Value of Northern Virginia Transit to the Commonwealth

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www.novatransit.org/valueoftransit

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Value of Northern Virginia Transit to the Commonwealth
Executive Summary

Northern Virginia's transit network is a vital component of its transportation system that supports its overall quality of life and economic competitiveness.

Without transit in Northern Virginia, income and sales tax revenue in the Commonwealth would decrease by approximately $1.5 billion in 2025. This represents a 5% decrease in general fund revenue. We estimate at least $1B of this value can be attributed to Metrorail.

Due to transit's integral role in the region and the Commonwealth, we need to ensure that it has ongoing support that is long-term and sustainable.

$693M (Indirect & Induced Impacts)

$1.5B Revenue from Personal Income and Sales Tax ($ 2021)

$828M (Direct Impacts)

$600M (Direct Impacts)

2018

2025

With transit:

Every $1 invested by the Commonwealth of Virginia returns that original dollar as well as an additional **$1.60** in personal income and sales tax revenue.

Saves commuters **$130M** in vehicle operating costs

Supports **128,000** households

Supports **311,000** jobs

Avoids over **400** serious injuries

Avoids **70,000** metric tons of CO_2 emissions

Value of Northern Virginia Transit to the Commonwealth

Methodology

To demonstrate the value of Northern Virginia's transit network to the Commonwealth, this study considered and measured the difference between two cases:

- **With transit options:** In this scenario, normal transit options remained including impacts of any projects committed by 2025.

- **No transit option:** In this scenario, transit services were removed (including local bus routes, regional bus routes, Metrorail and VRE) from the transportation network by 2025.

This study differs from the 2018 report in that it includes Northern Virginia's bus systems in addition to Metrorail and VRE. It also adjusts ridership estimates to account for changes due to COVID and considers the indirect and induced economic impacts associated with direct reductions in employment, which is a more robust calculation of economic impacts.

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Without transit:

+3 Lanes
Would need to be added to the 14th St. Bridge

+2 Lanes
Would need to be added to the Arlington Memorial, Theodore Roosevelt and Woodrow Wilson Bridges

Total employment would decrease by over
311,000 jobs
including nearly 41K jobs in areas of the Commonwealth outside of Northern VA and 76% within a 1/2 mile of a Metro station

The region would be unable to support **128,000 households** = 13% of Northern VA's housing stock

Value of Northern Virginia Transit to the Commonwealth

Technical Report

June 2023

Background

Northern Virginia is one of the Commonwealth's economic engines, accounting for over 40% of its Gross State Product (GSP) in 2021, according to data from the U.S. Bureau of Economic Analysis (BEA). Moreover, one in every three Commonwealth jobs is located in Northern Virginia (BEA). The economic activity represented by this output and employment does not occur in a silo. Northern Virginia economic activity supports the balance of the Commonwealth through economic linkages such as purchases of goods and services from businesses elsewhere in the Commonwealth and through tax revenues. Given this economic connection, investments to support Northern Virginia's economic health such as public transit have spillover effects for the balance of the Commonwealth.

Northern Virginia's transit network is a vital component of its transportation system, which supports the region's overall quality of life and economic competitiveness. In 2018, the Northern Virginia Transportation Commission (NVTC) released a study that quantified the value of the region's rail transit system to the Commonwealth of Virginia in terms of income and sales tax revenue.

This report updates and builds on those findings by taking a more comprehensive approach to quantifying the value of Northern Virginia's transit network to the Commonwealth. While the previous study considered only the value of Metrorail and the Virginia Railway Express (VRE), this study considered Metrobus and all local bus systems in addition to Metrorail and VRE. In addition, while the previous study considered only direct impacts, this study considered how such direct impacts flow into and impact the whole economy (the "total impacts," including direct, indirect and induced impacts). It also adjusts for the changes in ridership and travel patterns that occurred because of COVID. As a result, this study provides an updated and more holistic view of the value of transit in Northern Virginia.

Figure 1: Public Transit in Northern Virginia
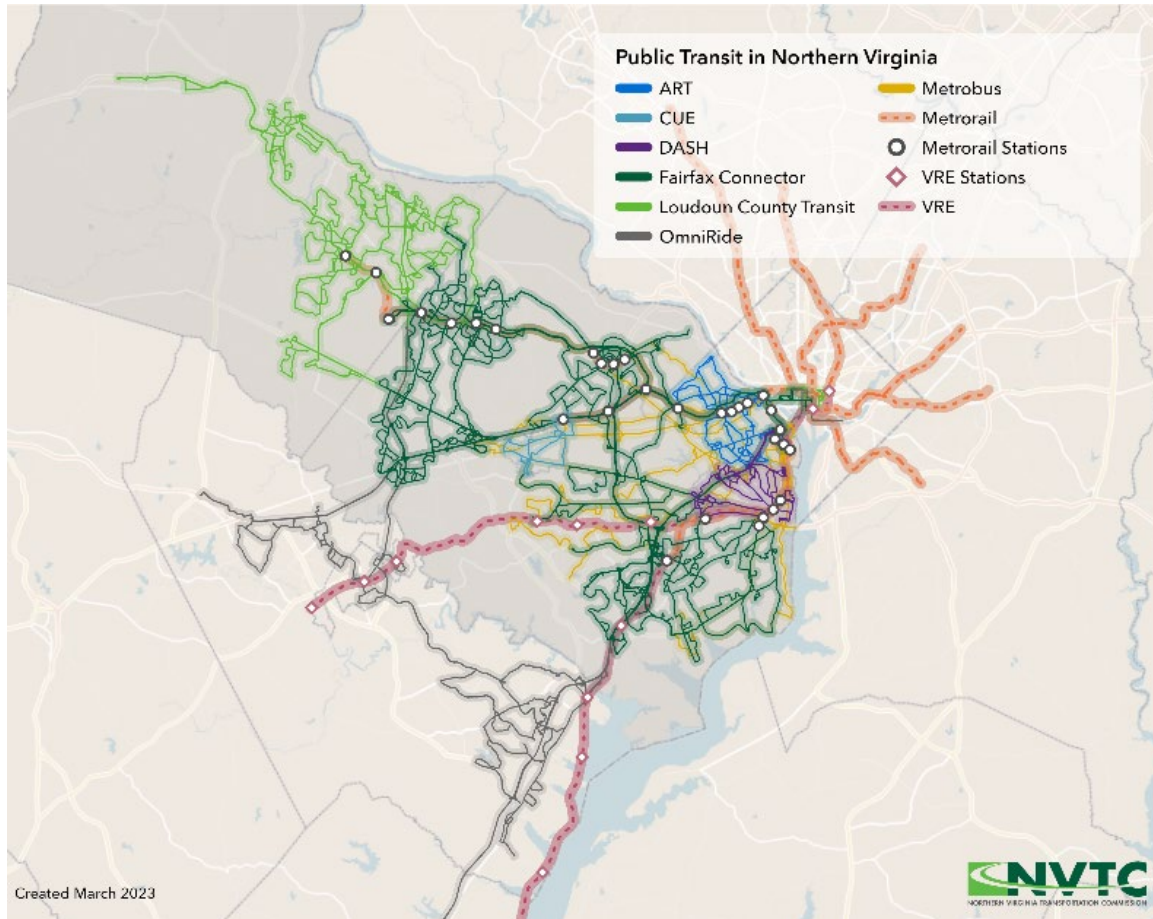
Purpose

This study describes how Northern Virginia's transit system supports the economic competitiveness of the Northern Virginia regional economy. It helps to:

- Justify seeking continued and expanded investments and funding for transit service, and,
- Identify ways that transit investment supports and advances regional and federal goals.

Toward this end, in this report the AECOM research team has:

1. Estimated the benefits provided by existing transit services in the region, and
2. Described how Northern Virginia's multi-modal transit network is important for the broader Virginia Commonwealth economy.

The following sections describe the process the research team used to identify the travel impacts that would occur if transit options were not available in Northern Virginia and the economic and fiscal impacts that would result from those changes.

Travel Modeling

Methodology

The research team used version 2.4 of the Metropolitan Washington Council of Governments (MWCOG's) travel demand model for 2021 and 2025 to estimate current and near-term travel conditions. The model results were compared with reported transit ridership data from the transit agencies serving Northern Virginia to ensure that the impact of the COVID-19 pandemic was realistically considered. The pandemic accelerated work-from-home trends and hybrid work arrangements, resulting in fewer work trips during the week and a substantial increase in virtual business meetings. There is also a greater dependence on e-commerce for shopping, recreation and personal business. Feeling safe at work and in shared rides and transit vehicles has also resulted in noticeable shifts in mode choice.

The observed travel data published data and research[1] was used to estimate trip adjustment factors for the MWCOG model to account for the likely near-term impacts of the pandemic on trip rates and mode choice. These adjustments reduced home-based-work trips to account for increased work-from-home rates. Adjustments to other trip purposes considered the impacts of e-commerce and virtual meetings on non-work trips. Alternative specific constants in the mode choice model were modified to match the overall market share of different modes.

The adjusted MWCOG model was applied to 2025 land use and network assumptions. Network performance measures were summarized to establish the baseline conditions. Transit services were then iteratively removed from the regional model, starting with local bus routes and proceeding to regional bus routes as well as Metrorail and VRE commuter rail routes. The MWCOG model was applied at each stage and performance measures were summarized.

As expected, removing transit service substantially increased congestion on the roadway network. Two methods were applied to compensate for the excess traffic in Northern Virginia: increasing roadway capacity and reducing economic activities (population and employment). Increases in roadway capacity were limited to planned improvements included in a future year highway network. This method estimates how much these plans and their associated construction costs would need to be accelerated if transit services were unavailable. The reduction in population and employment removes any growth included in the 2025 land-use forecast.

Since the combination of no growth and roadway capacity improvements had limited impact on excessive congestion levels, additional population and employment reductions were

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[1] COVID 19: Transportation Impacts and Opportunities, Northern Virginia Transportation Authority, July 9, 2020.
Travel Mode Choice During and After the Pandemic, University of Illinois at Chicago, November 19, 2020.
Will We Keep Working from Home After the Pandemic, Arizona State University, November 19, 2020.
Survey of Employers, Partnership for New York City, November 2021.
On the Horizon: Planning for Post-Pandemic Travel, American Public Transportation Association, November 2021.

applied to zones that had experienced substantial congestion increases over the baseline conditions or that contributed to capacity constraints on the Potomac River bridges. The majority of these zones surround Metrorail stations and large activity centers. The goal was to adjust to the level of economic activity that a "maximum" congestion level could accommodate. The maximum congestion level was set based on the 95th percentile volume-to-capacity ratio generated by the 2025 baseline model.

The overall travel modeling process is depicted in the following flow chart.

Figure 2: Travel Demand Modeling Methodology
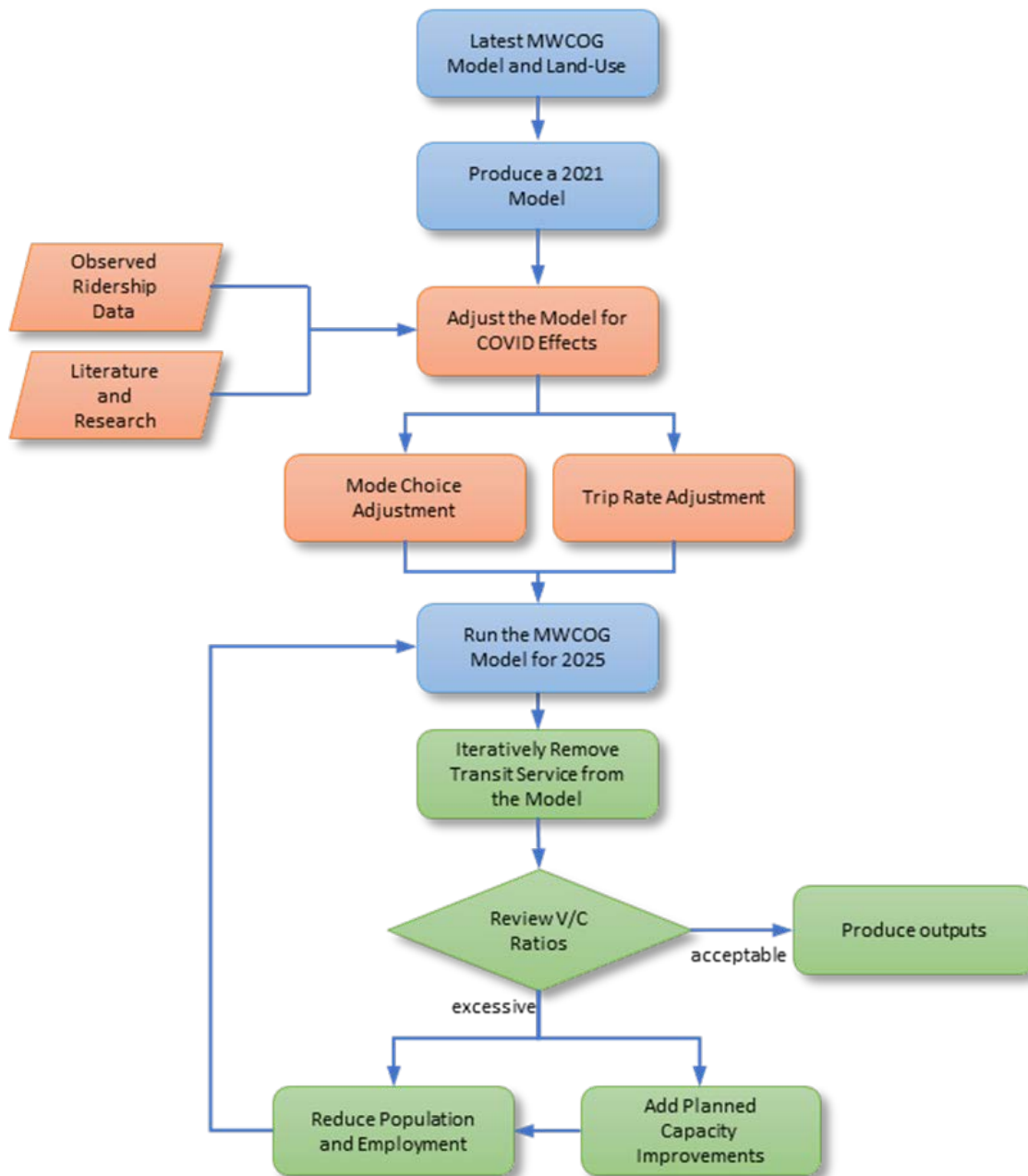
Results

This section summarizes the impacts of transit upon travel conditions in Northern Virginia.

Pandemic Ridership Impacts

Table 1 shows the ridership trends from a high in FY 2015, through pre-COVID conditions in FY 2019, to current ridership from FY 2022 for the transit systems that serve Northern Virginia. According to the Northern Virginia Transportation Authority's (NVTA) "Tracking Changes to Transportation Attitudes and Priorities" survey, conducted by Heart and Mind Strategies in 2019, much of the drop in ridership from 2015 to 2019 can be attributed to safety and equipment issues on Metrorail. The COVID-19 pandemic caused major reductions in ridership in FY 2021 and continued to impact ridership in FY 2022.

The impact on local bus services was less than the impact on Metrorail and VRE, due to the fact that a substantial portion of bus riders were considered essential workers that needed to continue to work at their work sites regardless of pandemic risks. Riders on Metrorail and VRE tend to work in professional service industries and could therefore work from home and avoid the dangers of the pandemic. Transit is slowly recovering from the pandemic, but it is likely to take several more years for post-pandemic conditions to stabilize. For this analysis, the research team used 2025 as a target date for estimating the impacts of a post-pandemic travel environment.

Table 1: Transit Ridership Trends

System	FY 2015	FY 2019	FY 2020	FY 2021	FY 2022	FY 22 vs FY 15	FY 22 vs FY 19
Arlington Transit	2,823,346	2,918,849	2,467,292	1,391,820	1,772,823	63%	61%
CUE	771,254	601,578	488,078	326,881	471,899	61%	78%
DASH	4,269,915	3,765,059	3,156,784	1,521,938	3,019,825	71%	80%
Fairfax Connector	9,764,166	8,334,616	6,788,632	4,566,013	5,191,499	53%	62%
Loudoun County Transit	1,782,698	1,706,093	1,297,221	326,981	408,941	23%	24%
Metrobus Virginia*	21,075,678	16,474,263	12,588,125	6,920,441	9,162,772	43%	56%
Metrorail Virginia*	110,146,465	90,305,328	66,347,907	13,677,941	30,183,438	27%	33%
OmniRide/Link	3,076,409	2,357,736	1,800,216	721,776	1,217,463	40%	52%
VRE	4,505,064	4,408,114	3,222,428	341,627	821,936	18%	19%
Total	158,214,995	130,871,636	98,156,683	29,795,418	52,250,596	33%	40%

*Unlinked trips calculation

Transit Travel in 2025

Table 2 shows a summary of total trip origins and destinations by jurisdiction in Northern Virginia for the year 2025. For this analysis, the City of Falls Church and the City of Fairfax were included in Fairfax County, and the cities of Manassas and Manassas Park were included in Prince William County. This analysis also shows the percentage of these trips that were estimated by the MWCOG mode choice model as using transit for each of these counties.

The trips were categorized by income levels. The MWCOG model classifies income based on household income ranges in 2007 dollars as follows:

Low	$0-$50,000
Med-Low	$50,000-$100,000
Med-High	$100,000-$150,000
High	$150,000+

The data shows that Arlington, Alexandria and Fairfax generate large percentages of transit trips, many of which are made by low and medium-low income households. The proportion of destinations reached by transit is highest in Arlington and Alexandria with low and medium-low income households representing the largest shares.

Table 2: Transit Share of Total Trips by Income

2025 Total Transit Trips										
	Origin						Destination			
Jurisdiction	Low	Med-Low	Med-High	High	Total		Low	Med-Low	Med-High	High	Total
Arlington	27,998	53,552	17,014	9,727	108,291		50,282	66,077	17,797	10,436	144,593
Alexandria	16,373	27,902	8,232	4,530	57,037		13,428	16,626	4,402	2,508	36,964
Fairfax*	45,258	93,986	32,399	21,915	193,558		37,010	47,978	12,578	7,001	104,567
Loudoun	4,798	10,030	3,691	2,485	21,004		1,226	1,672	418	185	3,501
Prince William**	7,124	12,806	3,732	1,764	25,427		1,775	2,351	579	267	4,973
Total	101,551	198,276	65,069	40,420	405,316		103,720	134,704	35,775	20,398	294,597

2025 Total Trips										
	Origin						Destination			
Jurisdiction	Low	Med-Low	Med-High	High	Total		Low	Med-Low	Med-High	High	Total
Arlington	73,020	139,554	120,506	151,836	484,916		102,096	166,633	144,653	219,251	632,633
Alexandria	59,276	100,460	77,790	86,507	324,033		58,083	89,480	76,922	112,495	336,979
Fairfax*	316,155	700,527	700,557	1,130,073	2,847,312		474,982	814,069	675,875	877,966	2,842,891
Loudoun	113,652	250,056	248,330	349,983	962,022		142,350	259,343	213,156	238,330	853,178
Prince William**	194,834	371,579	313,064	348,317	1,227,793		176,608	319,595	261,394	300,018	1,057,614
Total	756,937	1,562,177	1,460,247	2,066,715	5,846,076		954,118	1,649,120	1,371,999	1,748,060	5,723,296

Transit Mode Share										
	Origin						Destination			
Jurisdiction	Low	Med-Low	Med-High	High	Total		Low	Med-Low	Med-High	High	Total
Arlington	38.3%	38.4%	14.1%	6.4%	22.3%		49.2%	39.7%	12.3%	4.8%	22.9%
Alexandria	27.6%	27.8%	10.6%	5.2%	17.6%		23.1%	18.6%	5.7%	2.2%	11.0%
Fairfax*	14.3%	13.4%	4.6%	1.9%	6.8%		7.8%	5.9%	1.9%	0.8%	3.7%
Loudoun	4.2%	4.0%	1.5%	0.7%	2.2%		0.9%	0.6%	0.2%	0.1%	0.4%
Prince William**	3.7%	3.4%	1.2%	0.5%	2.1%		1.0%	0.7%	0.2%	0.1%	0.5%
Total	13.4%	12.7%	4.5%	2.0%	6.9%		10.9%	8.2%	2.6%	1.2%	5.1%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

When focusing on home-based-work trips, also known as commute trips, transit is much more competitive. Table 3 shows a summary of the 2025 transit mode share by household income. Once again, Arlington, Alexandria and Fairfax have large transit shares for work trips from low and medium-low income households. The shares are also substantial for low and medium-low income households in Loudoun and Prince William, medium-high income households in Fairfax, and all income levels in Arlington and Alexandria.

From an employment perspective, the transit mode share is remarkably high for low and medium-low income jobs in Arlington and Alexandria. Arlington and Alexandria also have notable transit mode share for medium-high income jobs and Fairfax attracts a similar transit mode share for low and medium-low income jobs.

Table 3: Home-Based-Work Mode Shares

	2025 Transit Work Trips									
	Household Origins					Employment Destinations				
Jurisdiction	Low	Med-Low	Med-High	High	Total	Low	Med-Low	Med-High	High	Total
Arlington	17,741	37,212	11,221	6,315	72,489	31,979	49,790	13,830	7,443	103,043
Alexandria	11,293	20,677	5,835	3,135	40,941	7,115	10,904	2,939	1,508	22,466
Fairfax*	33,310	69,821	23,873	17,068	144,072	19,343	28,585	7,581	3,868	59,377
Loudoun	4,345	8,719	3,195	2,247	18,505	644	821	195	79	1,739
Prince William**	6,184	10,813	3,191	1,598	21,786	718	916	206	89	1,929
Total	72,873	147,242	47,316	30,362	297,793	59,799	91,017	24,751	12,987	188,554

	2025 Total Work Trips									
	Household Origins					Employment Destinations				
Jurisdiction	Low	Med-Low	Med-High	High	Total	Low	Med-Low	Med-High	High	Total
Arlington	23,371	48,700	39,947	47,929	159,947	39,250	77,818	69,893	98,218	285,179
Alexandria	19,907	36,323	27,261	29,623	113,114	13,506	26,321	22,891	30,343	93,061
Fairfax*	90,512	198,894	192,821	310,240	792,468	132,246	234,019	189,224	234,999	790,488
Loudoun	32,584	68,533	67,533	98,494	267,144	33,490	53,222	39,244	39,837	165,793
Prince William**	54,374	99,187	82,888	94,896	331,344	41,001	65,768	48,178	51,380	206,326
Total	220,748	451,636	410,450	581,183	1,664,017	259,493	457,148	369,430	454,777	1,540,847

	Transit Mode Share									
	Household Origins					Employment Destinations				
Jurisdiction	Low	Med-Low	Med-High	High	Total	Low	Med-Low	Med-High	High	Total
Arlington	75.9%	76.4%	28.1%	13.2%	45.3%	81.5%	64.0%	19.8%	7.6%	36.1%
Alexandria	56.7%	56.9%	21.4%	10.6%	36.2%	52.7%	41.4%	12.8%	5.0%	24.1%
Fairfax*	36.8%	35.1%	12.4%	5.5%	18.2%	14.6%	12.2%	4.0%	1.6%	7.5%
Loudoun	13.3%	12.7%	4.7%	2.3%	6.9%	1.9%	1.5%	0.5%	0.2%	1.0%
Prince William**	11.4%	10.9%	3.9%	1.7%	6.6%	1.8%	1.4%	0.4%	0.2%	0.9%
Total	33.0%	32.6%	11.5%	5.2%	17.9%	23.0%	19.9%	6.7%	2.9%	12.2%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

It is important to understand that the tables presented above do not imply that all of the trips that start in Virginia end in Virginia. As Table 4 demonstrates, transit trips often involve travel between Virginia and Maryland or Washington, D.C. In the peak period (6:30 a.m. to 9:30 a.m.), only 36% of the transit trips start and end in Virginia. This percentage increases to 59% for off-peak transit trips. From a directional perspective, 48% of peak period transit trips travel from Virginia to jobs in Washington, D.C. and Maryland, while 16% of peak period transit trips travel from the district or Maryland to jobs in Virginia.

Table 4: Transit Trips Between States

| 2025 Base Transit Trips | | Peak | | |
From	To	Period	Off-peak	Daily
Virginia	DC/Maryland	172,135	30,141	202,276
DC/Maryland	Virginia	58,176	25,311	83,487
Virginia	Virginia	130,573	80,945	211,518
Total		360,884	136,397	497,281

Impacts of Removing Transit

All of the transit trips documented above would need to switch to other modes, or not travel at all, if transit services were not available in the region. As described in the methodology section, this study analyzed such an outcome, applying the MWCOG regional model after removing all transit from the region. Such an outcome impacted trip lengths, mode choice and highway assignment congestion levels.

This section will first summarize the difference between the "No Transit" results and the "2025 Base" results, including all population, employment, transit services, and highway improvements included in the MWCOG 2025 model. It will then identify the implications of capacity constraints to the Potomac River bridges and the number of households and jobs in Northern Virginia that could no longer be supported without transit services.

Change in Vehicle Trips

Table *5* shows the change in vehicle trips generated by each jurisdiction when transit services were removed. The overall increase in vehicle trips in Northern Virginia is about 5% on average, though substantially greater changes were seen in Arlington and Alexandria.

Table 5: Daily Vehicle Trips

Jurisdiction	No Transit	2025 Base	Increase	Percent
Arlington	627,259	532,050	95,209	17.9%
Alexandria	377,600	341,918	35,683	10.4%
Fairfax*	2,754,605	2,631,686	122,918	4.7%
Loudoun	906,506	896,031	10,474	1.2%
Prince William**	1,079,608	1,065,417	14,192	1.3%
Total	5,745,578	5,467,102	278,476	5.1%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Table 6 shows the vehicle trips in the AM Peak Period from trip origins (household locations) and destinations (employment locations). Household vehicle trips would increase by over 20% in Arlington and Alexandria under a No Transit model. In addition, Fairfax shows a 10% increase in household vehicle trips. From an employment perspective, vehicle trips would stand to increase 27% in Arlington and almost 13% in Alexandria.

Table 6: AM Peak Period Vehicle Trips

Origins					Destinations				
Jurisdiction	No Transit	2025 Base	Increase	Percent	Jurisdiction	No Transit	2025 Base	Increase	Percent
Arlington	98,494	80,121	18,373	22.9%	Arlington	131,621	103,325	28,296	27.4%
Alexandria	62,529	52,274	10,255	19.6%	Alexandria	60,916	53,981	6,935	12.8%
Fairfax*	454,358	412,638	41,720	10.1%	Fairfax*	456,574	436,658	19,915	4.6%
Loudoun	156,593	151,973	4,621	3.0%	Loudoun	133,718	132,897	822	0.6%
Prince William**	182,120	175,734	6,386	3.6%	Prince William**	152,899	151,914	985	0.6%
Total	954,095	872,739	81,355	9.3%	Total	935,728	878,775	56,953	6.5%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Figure 3 shows maps of where these changes in vehicle trips would be expected to occur. The Origins map shows changes in vehicle trips generated by households. The impacts would be widespread, with higher concentrations occurring inside the Beltway. The Destinations map shows changes in vehicle trips in regard to employment sites. These impacts are more concentrated inside Arlington and Old Town Alexandria, in Tysons and the I-66 corridor, and along the Dulles Toll Road in Reston and Herndon.

Increase in Vehicle Trips
AM Peak

☐ 0.0% to 2.0%　■ 2.1% to 4.0%　■ 4.1% to 8.0%　■ 8.1% to 12.0%　■ 12.1% to 54.4%
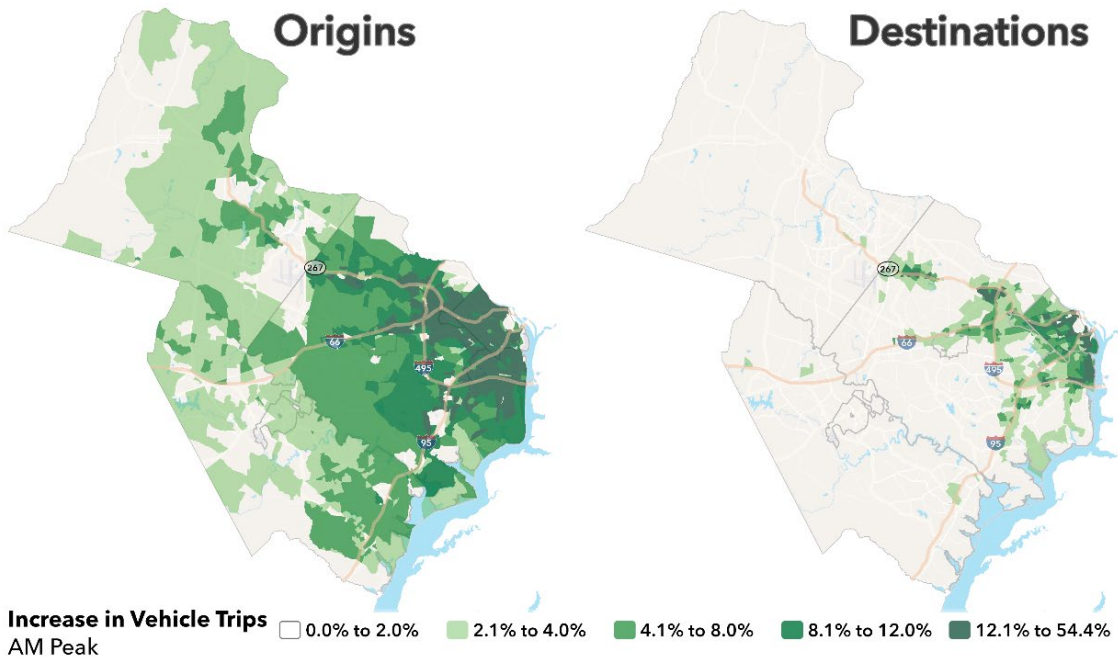
Similar vehicle trip increases are shown in Table 7 for the PM peak period. As expected, the PM peak period includes almost 75% more vehicle trips in the base than the AM peak period. The afternoon includes more non-work trips than the morning and the transit share of total trips is fewer. As a result, the percent increase in vehicle trips is less than the AM increase but the magnitude of the increase is greater. For example, the change in PM vehicle trip origins (i.e., from employment sites) is 28% higher than the change in AM vehicle trip destinations (i.e., to employment sites).

Table 7: PM Peak Period Vehicle Trips

Origin					Destination				
Jurisdiction	No Transit	2025 Base	Increase	Percent	Jurisdiction	No Transit	2025 Base	Increase	Percent
Arlington	195,820	161,934	33,885	20.9%	Arlington	163,294	138,858	24,436	17.6%
Alexandria	105,133	96,008	9,126	9.5%	Alexandria	107,845	95,341	12,504	13.1%
Fairfax*	774,736	747,983	26,753	3.6%	Fairfax*	772,461	724,575	47,886	6.6%
Loudoun	232,884	231,546	1,338	0.6%	Loudoun	254,686	249,632	5,055	2.0%
Prince William**	281,925	280,258	1,667	0.6%	Prince William**	309,788	302,836	6,952	2.3%
Total	1,590,499	1,517,729	72,770	4.8%	Total	1,608,075	1,511,243	96,833	6.4%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Change in Highway Travel and Performance

When the additional vehicle trips are loaded to the network, the traffic volumes and congestion levels also increase. Table 8 shows the increase in vehicle miles of travel. The Peak Period table

is the combined increase in the AM and PM peak periods. The Mid-Day table shows the increase in the middle of the day. As expected, the peak period has larger increases than the mid-day values due to the larger share of transit trips in peak periods. The percent increase in vehicle miles of travel is somewhat less than the increase in peak period vehicle trips. This indicates a reduction in trip length. Increasing congestion levels caused the MWCOG trip distribution model to assign vehicle trips to closer destinations.

Table 8: Vehicle Miles of Travel

Peak Period					Mid-Day				
Jurisdiction	No Transit	2025 Base	Increase	Percent	Jurisdiction	No Transit	2025 Base	Increase	Percent
Arlington	2,412,475	2,068,169	344,306	16.6%	Arlington	1,526,428	1,390,796	135,632	9.8%
Alexandria	1,377,048	1,165,202	211,845	18.2%	Alexandria	811,744	750,682	61,062	8.1%
Fairfax*	16,162,235	15,149,802	1,012,432	6.7%	Fairfax*	10,074,771	9,798,647	276,124	2.8%
Loudoun	4,525,580	4,423,680	101,900	2.3%	Loudoun	2,839,353	2,817,232	22,121	0.8%
Prince William**	5,693,173	5,579,180	113,993	2.0%	Prince William**	3,814,439	3,787,678	26,760	0.7%
Total	30,170,511	28,386,034	1,784,477	6.3%	Total	19,066,734	18,545,035	521,699	2.8%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Table 9 shows that the change in work trip length impacts lower income travelers more than higher income travelers.

Table 9: Change in Average Work Trip Length by Income (Miles)

Trip Type	No Transit	2025 Base	Reduction
Low Income	12.35	12.93	-4.49%
Med-Low Income	14.73	15.16	-2.84%
Med-High Income	16.32	16.64	-1.92%
High Income	17.17	17.18	-0.06%

Increases in congestion are typically measured in terms of "vehicle hours of delay." This is the sum of the hours of travel above the travel time that would otherwise be experienced without congestion. As shown in Table 10, the increase in hours of delay in both the peak and mid-day periods is substantial. In total, the peak period increase is 64% and the mid-day increase is over 11%. Furthermore, the peak period delay in Arlington and Alexandria more than tripled, and it increased by more than 50% in Fairfax. In addition, mid-day delays increased in Arlington and Alexandria. These are major increases in congestion that no amount of currently planned roadway improvements could address.

Table 10: Vehicle Hours of Delay

Peak Period					Mid-Day				
Jurisdiction	No Transit	2025 Base	Increase	Percent	Jurisdiction	No Transit	2025 Base	Increase	Percent
Arlington	84,089	21,734	62,355	286.9%	Arlington	5,123	3,490	1,632	46.8%
Alexandria	60,004	18,741	41,263	220.2%	Alexandria	3,082	2,326	756	32.5%
Fairfax*	275,621	180,842	94,779	52.4%	Fairfax*	28,089	25,288	2,801	11.1%
Loudoun	47,682	43,296	4,386	10.1%	Loudoun	9,374	9,105	269	3.0%
Prince William**	66,988	61,077	5,911	9.7%	Prince William**	9,687	9,444	243	2.6%
Total	534,385	325,690	208,694	64.1%	Total	55,354	49,653	5,701	11.5%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Potomac River Bridges

Another way to look at traffic congestion is through the volumes assigned to the Potomac River bridges. These bridges represent the only viable ways of crossing from Virginia to the district and Maryland without transit. Table 11 shows daily bridge volumes from both the No Transit and 2025 Base models. Under the No Transit model, all of the daily bridge volumes near downtown Washington, D.C. would increase by at least 20%. The overall Potomac crossings would be asked to absorb a 16% increase in traffic.

Furthermore, Table 12 shows that peak period traffic increases are even higher. The overall increase is 18%, but there are interesting distribution differences between the peak period and daily volumes. The data appears to suggest that the Arlington Memorial Bridge is more constrained during the peak period than on a daily basis. More peak period trips appear to shift to the Key Bridge and Chain Bridge to compensate.

Table 11: Daily Traffic Volumes on Potomac River Bridges

Potomac Crossings	No Transit	2025 Base	Increase	Percent
14th Street Bridge	217,356	180,654	36,702	20.3%
Arlington Memorial Bridge	88,761	63,762	24,999	39.2%
Theodore Roosevelt Bridge	138,809	111,526	27,284	24.5%
Key Bridge	66,028	54,563	11,465	21.0%
Chain Bridge	42,435	35,980	6,455	17.9%
American Legion Bridge	325,619	300,965	24,653	8.2%
Woodrow Wilson Bridge	250,572	226,395	24,177	10.7%
Total	1,129,580	973,846	155,735	16.0%

Table 12: Peak Period Traffic Volumes on Potomac River Bridges

Potomac Crossings	No Transit	2025 Base	Increase	Percent
14th Street Bridge	96,823	78,578	18,245	23.2%
Arlington Memorial Bridge	42,507	32,993	9,513	28.8%
Theodore Roosevelt Bridge	64,931	53,208	11,723	22.0%
Key Bridge	30,245	23,704	6,540	27.6%
Chain Bridge	21,904	17,306	4,597	26.6%
American Legion Bridge	161,380	143,175	18,206	12.7%
Woodrow Wilson Bridge	133,894	117,143	16,752	14.3%
Total	551,684	466,108	85,576	18.4%

A key consideration for this study is how these increases in peak period traffic impact the viability of the bridges and the implied need for additional roadway capacity crossing the Potomac. Table 13 shows the amount of peak period traffic that would exceed the capacity of the bridges. Note that all bridges would need to manage more traffic than capacity allows in the 2025 Base model. These bridges are congested today, and congestion will increase in the future. Without transit, however, the capacity constraint on the bridges would be substantially greater. These traffic levels suggest that the 14th Street Bridge would need an additional 3 lanes, while Arlington Memorial Bridge, Theodore Roosevelt Bridge and Woodrow Wilson Bridge would need 2 additional travel lanes each. These additions would be extremely costly.

Moreover, without additional capacity on the bridges, the congestion would hinder travel between Washington, D.C., Virginia and Maryland to the point that travelers would start to avoid the crossings. Over time, the regional economy would become less economically integrated, more fragmented and would ultimately become less competitive.

Table 13: Peak Period Traffic Volume Exceeding Bridge Capacity

Potomac Crossings	No Transit	2025 Base	Increase	Percent
14th Street Bridge	30,785	9,954	20,831	209.3%
Arlington Memorial Bridge	17,407	6,950	10,456	150.5%
Theodore Roosevelt Bridge	22,861	8,996	13,865	154.1%
Key Bridge	12,846	6,306	6,540	103.7%
Chain Bridge	6,164	3,959	2,205	55.7%
American Legion Bridge	7,379	3,651	3,728	102.1%
Woodrow Wilson Bridge	23,705	9,195	14,510	157.8%
Total	121,147	49,011	72,136	147.2%

Household and Employment Reductions

It is clear that a highway alternative to transit service is not a viable scenario. Even with planned capacity improvements, the region would not be able to accommodate the number of households and employment numbers currently forecasted for 2025.

As a way of quantifying the benefit of transit to the region, this analysis estimated the number of households and jobs that would need to be removed from a Northern Virginia without transit to restore roadway performance to a level comparable to what would exist if transit service were available. Table 14 shows that over 128,000 households would need to be reduced from Northern Virginia jurisdictions if transit was not available. Such a reduction represents 13% of Northern Virginia's housing stock. Over 30% would be lost in Arlington, 24% in Alexandria and 12.5% in Fairfax.

Table 14: Change in 2025 Households Without Transit

Jurisdiction	No Transit	2025 Base	Reduction	Percent
Arlington	81,057	117,866	(36,809)	-31.2%
Alexandria	61,127	80,779	(19,652)	-24.3%
Fairfax*	398,054	454,799	(56,745)	-12.5%
Loudoun	143,203	150,085	(6,882)	-4.6%
Prince William**	178,820	187,128	(8,308)	-4.4%
Total	862,261	990,657	(128,396)	-13.0%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Similarly, employment in Northern Virginia would also need to be reduced. The employment reductions shown in Table 15 include over 157,000 jobs, or 10% of total employment in Northern Virginia. The majority of this reduction would be in Arlington (≈36%), with other substantial reductions in Alexandria and Fairfax.

Table 15: Change in 2025 Employment Without Transit

Jurisdiction	No Transit	2025 Base	Reduction	Percent
Arlington	139,349	216,851	(77,502)	-35.7%
Alexandria	99,306	121,772	(22,466)	-18.4%
Fairfax*	731,091	784,676	(53,585)	-6.8%
Loudoun	217,656	219,395	(1,739)	-0.8%
Prince William**	215,680	217,578	(1,898)	-0.9%
Total	1,403,082	1,560,272	(157,190)	-10.1%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

The maps in Figure 4 show the relative distribution of the household and employment reductions in Northern Virginia. The household reductions impact a substantial portion of all jurisdictions. The reductions are greater inside the Beltway, but there are noticeable impacts in the Reston-Herndon area, the Ashburn area of Loudoun County, and the I-95 corridor in Prince William County. The employment distribution is more limited. Locations inside the Beltway show the greatest impacts. The Reston-Herndon area, the I-66 corridor, and the I-95 corridor into Prince William County also show impacts.

Figure 4: Change in Households and Employment
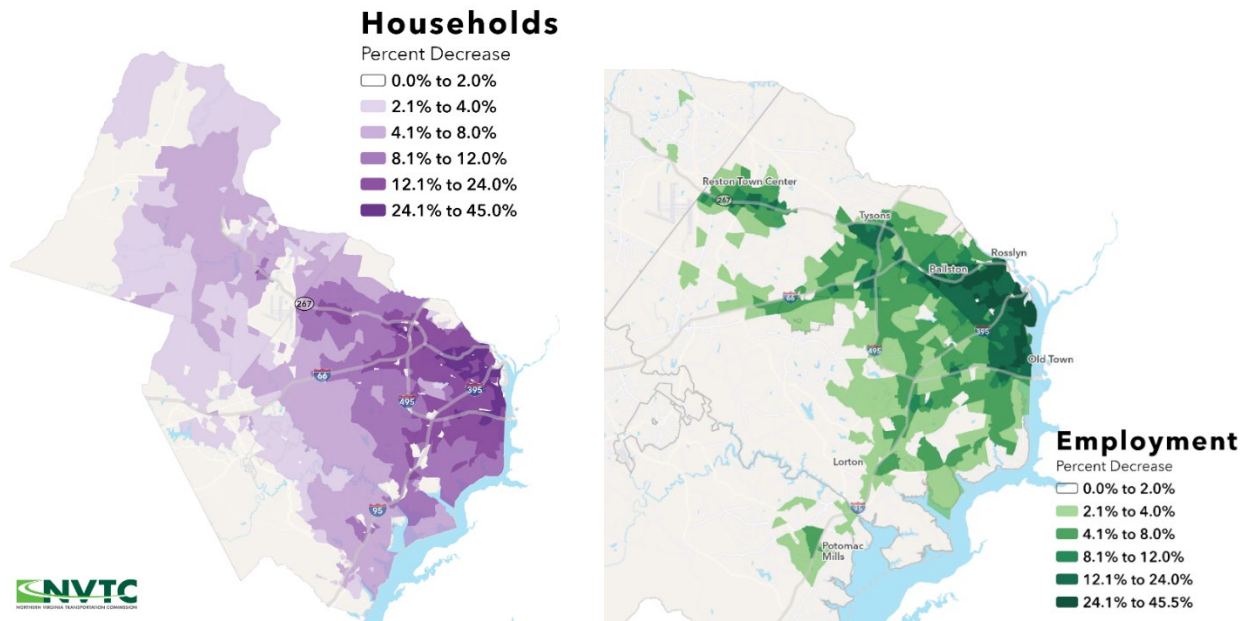
Household and Employment Reductions by Income

Another consideration in regard to changes to households is highlighted in Table 16. This analysis distributes the household reductions to income levels within each jurisdiction. The greatest impacts are to low and medium-low income households in Arlington, Alexandria and Fairfax. These impacts are over 50% in Arlington and over 35% in Alexandria. These are the households that are also the most dependent on transit services and would likely not be able to live in Northern Virginia without these services.

Table 16: Change in Households by Income

2025 Base Households			Income Share				2025 Base Households by Income			
Jurisdiction	Households	Percent	Low	Med-Low	Med-High	High	Low	Med-Low	Med-High	High
Arlington	117,866	12%	14.9%	29.2%	24.9%	31.0%	17,618	34,409	29,327	36,512
Alexandria	80,779	8%	18.1%	31.3%	24.0%	26.6%	14,632	25,276	19,412	21,459
Fairfax*	454,799	46%	11.2%	24.7%	24.5%	39.6%	50,814	112,385	111,630	179,971
Loudoun	150,085	15%	11.9%	25.9%	25.7%	36.5%	17,856	38,901	38,568	54,761
Prince William**	187,128	19%	16.0%	30.2%	25.4%	28.4%	29,910	56,501	47,522	53,194
Total	990,657	100%	13.0%	26.8%	24.9%	35.3%	130,830	267,471	246,459	345,897

No Transit Households			Income Share				No Transit Households by Income			
Jurisdiction	Households	Percent	Low	Med-Low	Med-High	High	Low	Med-Low	Med-High	High
Arlington	81,057	9%	10.4%	18.8%	29.3%	41.5%	8,470	15,242	23,739	33,606
Alexandria	61,127	7%	14.9%	25.0%	27.3%	32.8%	9,107	15,297	16,659	20,064
Fairfax*	398,054	46%	9.4%	21.2%	25.7%	43.6%	37,494	84,530	102,333	173,697
Loudoun	143,203	17%	11.3%	24.9%	26.1%	37.7%	16,226	35,640	37,388	53,948
Prince William**	178,820	21%	15.4%	29.3%	25.9%	29.4%	27,507	52,370	46,328	52,615
Total	862,261	100%	11.5%	23.6%	26.3%	38.7%	98,804	203,079	226,448	333,930

Reduced Households			Percent Reduced				Reduced Households by Income			
Jurisdiction	Households	Percent	Low	Med-Low	Med-High	High	Low	Med-Low	Med-High	High
Arlington	(36,809)	-31.2%	-51.9%	-55.7%	-19.1%	-8.0%	(9,148)	(19,167)	(5,588)	(2,906)
Alexandria	(19,652)	-24.3%	-37.8%	-39.5%	-14.2%	-6.5%	(5,525)	(9,979)	(2,753)	(1,396)
Fairfax*	(56,745)	-12.5%	-26.2%	-24.8%	-8.3%	-3.5%	(13,320)	(27,854)	(9,297)	(6,273)
Loudoun	(6,882)	-4.6%	-9.1%	-8.4%	-3.1%	-1.5%	(1,630)	(3,261)	(1,180)	(812)
Prince William**	(8,308)	-4.4%	-8.0%	-7.3%	-2.5%	-1.1%	(2,403)	(4,131)	(1,194)	(580)
Total	(128,396)	-13.0%	-24.5%	-24.1%	-8.1%	-3.5%	(32,026)	(64,392)	(20,011)	(11,967)

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

The impact to jobs by income levels is shown in Table 17. The low and medium-low income jobs would be hugely impacted by eliminating transit. The impacts on jobs in Arlington are 72% and 65% reductions for low and medium-low income jobs, respectively. The reductions in Alexandria are over 33% and the Fairfax impacts are over 11%. As with households, these low and medium-low income employees are most dependent on transit services and would likely not be able to work in Northern Virginia without these services.

Table 17: Change in Employment by Income

2025 Base Employment			Income Share				2025 Base Employment by Income			
Jurisdiction	Employment	Percent	Low	Med-Low	Med-High	High	Low	Med-Low	Med-High	High
Arlington	216,851	14%	15.4%	26.6%	23.4%	34.6%	33,396	57,756	50,691	75,008
Alexandria	121,772	8%	16.6%	26.9%	23.2%	33.2%	20,271	32,791	28,263	40,447
Fairfax*	784,676	50%	16.7%	28.8%	23.8%	30.6%	131,139	226,348	186,830	240,360
Loudoun	219,395	14%	17.3%	30.7%	24.8%	27.3%	37,860	67,298	54,344	59,892
Prince William**	217,578	14%	17.2%	30.5%	24.5%	27.8%	37,460	66,337	53,290	60,491
Total	1,560,272	100%	16.7%	29.0%	24.0%	30.3%	260,126	450,531	373,418	476,197

No Transit Employment			Income Share				No Transit Employment by Income			
Jurisdiction	Employment	Percent	Low	Med-Low	Med-High	High	Low	Med-Low	Med-High	High
Arlington	139,349	10%	6.6%	14.6%	28.9%	49.9%	9,258	20,279	40,335	69,477
Alexandria	99,306	7%	13.2%	22.0%	25.5%	39.2%	13,156	21,887	25,324	38,939
Fairfax*	731,091	52%	15.5%	27.4%	24.6%	32.4%	113,561	200,549	180,044	236,937
Loudoun	217,656	16%	17.1%	30.5%	24.9%	27.5%	37,216	66,477	54,149	59,813
Prince William**	215,680	15%	17.0%	30.3%	24.6%	28.0%	36,753	65,437	53,087	60,403
Total	1,403,082	100%	15.0%	26.7%	25.2%	33.2%	209,944	374,629	352,940	465,570

Reduced Employment			Percent Reduced				Reduced Employment by Income			
Jurisdiction	Employment	Percent	Low	Med-Low	Med-High	High	Low	Med-Low	Med-High	High
Arlington	(77,502)	-35.7%	-72.3%	-64.9%	-20.4%	-7.4%	(24,138)	(37,477)	(10,355)	(5,531)
Alexandria	(22,466)	-18.4%	-35.1%	-33.3%	-10.4%	-3.7%	(7,115)	(10,904)	(2,939)	(1,508)
Fairfax*	(53,585)	-6.8%	-13.4%	-11.4%	-3.6%	-1.4%	(17,578)	(25,799)	(6,786)	(3,422)
Loudoun	(1,739)	-0.8%	-1.7%	-1.2%	-0.4%	-0.1%	(644)	(821)	(195)	(79)
Prince William**	(1,898)	-0.9%	-1.9%	-1.4%	-0.4%	-0.1%	(707)	(901)	(203)	(87)
Total	(157,190)	-10.1%	-19.3%	-16.8%	-5.5%	-2.2%	(50,182)	(75,903)	(20,478)	(10,627)

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Economic Analysis
Methodology

The economic analysis builds on the travel modeling analysis presented in the prior section. By comparing outcomes between the No Transit and 2025 Base scenarios, the economic analysis estimates three types of impacts that would occur without Northern Virginia's transit network in order to illustrate the value to the region and the Commonwealth:

- Additional user and environmental costs – including travel time costs, vehicle operating costs, emissions costs and crash costs;
- Economic impacts – including reductions in total employment and earnings; and
- Fiscal impacts – including reductions in income and sales tax revenue to the Commonwealth.

As reference, the two travel model scenarios are:

- No Transit – assumed transit services were removed (including local bus routes, regional bus routes, Metrorail and VRE) from the transportation network by 2025.
- 2025 Base – assumed normal business operations, including impacts of any projects committed by 2025.

User and Environmental Costs

User and environmental costs represent additional costs driven by a lack of Northern Virginia's transit network in 2025. These include:

- Travel time costs;
- Vehicle operating costs – including gasoline, maintenance, tires and depreciation;
- Emissions costs – including NO_X, SO_X, $PM_{2.5}$ and CO_2; and
- Crash costs – including injuries and fatalities.

The research team's approach to estimating these user costs drew upon a range of inputs, including travel modeling outputs, U.S. Department of Transportation (USDOT) "2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs" guidance, and other assumptions described in this section.

In the absence of Northern Virginia's transit network, travel modeling outputs highlight that there would be an additional:

- 209,000 vehicle hours of delay during peak periods in 2025, which represents a 64.1% increase (refer to Table 18); and
- 1.8 million vehicle miles of travel during peak periods in 2025, which represents a 6.3% increase (refer to Table 19).

Table 18: Increase in Vehicle Hours of Delay by Jurisdiction, Peak Period, 2025

Jurisdiction	No Transit	2025 Base	Increase	Percentage Increase
Arlington	84,089	21,734	62,355	286.9%
Alexandria	60,004	18,741	41,263	220.2%
Fairfax*	275,621	180,842	94,779	52.4%
Loudoun	47,682	43,296	4,386	10.1%
Prince William**	66,988	61,077	5,911	9.7%
Northern Virginia	534,385	325,690	208,694	64.1%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Table 19: Increase in Vehicle Miles of Travel by Jurisdiction, Peak Period, 2025

Jurisdiction	No Transit	2025 Base	Increase	Percentage Increase
Arlington	2,412,475	2,068,169	344,306	16.6%
Alexandria	1,377,048	1,165,202	211,845	18.2%
Fairfax*	16,162,235	15,149,802	1,012,432	6.7%
Loudoun	4,525,580	4,423,680	101,900	2.3%
Prince William**	5,693,173	5,579,180	113,993	2.0%
Northern Virginia	30,170,511	28,386,034	1,784,477	6.3%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

A factor of 300, based on the travel modeling, was used to transform travel modeling outputs of vehicle hours of delay and vehicle miles of travel from average weekday to annual estimates. It is worth noting that these estimates represent user costs during peak periods only in 2025. This is considered reasonable as the majority of the pressure on the road network is expected to occur during peak periods. However, these total user costs could be considered conservative to the extent that additional costs would be present during off-peak periods.

The following sub-sections summarize the approach adopted to estimate these user costs.

Travel Time Costs

Travel time costs represent the cost of delays experienced by road users due to increased congestion on the road network.

To estimate these travel time costs, estimated additional vehicle hours of delay were annualized and applied to the value of time per person-hour of $18.80[2] ($ 2021) for all purposes and the average occupancy for passenger vehicles (weekday peak) of 1.48.[3]

Vehicle Operating Costs

Vehicle operating costs represent the additional costs incurred by road users due to increased vehicle miles traveled on the road network. These operating costs cover gasoline, maintenance, tires and depreciation.

To estimate these vehicle operating costs, additional vehicle miles traveled were annualized and applied to the operating cost per mile for light duty vehicles of $0.46[4] ($ 2021). The fare revenue paid by riders in Northern Virginia was netted out against the vehicle operating costs to account for the transit-related costs.

Emissions Costs

Emissions costs represent the additional environmental costs of emissions due to increased vehicle miles traveled on the road network. These cover a range of emissions, including nitrogen oxides (NO_X), sulfur oxides (SO_X), fine particulate matter ($PM_{2.5}$) and carbon dioxide (CO_2). To estimate the number of additional emissions, additional vehicle miles traveled were annualized and applied to net emissions rates for passenger vehicles in 2025 (refer to Table 20).

Table 20: Net Emission Rates (grams/mile), 2025

	Net Emission Rates (grams/mile)
NO_X	0.0180
SO_X	0.0013
$PM_{2.5}$	0.0006
CO_2	128.3673

Source: California Air Resources Board; WMATA, Metro's CO_2 Emissions

Note: The emission rates for transit were netted out against the emission rates for vehicles to account for the transit-related emissions using data from WMATA.

To estimate emissions costs, the amount of additional emissions was then applied to the damage costs for emissions per metric ton (Table 21).

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[2] 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs – Table A-3
[3] 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs – Table A-4
[4] 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs – Table A-5

Table 21: Damage Costs for Emissions per Metric Ton ($ 2021), 2025

Damage Costs for Emissions per Metric Ton ($ 2021)	
NO_X	$17,200
SO_X	$46,900
$PM_{2.5}$	$838,800
CO_2	$59

Source: USDOT 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs – Table A-6

Crash costs

Crash costs represent the additional costs of crashes due to increased vehicle miles traveled on the road network. This approach captured the cost of crashes that result from injuries and fatalities.

To estimate the number of additional crashes, additional vehicle miles traveled were annualized and applied to net crash rates (Table 22).

Table 22: Net Crash Rates per 100 Million Vehicle Miles

Net Crash Rates per 100 Million Vehicle Miles	
Injury	75.47
Fatal	1.28

Source: Bureau of Transportation Statistics, Motor Vehicle Safety Data; NSC Injury Facts, Deaths by Transportation Mode

Note: The crash rates for transit were netted out against the crash rates for vehicles to account for the transit-related crashes using data from NSC Injury Facts.

To estimate the crash costs, the number of additional crashes were then applied to the value of reduced fatalities and injuries (Table 23).

Table 23: Value of Reduced Fatalities and Injuries ($ 2021)

Value of Reduced Fatalities and Injuries ($ 2021)	
Injury	$307,800
Fatal	$13,046,800

Source: USDOT 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs – Table A-1

Economic Impacts

Economic impacts estimate the reduction in total employment and earnings in the absence of Northern Virginia's transit network in 2025.

The approach for estimating the economic impacts drew upon inputs, including travel modeling outputs, Bureau of Economic Analysis (BEA) Regional Input-Output Modelling System (RIMS II) multipliers, and other assumptions described in this section.

Without Northern Virginia's transit network, the travel modeling results highlight that there would be a reduction of:

- 157,000 direct jobs in 2025, which represents a 10.1% decrease (Table 24); and
- 128,000 households in 2025, which represents a 13.0% decrease (Table 25).

Table 24: Reduction in Employment by Jurisdiction, 2025

Jurisdiction	No Transit	2025 Base	Reduction	Percentage Reduction
Arlington	139,349	216,851	77,502	35.7%
Alexandria	99,306	121,772	22,466	18.4%
Fairfax*	731,091	784,676	53,585	6.8%
Loudoun	217,656	219,395	1,739	0.8%
Prince William**	215,680	217,578	1,898	0.9%
Northern Virginia	1,403,082	1,560,272	157,190	10.1%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Table 25: Reduction in Households by Jurisdiction, 2025

Jurisdiction	No Transit	2025 Base	Reduction	Percentage Reduction
Arlington	81,057	117,866	36,809	31.2%
Alexandria	61,127	80,779	19,652	24.3%
Fairfax*	398,054	454,799	56,745	12.5%
Loudoun	143,203	150,085	6,882	4.6%
Prince William**	178,820	187,128	8,308	4.4%
Northern Virginia	862,261	990,657	128,396	13.0%

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

RIMS II multipliers were sourced from the BEA and used to estimate total economic impacts. The multipliers are based on the "2012 Benchmark Input-Output Table for the Nation" and 2020 regional data.

Type II multipliers were adopted, which capture the following impacts:

- Direct impacts – the changes in economic activity resulting from the initial round of inputs purchased by the final-demand industry;
- Indirect impacts – the changes in economic activity resulting from subsequent rounds of inputs purchased by industries affected by a final-demand change; and
- Induced impacts – the changes in economic activity resulting from changes in spending by workers whose earnings are affected by a final-demand change.

> What are direct, indirect and induced impacts? Expenditure in the construction industry is one example:
>
> - Direct impacts describe the **activity generated by the construction industry** due to the increased expenditure;
> - Indirect impacts describe the **activity generated by other industries that supply the construction industry with inputs** (e.g., equipment, steel, concrete, etc.); and
> - Induced impacts describe the **activity generated through consumption** (e.g., consumer goods and services, food, etc.) due to the activity generated by the expenditure in the construction industry through the direct and indirect impacts.
>
> The combined direct, indirect and induced impacts provide a more comprehensive view of how expenditure will flow through the economy.

The following sub-sections summarize the approach adopted to estimate the total reduction in employment and earnings (including direct, indirect and induced impacts).

Employment

The total change in employment was estimated by applying the direct reduction in employment by income level (Table 26) to the direct effect employment multiplier (Table 27).

This multiplier represents the total change in number of jobs in all industries for each additional job in the industry corresponding to the entry.

Table 26: Reduction in Employment by Jurisdiction and Income Level, 2025

Jurisdiction	Low	Med-Low	Med-High	High	Total Reduction
Arlington	24,138	37,477	10,355	5,531	77,502
Alexandria	7,115	10,904	2,939	1,508	22,466
Fairfax*	17,578	25,799	6,786	3,422	53,585
Loudoun	644	821	195	79	1,739
Prince William**	707	901	203	87	1,898
Northern Virginia	50,182	75,903	20,478	10,627	157,190

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Table 27: RIMS II Multipliers, Type II, Direct Effect Employment Multipliers by Jurisdiction

Jurisdiction	Direct effect employment multipliers, all industries
Arlington	1.3669
Alexandria	1.3671
Fairfax*	1.5620
Loudoun	1.6021
Prince William**	1.4359
Northern Virginia	1.7222
Virginia	1.9814

Source: RIMS II, Regional Product Division, BEA

Notes: To obtain the direct effect employment multiplier for all industries, a weighted average across all industries was calculated using data from the Bureau of Labor Statistics' "Quarterly Census of Employment and Wages" (2022, Second Quarter).

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Earnings

Reductions in direct earnings were calculated using outputs provided by the travel modeling, including the reduction in households by income level (Table 28) as well as the corresponding household income, escalated to $ 2021[5] (Table 29).

Table 28: Reduction in Households by Jurisdiction and Income Level, 2025

Jurisdiction	Low	Med-Low	Med-High	High	Total Reduction
Arlington	9,148	19,167	5,588	2,906	36,809
Alexandria	5,525	9,979	2,753	1,396	19,652
Fairfax*	13,320	27,854	9,297	6,273	56,745
Loudoun	1,630	3,261	1,180	812	6,882
Prince William**	2,403	4,131	1,194	580	8,308
Northern Virginia	32,026	64,392	20,011	11,967	128,396

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Table 29: Household Income Ranges

	Range ($ 2007)	Midpoint ($ 2007)	Midpoint ($ 2021)
Low	$0-$50,000	$25,000	$31,719
Med-Low	$50,000-$100,000	$75,000	$95,156
Med-High	$100,000-$150,000	$125,000	$158,594
High	$150,000+	$150,000	$190,312

Source: MWCOG Travel Model

The total change in earnings was estimated by applying the direct reduction in earnings to the direct effect earnings multiplier (Table 30).

This multiplier represents the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry corresponding to the entry.

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[5] The MWCOG model classifies income based on household income ranges in $ 2007. Thus, the household income ranges were escalated to $ 2021.

Table 30: RIMS II Multipliers, Type II, Direct Effect Earnings Multipliers by Jurisdiction

Jurisdiction	Direct Effect Earnings Multipliers, All Industries
Arlington	1.2963
Alexandria	1.3431
Fairfax*	1.4186
Loudoun	1.4638
Prince William**	1.3887
Northern Virginia	1.5546
Virginia	1.8369

Source: RIMS II, Regional Product Division, BEA

Notes: To obtain the direct effect earnings multiplier for all industries, a weighted average across all industries was calculated using data from the Bureau of Labor Statistics' "Quarterly Census of Employment and Wages" (2022, Second Quarter).

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Fiscal Impacts

Fiscal impacts estimate the reduction in income and sales tax revenues in the absence of Northern Virginia's transit network in 2025.

The approach for estimating the fiscal impacts draws upon results of the economic impact section, as well as other assumptions described in this section.

The following sub-sections summarize the approach adopted to estimate the total reduction in income and sales tax revenue.

Income Tax Revenue

The reduction in income tax revenue was estimated by applying the reduction in total earnings (estimated in the economic impact section) to the effective income tax rate in Virginia.

An effective income tax rate of 5.4% was adopted from the "Virginia Tax Annual Report." [6] This was calculated as the ratio between the total tax liability and total taxable income (which accounts for exemptions and deductions) in Virginia.

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[6] "Virginia Tax Annual Report" (Fiscal Year 2022).

Sales Tax Revenue

The reduction in consumption was estimated by applying the reduction in total earnings to the following parameters sourced from the Bureau of Labor Statistics[7]:

- Average propensity to consume of 72% – calculated as the ratio between total expenditure and income before taxes.
- Average consumption expenditure subject to sales tax of 27% – calculated as the ratio between taxable expenditures (including food away from home, alcoholic beverages, apparel and services, transportation, entertainment, and personal care products) and total expenditures.

The reduction in consumption was then multiplied by the assumed sales tax, which is 6% in Northern Virginia, consistent with Virginia Tax[8].

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[7] Bureau of Labor Statistics. "Table 2700." Census division of residence: "Annual expenditure means, standard errors, and coefficients of variation - Consumer Expenditure Surveys" (2020-2021). Based on the Middle Atlantic region.

[8] Virginia Tax. "Retail Sales and Use Tax" (2023).

Results

This section summarizes economic analysis results, covering user and environmental costs, economic impacts and fiscal impacts.

User and Environmental Costs

In the absence of transit, there would be a range of user and environmental costs including travel time costs, vehicle operating costs, emissions costs and crash costs. These costs are driven by the increased vehicle hours of delay and miles of travel. For example, the increased vehicle miles of travel lead to a higher incidence of crashes and level of emissions across Northern Virginia (Table 31).

Table 31: Increased Crashes and Emissions by Jurisdiction, 2025

Jurisdiction	Crashes		Emissions (Metric Tons)			
	Injury Crash	Fatal Crash	NO_X	SO_X	$PM_{2.5}$	CO_2
Arlington	77.9	1.3	1.9	0.1	0.1	13,259
Alexandria	48.0	0.8	1.1	0.1	0.04	8,158
Fairfax*	229.2	3.9	5.5	0.4	0.2	38,989
Loudoun	23.1	0.4	0.6	0.04	0.02	3,924
Prince William**	25.8	0.4	0.6	0.04	0.02	4,390
Northern Virginia	404.0	6.9	9.7	0.7	0.3	68,721

Source: AECOM estimates

Emissions include nitrogen oxides (NO_X), sulfur oxides (SO_X), fine particulate matter ($PM_{2.5}$), and carbon dioxide (CO_2).

Northern Virginia is the sum of Arlington, Alexandria, Fairfax, Loudoun, and Prince William. Virginia is inclusive of Northern Virginia and the rest of Virginia.

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

In monetary terms, the findings highlight that, in the absence of transit, the total user and environmental costs would total close to $2.1 billion during peak periods across Northern Virginia and its jurisdictions in 2025 (Table 32).

Travel time costs account for around 80% of user costs (~$1.7 billion). The balance of user costs is comprised of vehicle operating costs (~$130 million), crash costs (~$210 million), and emissions costs (~$5 million).

The user costs are concentrated within the counties of Fairfax (~$1.0 billion) and Arlington (~$590 million), as well as the city of Alexandria (~$390 million). Prince William and Loudoun account for the remaining user costs at around $70 million and $60 million, respectively.

Table 32: User and Environmental Costs ($ 2021) by Jurisdiction, $ M, 2025

Jurisdiction	Travel Time Costs	Vehicle Operating Costs	Emissions Costs	Crash Costs	Total User Costs
Arlington	$520.5	$25.2	$0.9	$41.2	$587.8
Alexandria	$344.4	$15.5	$0.5	$25.4	$385.8
Fairfax*	$791.1	$74.0	$2.6	$121.3	$989.0
Loudoun	$36.6	$7.4	$0.3	$12.2	$56.5
Prince William**	$49.3	$8.3	$0.3	$13.7	$71.6
Northern Virginia	$1,742.0	$130.4	$4.5	$213.8	$2,090.7

Source: AECOM estimates

Northern Virginia is the sum of Arlington, Alexandria, Fairfax, Loudoun, and Prince William. Virginia is inclusive of Northern Virginia and the rest of Virginia.

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Comparison with 2018 report: *The estimation of user costs – including travel time costs, vehicle operating costs, emissions costs and crash costs – represents new analysis. As a result, there are no results to compare with the 2018 report.*

Economic Impacts

The findings highlight that there would be a reduction in total employment and earnings across Virginia and its jurisdictions.

After accounting for indirect and induced impacts, total employment would decrease by over 311,000 jobs across Virginia in 2025 (Table 33). This is expected to negatively impact all jurisdictions; however, the jurisdictions hit the hardest are those with the largest labor forces, including Arlington (~127,000 jobs), Fairfax (~100,000 jobs), and Alexandria (~37,000 jobs).

As noted above, this would disproportionately affect lower-income households (earning less than $50,000 in $ 2007); such households account for 32% of the job losses, despite representing only 17% of the labor force.

Table 33: Reduction in Total Employment by Jurisdiction and Income Level, 2025

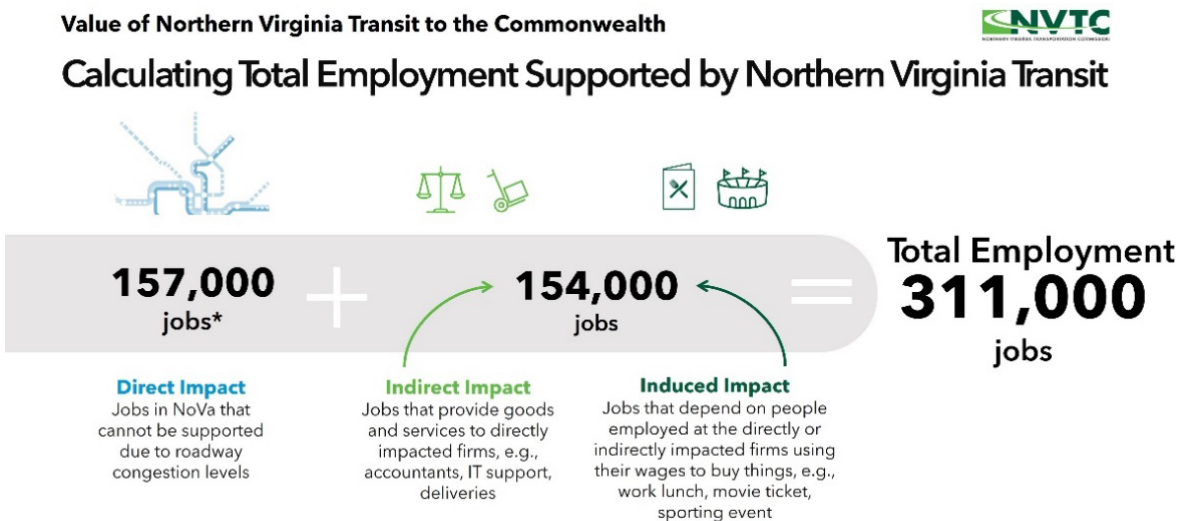| Jurisdiction	Low	Med-Low	Med-High	High	Total Reduction
Arlington	39,480	61,410	16,993	9,092	126,975
Alexandria	11,640	17,871	4,824	2,479	36,813
Fairfax*	32,855	48,311	12,725	6,429	100,321
Loudoun	1,235	1,577	374	152	3,338
Prince William**	1,214	1,550	351	151	3,266
Northern Virginia	86,423	130,720	35,268	18,302	270,713
Virginia	99,429	150,392	40,575	21,056	311,452
Percentage of total reduction by income level	32%	48%	13%	7%	100%

Source: AECOM estimates

Notes: Results for the Arlington, Alexandria, Fairfax, Loudoun, and Price William jurisdictions are scaled to ensure that they sum to equal Northern Virginia. Income ranges ($ 2007) are defined as follows: Low – $0-$50,000; Med-Low – $50,000-$100,000; Med-High – $100,000-$150,000; High – $150,000+.

Northern Virginia is the sum of Arlington, Alexandria, Fairfax, Loudoun, and Prince William. Virginia is inclusive of Northern Virginia and the rest of Virginia.

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Figure 5: Calculating Total Employment Supported by Northern Virginia Transit

Value of Northern Virginia Transit to the Commonwealth

Calculating Total Employment Supported by Northern Virginia Transit

157,000 jobs*
+
154,000 jobs
=
Total Employment 311,000 jobs

Direct Impact
Jobs in NoVa that cannot be supported due to roadway congestion levels

Indirect Impact
Jobs that provide goods and services to directly impacted firms, e.g., accountants, IT support, deliveries

Induced Impact
Jobs that depend on people employed at the directly or indirectly impacted firms using their wages to buy things, e.g., work lunch, movie ticket, sporting event

*76% of these jobs are within ½ mile of a Metro station

Total earnings would decrease across Virginia to the order of $23.1 billion in 2025 (Table 34). The impacts are similarly concentrated in Fairfax (~$9.2 billion), Arlington (~$5.2 billion) and Alexandria (~$2.8 billion). The reduction in earnings is greatest in Fairfax, consistent with the observation borne from travel modeling that this jurisdiction would lose the largest number of households.

Table 34: Reduction in Total Earnings by Jurisdiction and Income Level ($ 2021), $ M, 2025

Jurisdiction	Low	Med-Low	Med-High	High	Total Reduction
Arlington	$426.6	$2,681.1	$1,298.9	$806.6	$5,213.2
Alexandria	$267.0	$1,446.2	$662.9	$401.4	$2,777.5
Fairfax*	$679.7	$4,263.8	$2,364.9	$1,905.5	$9,213.9
Loudoun	$85.8	$515.0	$309.6	$254.5	$1,165.0
Prince William**	$120.0	$619.1	$297.3	$172.3	$1,208.7
Northern Virginia	$1,579.2	$9,525.2	$4,933.6	$3,540.3	$19,578.4
Virginia	$1,866.0	$11,255.2	$5,829.7	$4,183.3	$23,134.2
Percentage of total reduction by income level	8%	49%	25%	18%	100%

Source: AECOM estimates

Notes: Results for the Arlington, Alexandria, Fairfax, Loudoun, and Price William jurisdictions are scaled to ensure that they sum to equal Northern Virginia. Income ranges ($ 2007) are defined as follows: Low – $0-$50,000; Med-Low – $50,000-$100,000; Med-High – $100,000-$150,000; High – $150,000+.

Northern Virginia is the sum of Arlington, Alexandria, Fairfax, Loudoun, and Prince William. Virginia is inclusive of Northern Virginia and the rest of Virginia.

* Includes Fairfax County and the cities of Fairfax and Falls Church.
** Includes Prince William County and the cities of Manassas and Manassas Park.

Comparison with 2018 report: The reduction in employment estimated by this report (~311,000 jobs) is larger than that estimated by the 2018 report (~130,000 jobs), a change driven by important differences in both timing and methodological approach:

- Timing – this report is based on travel modeling outputs estimated for the year 2025, which represents a seven-year difference compared with the 2018 report.
- Methodological approach – this report considers **total** impacts, which include direct, indirect and induced impacts. In contrast, the 2018 report considered only **direct** impacts. In addition to Metrorail and VRE routes, this report also assumed the removal of local and regional bus routes, while the 2018 report did not.

For these reasons, these results are expected to be higher than those presented in the 2018 report. The table below summarizes the differences between the reports, which are consistent with expectations.

	2018 report	This report (2025)
Reduction in jobs and direct impact	130,000	157,190
Reduction in jobs, indirect and induced impacts	N/A	154,263
Reduction in jobs and total impacts (direct, indirect and induced impacts)	130,000	311,452

Notes:

- Direct impacts – the changes in economic activity resulting from the initial round of inputs purchased by the final-demand industry.
- Indirect impacts – the changes in economic activity resulting from subsequent rounds of inputs purchased by industries affected by a final-demand changes.
- Induced impacts – the changes in economic activity resulting from changes in spending by workers whose earnings are affected by a final-demand change.

Fiscal Impacts

The findings highlight that income and sales revenues in Virginia would decrease by approximately $1.5 billion ($ 2021) in 2025. According to the "Virginia Tax Annual Report"[9] (Fiscal Year 2022), general fund revenues totaled around $29 billion. The state's portion of collected revenues represents approximately 5% of general fund revenues.

Income tax collected in Virginia would decrease by around $1.2 billion ($ 2021) in 2025, as the absence of Northern Virginia's transit network would lead to fewer households and lower employment in Virginia.

Sales tax collected in Virginia would decrease by around $270 million ($ 2021) in 2025, as any reduction in earnings would lead to a lower level of consumption, and thus a lower level of sales tax revenue.

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[9] "Virginia Tax Annual Report" (Fiscal Year 2022).

Comparison with 2018 report: The reduction in income and sales tax revenue estimated by this report (~$1.5 billion) is larger than that estimated by the 2018 report (~$600 million), a change driven by important differences in both timing and methodological approach:

- Timing – this report is based on travel modeling outputs estimated for the year 2025, which represents a seven-year difference compared with the 2018 report.
- Methodological approach – this report considers **total** impacts, which include direct, indirect and induced impacts. In contrast, the 2018 report considered only **direct** impacts. In addition to Metrorail and VRE routes, this report also assumed the removal of local and regional bus routes, while the 2018 report did not.

For these reasons, the results are expected to be higher than those presented in the 2018 report. The table below summarizes the differences between the reports, which are consistent with expectations.

	2018 report	This report (2025)
Reduction in tax revenue ($ 2021), $ M, direct impact	$600	$828
Reduction in tax revenue ($ 2021), $ M, indirect and induced impacts	N/A	$693
Reduction in tax revenue ($ 2021), $ M, total impacts (direct, indirect, and induced impacts)	$600	$1,520

Notes:

- Direct impacts – the changes in economic activity resulting from the initial round of inputs purchased by the final-demand industry.
- Indirect impacts – the changes in economic activity resulting from subsequent rounds of inputs purchased by industries affected by a final-demand change.
- Induced impacts – the changes in economic activity resulting from changes in spending by workers whose earnings are affected by a final-demand change.

Does the availability of transit and rail service in Northern Virginia help attract and promote the retention of corporations in the region?

In an interview with the Virginia Economic Development Partnership (VEDP) on February 3, 2023, it was noted that transit plays an important role in attracting and retaining corporations in the Northern Virginia region. Both the costs of doing business and connectivity are key determinants of a company's choice of location.

Among the site-specific factors that influence a company's final location, the availability of public transit is a priority factor. Reliable public transit that can be easily accessed is important not only from an employee / end user perspective, but provides several benefits for employers as well:

- Access to transit improves employee quality of life, making transit-accessible businesses more attractive to employees;

- Offering transit subsidies allows employers to improve employee compensation packages while managing labor costs; and

- Reliable transit that allows employees to consistently predict commuting schedules improves their attendance, punctuality and overall productivity.

An example that underscores these conclusions can be found in Amazon's recent choice to set up a second headquarters at Arlington's National Landing in 2023. Amazon cited in its RFP that "access to mass transit on site" was one of their core preferences, and explicitly required direct access to rail, train, subway/metro and bus routes. In an article by the Fairfax Times,[1] the area's existing transit system was a significant factor in Amazon's choice, as it included:

- Three existing Metrorail stations at Pentagon, Pentagon City and Crystal City;

- At National Landing, the region's only currently operating bus rapid transit system with the Washington Metropolitan Area Transit Authority-operated Metroway;

- Area stops for the Fairfax Connector, Arlington Transit, Loudoun County Transit, DASH, Metrobus and OmniRide bus systems; and

- Two VRE lines passing through the Crystal City Metro Station.

To this end, the Commonwealth's investment of $195 million in infrastructure projects at National Landing was part of the incentive package offered to Amazon. These projects include additional entrances for the Crystal City station and the City of Alexandria's planned Potomac Yard Metro Station. This incentive was added to accommodate future housing needs of employees and easy access to transportation. Although Amazon has delayed construction of HQ2 in Northern Virginia, the company released a public statement on March 3, 2023, stating their commitment to the Arlington, Virginia area and the Greater Capital Region.

Looking to the future, the role of transit in the post-Covid environment has shifted. While VEDP acknowledges there has been a tremendous reduction in office projects, new corporate developments are catering to a hybrid model that improves flexibility and focuses on attracting skilled professionals. Not only are professionals looking for reliable commuting options, but also the availability of housing, moderate costs of living and access to amenities. Having access to transit provides an underlying network that will support the changing needs of the modern workforce and provide employers with the competitive edge necessary for attracting quality workers.