County, VA | $13.06 | $26.11 |
| Alexandria City, VA | $5.14 | $10.28 |
| Total | $48.46 | $96.93 |

Sources: LEHD's Job-to-Job Flows; U.S. Bureau of Labor; U.S. Department of Agriculture Economic Research Service; U.S. Census Bureau; The Stephen S. Fuller Institute at the Schar School, GMU

Firms in other industries and jurisdictions would also benefit from decreased turn-over costs as a result of expanded rail services. These benefits are cannot be isolated because of the small share of rail commuters in these industries and the small proportion of other quality of life improvements (travel time savings) that would accrue to the road users. Even

[31] For an early example, see Smith, F. J., & Kerr, W. A. (1953). Turnover factors as assessed by the exit interview. *Journal of Applied Psychology*, 37(5), 352-355. http://dx.doi.org/10.1037/h0058432
[32] Housing and transportation are often cited simultaneously and are difficult to disentangle when examining survey responses.
[33] For a summary of studies, see https://www.americanprogress.org/wp-content/uploads/2012/11/CostofTurnover.pdf
For practitioner guides, see https://www.predictiveindex.com/blog/how-to-calculate-employee-turnover-cost/ and https://jumpstart-hr.com/the-true-cost-of-employee-turnover/

still, because of this omission, this estimate of business savings from decreased turn-over is conservative.

## 3.5 The Impact of Expanded Passenger Rail Services Across Long Bridge: Time Savings

The expanded rail services and frequencies would reduce travel times for both rail passengers and road users compared to the no-build scenario in 2040. These time savings are valuable for the passengers and road users and constitute another secondary economic benefit of these expanded services. The value of these time savings is estimated using existing studies for the value of improved on-time performance for rail passengers on Amtrak and VRE and the time savings value of road users based on the increased passenger volume accommodated by peak-service VRE. This estimate excludes any potential time savings that result from VRE/MARC run-through service because the level of service has not yet been established. As such, these time savings valuations are conservative.

The time savings that result from improved on-time performance of Amtrak and VRE for riders boarding in Virginia, D.C., and Maryland is valued at $16.9 million in 2040 in 2018 dollars. The value of time savings in 2040 for road users in Northern Virginia because of the expanded peak-hour VRE services is between $24.3 and $58.8 million in 2018 dollars. These benefits are annual and recur for each year of expanded services.

### 3.5.1 Time Savings of On-Time Service Improvements for Rail Passengers

The Washington, D.C. to Richmond, VA Southeast High Speed Rail Corridor Service Development Plan, Administrative Draft (November 2018) (the draft SDP) forecasts the average passenger delay by route type for both the build and no-build scenarios. The value of time savings is based on the U.S. Department of Transportation (DOT) Benefit-Cost Analysis for Discretionary Grant Programs (June 2018) and the draft SDP. The value of time savings for Amtrak riders uses the inflation-adjusted estimate from the draft SDP of the weighted average of business and personal travel and equals $46.22 per hour saved. The value for VRE riders re-weights the in-vehicle personal travel rate reported by the DOT to account for average wage differential between the rail commuters in the Northern Virginia region and the average of all jobholder and is $28.86 per hour saved.[34]

Only riders that board in Virginia, D.C. or Maryland are included in this estimate. The value of the savings is shown in Table 36 based on the origin of the trip. Only the existing passenger base is included as the time savings accrue to those that would take trips in both the no-build and build scenarios. Similarly, the expanded VRE and VRE/MARC run-through scenarios are not incorporated in these valuations. The origins and destinations are from modeled data from RGS for Amtrak rides as of 2015. The total number of VRE trips is from

[34] Time savings for high-speed rail travel is comparable to that for air travel. The likely substitute for VRE commuters is vehicle travel so the adjusted vehicle travel rate is used in this estimate.

the Federal Transit Administration's National Transportation Database. The VRE commuter home and work locations are derived from a survey administered by VRE in October 2017. Each commuter is assumed to use the same pair of stations for both the morning and evening commute.

VRE origins and destinations are distributed using a VRE-administered survey of morning trips taken in October 2017, assumes that the return trip is the reverse of the morning commute, and is re-weighted to total the number of unlinked passenger in 2017.

The total value of time savings for rail passengers is $16.9 million in 2040 for riders boarding in Virginia, D.C., or Maryland. This valuation estimates the willingness to pay for time savings and is a proxy for the increase in utility that accrues to these users. While this measure is not directly transferable to any measure of economic activity, it does reflect benefits enjoyed by local rail riders. These benefits would recur annually for each year with improved on-time performance.

The largest time savings accrue to passengers that board in the District of Columbia, driven by the large volume of Amtrak trips that begin at Union Station. These riders may live or work outside of the District so the estimated $8.4 million in time savings may be more geographically dispersed, especially when compared to the VRE time savings. The time savings of VRE riders boarding in the District is valued at $0.46 million, which primarily accrues to commuters that work in the District and live in the Commonwealth.

The on-time savings that accrue to riders that begin their trips in Maryland is valued at $4.9 million in 2040 as the result of improved on-time performance of Amtrak trips along the Long Bridge Corridor. This benefit does not include any potential time savings for commuter rail passengers that would result from run-through service and is an under-estimate based on available data.

For riders boarding in the Commonwealth of Virginia, Amtrak passengers' time savings are valued at $2.2 million and VRE passengers' time-savings are valued at $0.9 million. The combined savings of $3.1 million accounts for 18.3 percent of all time savings that accrue to riders in boarding in these states. Within the Commonwealth, passengers that board in Northern Virginia account for more than one-half (52.5%) of the time savings that are to the benefit of Virginia passengers. VRE passengers have the largest time savings benefit, which is valued at $0.9 million in 2018 dollars. Amtrak passengers gain the equivalent of $0.7 million in 2018 dollars. Within Northern Virginia, riders that board in the Prince William area have the largest time savings, valued at $0.45 million in 2040, followed by riders boarding in the Stafford area that have savings valued at $0.40 million.

Table 36. Annual Value of Rail Passenger Time Savings Resulting From On-Time Performance Improvements from Long Bridge Projects in 2040 Existing Passenger Base (2018 Dollars)

| | Amtrak | VRE | Total |
|---|---|---|---|
| Arlington County, VA | $0 | $120,582 | $120,582 |
| Alexandria City, VA | $289,709 | $51,225 | $340,934 |
| Stafford County & Fredericksburg City, VA | $218,746 | $183,617 | $402,363 |
| Prince William County & the cities of Manassas & Manassas Park, VA | $124,052 | $327,454 | $451,506 |
| Fairfax County & the cities of Fairfax & Falls Church, VA | $24,900 | $191,008 | $215,908 |
| Elsewhere in Northern Virginia | $32,534 | $57,035 | $89,568 |
| Northern Virginia, Total | $689,941 | $930,921 | $1,620,861 |
| | | | |
| Elsewhere in Virginia | $1,465,190 | $0 | $1,465,190 |
| Virginia, Total | $2,155,131 | $930,921 | $3,086,052 |
| | | | |
| D.C. | $8,446,508 | $464,392 | $8,910,900 |
| Maryland | $4,867,909 | $0 | $4,867,909 |
| | | | |
| Virginia, D.C. & Maryland Riders, Total | $15,469,548 | $1,395,313 | $16,864,861 |

Sources: Washington, D.C. to Richmond, VA Southeast High Speed Rail Corridor Service Development Plan, Administrative Draft (November 2018) and origin-destination data provided by RGS; Virginia Railway Express October 2017 Survey; U.S. DOT National Transportation Database 2017 Service Statistics; U.S. Department of Transportation Benefit-Cost Analysis for Discretionary Grant Programs (June 2018); The Stephen S. Fuller Institute at the Schar School, GMU NOTES: Passenger savings shown by place of boarding; Reflects difference in on-time performance of no build and build scenarios in 2040 without expanded VRE services, which does cannot have a no build estimate.

### 3.5.2 Time Savings of Increased Virginia Railway Express Operations for Road Users

The Virginia Railway Express Congestion Relief Report released in 2015 valued the time savings for road users based on the existing peak service passenger volumes carried by VRE. The results in this congestion relief report are used to estimate the time saving that accrue to road users in 2040 resulting from increased VRE services in 2040. The delay hours in the 2015 congestion relief report were modeled using based data from 2012. Given the likely increase in traffic congestion by 2040, the estimates of delay hours and time savings values resulting from additional VRE services are conservative.

The Virginia Railway Express System Plan 2040 Study (System Plan) estimates future VRE service levels in three phases for peak, off-peak and reverse-peak trains. Of the additional

54 trains that could be accommodated by the Long Bridge projects, the System Plan phases indicate that approximately 15 daily trains would occur for peak services. The System Plan was released in 2014 and the number of peak service trains may change in future plans. No time savings are valued for off-peak or reverse-peak trains, which are substituting for trips on less congested roadways. However, there may be additional time savings for road users as the result of VRE off-peak and reverse-peak passenger services.

Table 37. Value of Annual Road User Time Savings
Resulting From Expanded Virginia Railway Express Services in 2040
Peak-Hour Commute (Millions of 2018 Dollars)

| | Value Range | |
|---|---|---|
| | Low[1] | High[2] |
| Northern Virginia Drivers | $24.3 | $58.8 |

Sources: Virginia Railway Express Congestion Relief Report (June 2015); Virginia Railway Express System Plan 2040 Study; U.S. Department of Transportation Benefit-Cost Analysis for Discretionary Grant Programs (June 2018); The Stephen S. Fuller Institute at the Schar School, GMU
[1]Assumes that VRE trips are replacing trips taken in vehicles with average occupancies of 1.1;
[2]Assumes that VRE trips are replacing trips taken in vehicles with single-occupancy

As the result of commuters using the expanded peak-service VRE trains, road users in Northern Virginia would save between 1.5 and 3.5 million hours, collectively, in 2040. The larger estimate assumes that VRE passengers would drive to their destination alone and the smaller estimate assumes that VRE passengers would ride in vehicles with average occupancy of 1.1 passengers. The value of the time savings for these road users ranges from $24.3 to $58.8 million in 2040. These benefits would occur for each year of expanded VRE passenger operations.

## 3.6 The Impact of Expanded Long Bridge Corridor Capacity on Existing Infrastructure and Services

The final type of secondary benefit of the additional capacity provided by the Long Bridge projects would those that accrue to the existing infrastructure, service operators and users along and near the Long Bridge Corridor. For the existing infrastructure, the benefits result from maintenance savings, improved efficiencies and reductions in the growth in demand for additional capacity. For service operators, the benefits include increased flexibility, improved reliability and reduced risk that results from the added network redundancy. For users of existing services affected by the Long Bridge corridor, the benefits include increased flexibility, improved reliability, as well as improved multi-modal connectivity and increased options with respect to transportation options. The most extreme case, the total failure of the existing Long Bridge, is used to highlight the potential disruption to these users.

The Long Bridge projects will reduce the growth in demand on existing transportation infrastructure, including both roadways and railways. The diminished demand relative to a no-build scenario will reduce the maintenance costs that would be needed if the added rail passengers used the existing infrastructure. Local and federal governments and CSXT would benefit from these reduced maintenance costs. Similarly, the increase in demand that is accommodated by the expanded passenger rail services mitigates the need to expand the existing road and transit infrastructure to the degree that would be required without these services. The Long Bride projects also improve the efficiency of existing services. In particular, the increased frequency and scale of commuter rail services will support more intensity of land use around the VRE and MARC station areas. The increased land use near these transit-rich nodes will generate region-wide efficiencies that benefit the existing transportation networks and the housing and commercial office space markets. The role of commuter rail in accommodating growth is detailed in the next section.

The expanded capacity of the Long Bridge Corridor would benefit the existing or future service operators along the corridor. Amtrak, VRE, MARC, CSXT, and Norfolk Southern, which has trackage rights but does not currently operate on the Long Bridge Corridor, would all have increased flexibility and be better able to respond to changes in demand without diminishing the service level of another operator after the Long Bridge projects are completed. The expected increases in demand for Amtrak and VRE have been described in prior sections and the growth in these services is limited by the current capacity of the Long Bridge and the expected level of service demanded for CSXT and Norfolk Southern. The added capacity would be better able to absorb the demand forecasted for passenger rail services and allow for unanticipated increases in demand for freight rail simultaneously. The majority of the forecasts for passenger rail services were produced prior to the announcement that Amazon's second headquarters (HQ2) would locate in Arlington County, VA, which may alter the total level of demand. In order to accommodate that demand without reducing reliability or on-time performance, additional capacity is required.

Lastly, the service operators benefit from the added redundancy and resiliency provided by the second crossing. Current operators are at risk from service disruptions if the existing Long Bridge is inoperable. This risk is costly and may be monetized in insurance and liability premiums. In the worst-case scenario that the existing Long Bridge is not operational for an extended period of time, the decrease in passenger and freight services would have a national economic effect, disrupting a share of the 1.1 million passenger trips and the $26.6 billion in goods that cross the bridge annually. The addition of a second rail crossing would reduce the risk of a service disruption.

Existing service users would also benefit from expanded Long Bridge corridor capacity. Like the service provides, existing users would gain increased flexibility and reliability that the additional capacity would allow. Existing users would also benefit from the expanded transportation options and multi-modal efficiencies, even if these users do not take advantage of the added rail services. Choice and variety is frequently found to confer benefits to those that have access to them, regardless of which option is selected. For transportation, the added variety may allow multiple members of a household to commute

more efficiently or it may facilitate more efficient commuting for one individual over time, allowing for flexibility with home, work and leisure destinations over the individual's life cycle. The ability of transportation networks to accommodate multiple or changing travel patterns generates region-wide economic benefits.

If the existing Long Bridge failed, the public, the users and service providers along and near the Long Bridge Corridor would all incur costs. These costs would depend on the exact nature of the failure and the length of time it takes to return service levels to pre-failure levels, so a precise estimate is not presented here. Instead, the types of costs would include

- The cost to reconstruct the Long Bridge, both the hard costs and soft costs, inclusive of the cause-of-failure investigation and any fines, insurance premiums or legal fees,
- The cost of casualties including injury and death,
- The cost of service disruption for CSXT and the suppliers and buyers of CSXT-transported good, which were valued at $26.6 billion in 2012, and the indirect supply-chain inefficiencies that would occur from late deliveries or lost inventory,
- The cost of increased travel time for road users because of the added passenger trips that had been accommodated by rail, with congestion savings from current VRE trips, alone, valued at between $26.4 and $62.7 million per year,
- The cost of increased travel times for road users because of the added freight trucking using roads instead of rail,
- The administrative costs required to divert or stop rail traffic and manage the additional road traffic,
- The administrative and litigation costs to service providers and users from breach of contract or other disputes, and
- The future loss of revenue for rail service providers that could result from worsened public opinion about these providers' abilities to manage infrastructure and proved a safe transportation option.

Altogether, the benefits that will accrue to the existing infrastructure, service operators and users along and near the Long Bridge Corridor include a broad range of cost and time savings that, in the worst case scenario of a failure of the existing structure, would extend not only to the immediate users of the Long Bridge Corridor, but also other parts of the nation.

## 4. Pedestrian and Bicycle Commuting Between D.C. and Virginia

The Long Bridge projects include a new pedestrian and bicycle crossing between D.C. and Virginia that could accommodate new trips. Pedestrian and bicycle commuting between these jurisdictions is a fast-growing mode of choice for many residents. While the total number of commuters is modest, the economic contribution to the regional economy of these commuters is important and detailed in this section.

## 4.1 Current State of Pedestrian and Bicyclist Commuting Between D.C. and Virginia

As of 2019, a total of 5,790 workers regularly walk or bike to their job across the Potomac River between D.C. and Virginia, including 2,400 workers that live in D.C. and work in Virginia and 3,390 workers living in Virginia and working in D.C. These workers contribute $970 million to the regional economy as measured through the region's Gross Regional Product in 2018 dollars, accounting for 0.2% of all economic activity in the region.

Table 38. Pedestrian and Bicyclist Commuting Between D.C. and Virginia, 2019

| | Workers | GRP Value (millions, 2018 $s) |
|---|---|---|
| D.C. Residents Working in Virginia | 2,400 | $430 |
| Virginia Residents Working in D.C. | 3,390 | $540 |
| Total | 5,790 | $970 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

## 4.2 2040 Forecast of Pedestrian and Bicyclist Commuting Between D.C. and Virginia

Based on industry and job location patterns, 7,090 workers would regularly walk or bike to their job across the Potomac River in 2040, assuming no changes to preference of these workers. Compared to 2019, 1,300 additional commuters would prefer to walk or bicycle across the Potomac River to their jobs, an increase of 22.5 percent, and include an additional 850 D.C. residents commuting to a job in Virginia and an additional 450 Virginia residents commuting to a job in D.C.

Table 39. Pedestrian and Bicyclist Commuting Between D.C. and Virginia, 2040

| | 2040 | | Change from 2019 | |
|---|---|---|---|---|
| | Workers | GRP Value (millions, 2018 $s) | Workers | GRP Value (millions, 2018 $s) |
| D.C. Residents Working in Virginia | 3,250 | $760 | +850 | +$330 |
| Virginia Residents Working in D.C. | 3,840 | $800 | +450 | +$260 |
| Total | 7,090 | $1,560 | +1,300 | +$590 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

These workers would contribute $1.56 billion to the regional economy annually as measured through the region's GRP in 2018 dollars, and increase of $590 million (60.9%) compared to 2019. The new commuters living in D.C. would contribute an additional $330 million to the regional economy while the new commuters living in Virginia would contribute an additional $260 to the economy, as measured by the region's GRP in 2018 dollars.

## 5. Overview of the Long-Term Economic Impacts of the Long Bridge Projects

The addition of 80 daily trains crossing the Long Bridge will benefit the national economy and the economies of Virginia, Maryland and the District. The current rail infrastructure cannot accommodate this increase and the Long Bridge projects must be completed in order for these gains to be realized. The long-term economic benefits include the economic impacts of the increased operational expenditures, the economic growth that is accommodated by the new rail services, the decreased cost of turn-over for firms in the Washington region, the value of time savings for rail passengers and road users, the cost savings and value added to existing infrastructure and services. These benefits are annual and cumulative over the lifespan of the Long Bridge projects infrastructure and the services that the projects accommodate.

As shown in Table 40, the annual economic contribution, the total output, of the increased operational expenditures, the direct outlays, ranges from between 1.2070 time larger for the District to 2.5547 times larger for the U.S., overall, depending upon the size and structure of the economy and its ability to capture the indirect and induced effects generated by the direct expenditures. Personal earnings that accrue to the residents in the area of the total economic effect of the expenditures range from $0.06 cents per dollar of direct outlays in the District to $0.68 cents per dollar of direct outlays for the U.S., overall. This range reflects both the economic composition in the area and the commuting patterns of its jobholders.

These impacts recur annually and the cumulative effect of these operations will be larger. During 80 years of operations, the economic effect on Commonwealth of Virginia's economy will total nearly $16.5 billion in 2018 dollars. For the same period, the benefit to the Maryland economy will be $8.9 billion and that to the District's economy will total $848.9 million, both in constant 2018 dollars. The national economic impact for 80 years of operations will total nearly $89.8 billion in 2018 dollars.

Table 40. The Annual Impact of Increased Operational & Maintenance Expenditures from Passenger Rail Services Over Long Bridge on the Select Economies in 2040 (2018 dollars)

| | Direct Outlays | Total Output[1] | Personal Earnings[2] |
|---|---|---|---|
| Alexandria City, VA | 7,535,545 | 9,398,332 | 532,009 |
| Prince William Area[4] | 7,575,542 | 10,611,062 | 1,706,770 |
| Spotsylvania Area[5] | 11,967,298 | 16,551,970 | 2,674,691 |
| Northern Virginia, Not Geographically Identifiable | 53,938,161 | 83,148,685 | 19,66,950 |
| Northern Virginia, Total | 81,016,546 | 119,710,048 | 24,580,420 |
| | | | |
| Virginia, Not Geographically Identifiable | 38,356,688 | 86,232,655 | 25,305,654 |
| Virginia, Total | 119,373,234 | 205,942,703 | 49,886,074 |
| | | | |
| D.C. | 5,457,156 | 6,586,787 | 335,615 |
| Maryland | 64,870,058 | 111,284,585 | 27,070,275 |
| | | | |
| Elsewhere in the U.S. | 249,641,515 | 798,572,838 | 219,527,465 |
| | | | |
| U.S. | 439,341,963 | 1,122,386,913 | 296,819,430 |

Sources: See Table 19

[1]total impact on the economy in the specified jurisdiction; [2]new labor income of workers residing in the specified jurisdiction; Totals many not sum due to rounding.

Commuter rail services provide an efficient means to accommodate employment and residential growth. Currently, rail commuting is favored by highly educated workers in specialized industries in the Washington region. The Washington region is projected to have a faster rate of jobs gains in these industries through 2040, and both jobs and residential growth is forecasted to be disproportionately concentrated near a commuter rail or MetroRail station. In combination, these trends suggest that rail commuting can play a role in the regional transportation network that more closely resembles that in most other large, dense metropolitan areas.

Based on current patterns of rail commuters and future patterns of job growth and rail service levels, the Long Bridge projects could accommodate 16,110 new commuters, including rail, pedestrian and bicycle commuters. The economic contributions of these workers to the regional economy totals $6.5 billion (in 2018 dollars).

Table 41. The Number and Economic Contribution of Commuters Crossing the Long Bridge

| | 2019 | 2040 | Increase |
|---|---|---|---|
| Rail Commuters | | | |
| Commuters | 31,590 | 46,400 | 14,810 |
| Annual GRP Contribution (billions of 2018 $s) | $6.2 | $12.2 | $5.9 |
| | | | |
| Pedestrian/Bicycle Commuters[1] | | | |
| Commuters | 5,790 | 7,090 | 1,300 |
| Annual GRP Contribution (millions of 2018 $s) | $970 | $1,560 | $590 |
| | | | |
| Total | | | |
| Commuters | 37,380 | 53,490 | 16,110 |
| Annual GRP Contribution (billions of 2018 $s) | $7.2 | $13.7 | $6.5 |

Sources: 2012-2017 American Community Survey Microdata; IHS Markit; The Stephen S. Fuller Institute at the Schar School, GMU NOTE: May not sum due to rounding

[1]includes all commuters crossing the Potomac River between D.C. and Virginia and represents the maximum for Long Bridge.

Two other types of economic benefits are quantified: the reduction in turn-over costs that accrue to regional firms and the value of time savings for rail passengers and road users. As a result of a reduction the turnover rates in the Professional & Business Service industry associated with the quality of life improvements that added rail services are likely to provide, firms in D.C., Arlington, VA and Alexandria, VA, would reduce hiring and training costs by between $48.5 million and $96.9 million in 2040. These benefits would recur annually.

Rail passengers and road users will have time savings in the form of improved on-time performance for rail passengers and smaller congestion effects for road users. The time savings benefit that accrues to rail passengers boarding in Virginia, the District, and Maryland is valued at $16.9 million per year in 2018 dollars. The value of time savings for road users in Northern Virginia because of the expanded peak-hour Virginia Railway Express services is between $24.3 and $58.8 million in 2018 dollars.

Lastly, the additional capacity provided by the Long Bridge projects would provide benefits to existing infrastructure, service operators and users along and near the Long Bridge Corridor. Existing infrastructure will have maintenance savings, improved efficiencies and reductions in the growth in demand for additional capacity. Service operators will benefit from increased flexibility, improved reliability and reduced risk that results from the added network redundancy. Users of existing services affected by the Long Bridge corridor will benefit from increased flexibility, improved reliability, as well as improved multi-modal connectivity and increased options with respect to transportation options.