VTrans2040 Multimodal Transportation Plan

Corridors of Statewide Significance Needs Assessment

Executive Summary and Methodology

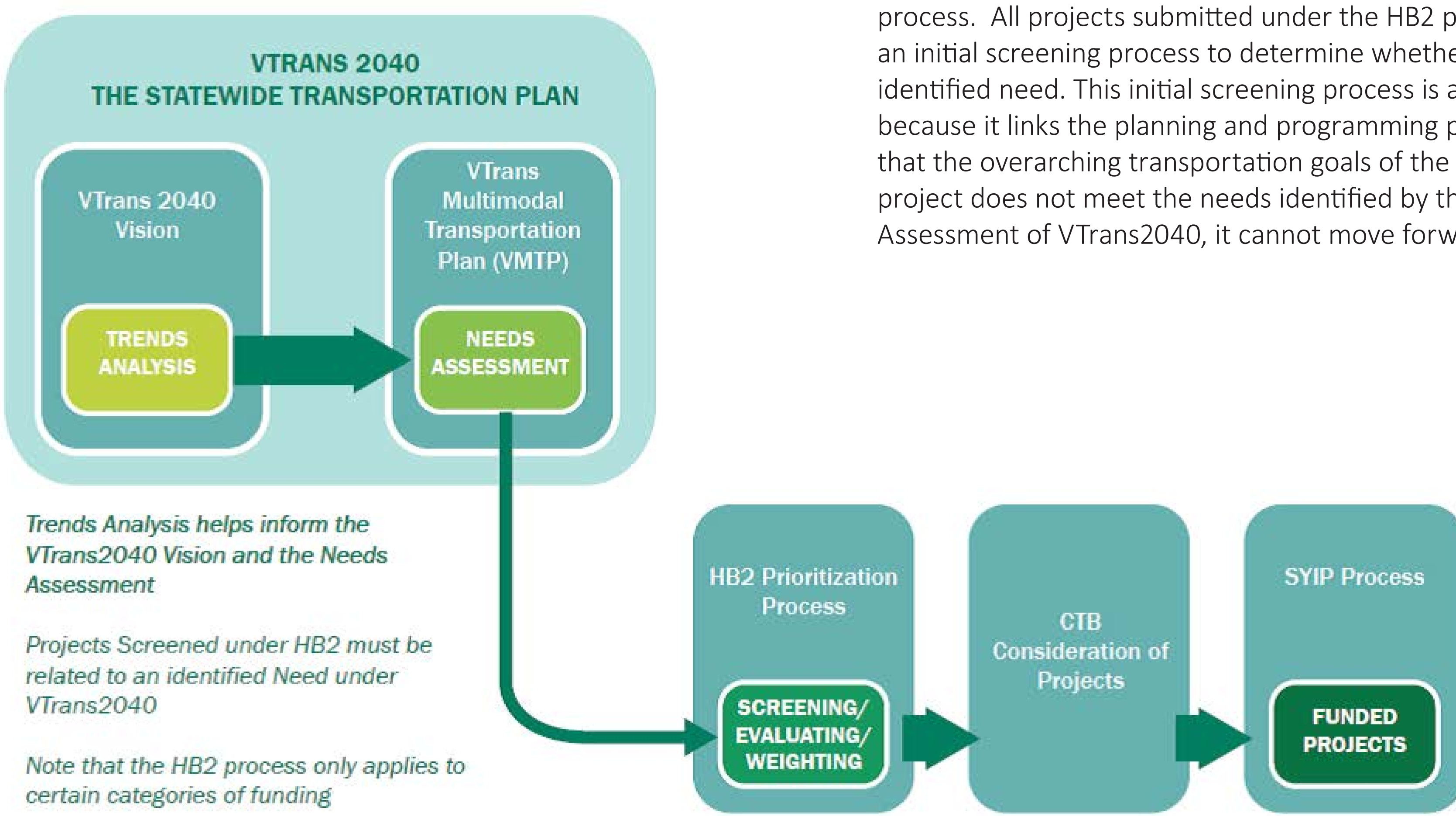
Office of INTERMODAL Planning and Investment

PURPOSE

The Virginia General Assembly, through new legislation, has directed the Commonwealth Transportation Board (CTB) to coordinate the development of a Statewide Transportation Needs Assessment. This Transportation Needs Assessment is conducted under the Office of Intermodal Planning and Investment (OIPI) as part of the Statewide Transportation Plan (VTrans2040) and the process of its development and implementation is a component of the VTrans Multimodal Transportation Plan (VMTP). The VMTP and the VTrans Vision Plan make up the overall VTrans2040. One of the key purposes of the Needs Assessment is to serve as a screening mechanism for projects applying for consideration under the House Bill 2 (2014) (HB2) prioritization process. All projects submitted under the HB2 process undergo an initial screening process to determine whether they relate to an identified need. This initial screening process is a critical component because it links the planning and programming processes to ensure that the overarching transportation goals of the CTB are advanced. If a project does not meet the needs identified by the Transportation Needs Assessment of VTrans2040, it cannot move forward in the HB2 process.

The Transportation Needs Assessment evaluates the State's transportation needs at three scales, listed below, and includes a statewide assessment of safety needs:

- Corridors of Statewide Significance (CoSS)- Interregional travel market
- Regional Networks (RN)- Intraregional travel market
- Urban Development Areas (UDA)- Local activity center market



INTRODUCTION TO CORRIDORS OF STATEWIDE SIGNIFICANCE NEEDS ASSESSMENT

Corridors of Statewide Significance:

A	Coastal Corridor (US 17)
B	Crescent Corridor (I-81)
C	East-West Corridor (I-64)
D	Eastern Shore Corridor (US 13)
E	Heartland Corridor (US 460)
F	North Carolina to West Virginia Corridor (US 220)
G	North-South Corridor (VA 234)
H	Northern Virginia Corridor (I-66)
I	Seminole Corridor (US 29)
J	Southside Corridor (US 58)
K	Washington to North Carolina Corridor (I-95)
L	Western Mountain Corridor (I-77)

Needs Assessment Metrics:

	Redundancy and Mode Choice
	Safety
	Congestion and Bottlenecks
	Reliability

The VTrans2035 plan, as adopted by the Commonwealth Transportation Board (via a resolution dated December 17, 2009), initially designated 11 CoSS; a 12th corridor was subsequently added (via a CTB resolution dated May 18, 2011). The designation and study of these multimodal corridors is a responsibility of the Commonwealth Transportation Board in accordance with the Code of Virginia §33.2-353. The official definition of a CoSS as defined in VTrans2035 is:

"An integrated, multimodal network of transportation facilities that connect major centers of activity within and through the Commonwealth and promote the movement of people and goods essential to the economic prosperity of the state."

To be considered a CoSS, a corridor must meet all four of the following criteria:

1. Multimodal – must involve multiple modes of travel or must be an extended freight corridor.
2. Connectivity – must connect regions, states, and/or major activity centers.
3. High Volume – must involve a high volume of travel.
4. Function – must provide a unique statewide function and/or address statewide goals.

Corridor Components

Components of the CoSS are those facilities and services which comprise the multimodal network connecting major centers of activity (RNs and UDAs) and accommodate inter-city travel between these centers as well as inter-state traffic. CoSS component facilities include a primary facility (generally an Interstate or US Highway Route) and the major facilities/services (typically within approximately five miles of the primary highway) that provide multiple modes and parallel routes connecting major centers of activity along the corridor. The component facilities included in each CoSS are outlined in the table on Page 5.

For analysis purposes, each CoSS is divided into segments which are identified by points where major transportation facilities enter or exit a corridor, areas affected by similar types of transportation issues, and locations where geometric or socio-economic conditions change substantially. Thirty-nine segments were identified on the 12 CoSS, as shown in the Map on Page 4. Due to the overlap of route and freeway designations, it is possible for a facility to be included in multiple CoSS segments.

Needs Assessment Report Format

The CoSS Needs Assessment included data-driven analysis and stakeholder feedback to develop quantitative and qualitative performance measures to identify needs on the corridors. Each corridor has an individual Needs Assessment Report. Corridor and segment profiles in each report provide a snapshot of demand and travel patterns for various modes of passenger and freight travel. These profiles illustrate the connection between regional economics and transportation and provide segment-specific context to the subsequent analysis of needs.

The reports are organized as follows:

- Corridor Overview – Describes the corridor and details the transportation facilities comprising the corridor. Demographics, economic trends and corridor travel patterns are also described.
- Segment Profile – Describes the segment and details the transportation facilities comprising the segment along with future capacity and safety-related projects. Travel demand is also detailed for the segment.
- Segment Needs – Details performance measures for four categories of needs: redundancy and mode choice, safety, congestion, and reliability. A summary of needs for each segment outlines issues identified from the performance measures and incorporates comments received during regional forums held across the state during the months of May and July 2015.

INTRODUCTION TO CORRIDORS OF STATEWIDE SIGNIFICANCE NEEDS ASSESSMENT

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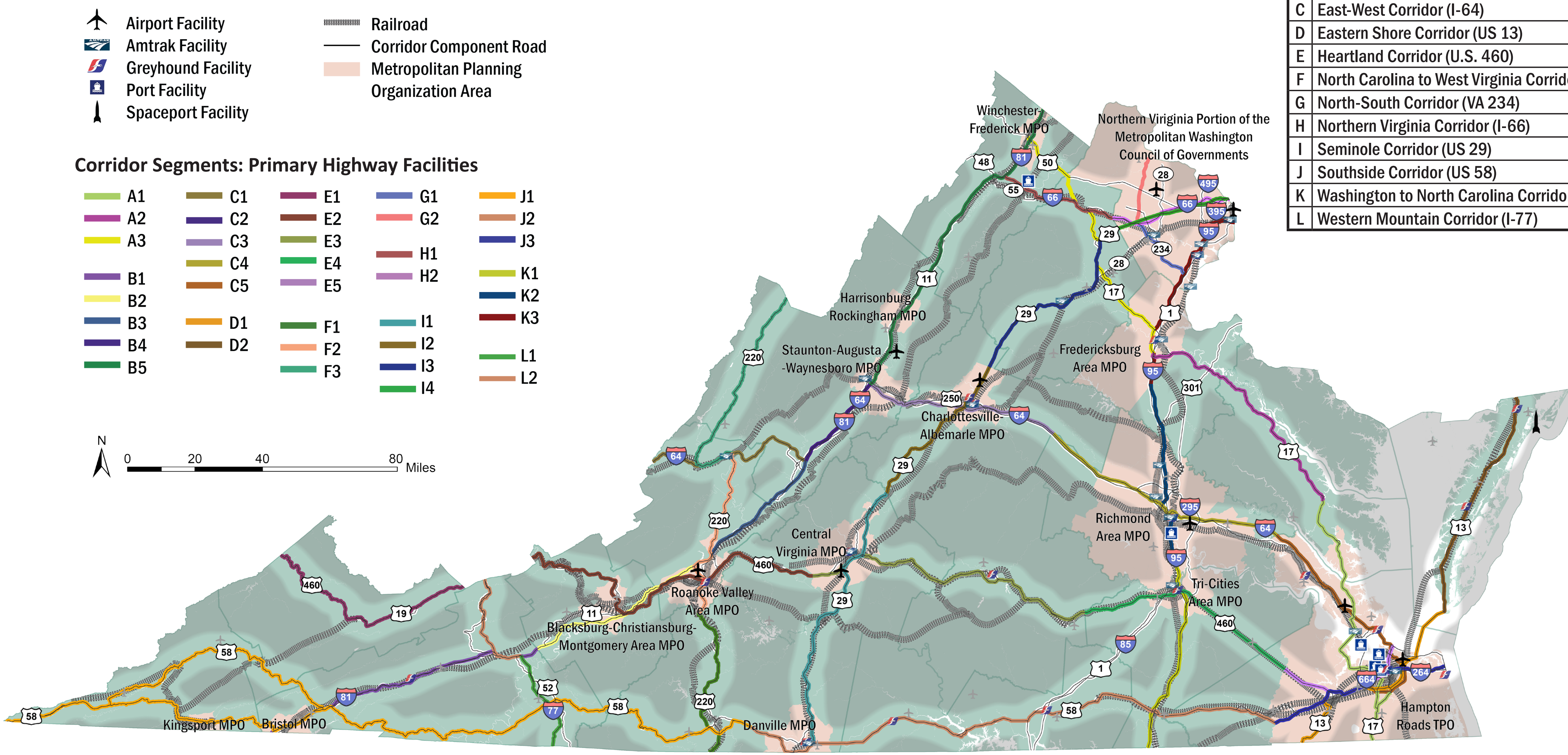
C	East-West Corridor (I-64)
D	Eastern Shore Corridor (US 13)
E	Heartland Corridor (U.S. 460)
F	North Carolina to West Virginia Corridor (US 220)
G	North-South Corridor (VA 234)
H	Northern Virginia Corridor (I-66)
I	Seminole Corridor (US 29)
J	Southside Corridor (US 58)
K	Washington to North Carolina Corridor (I-95)
L	Western Mountain Corridor (I-77)



INTRODUCTION TO CORRIDORS OF STATEWIDE SIGNIFICANCE NEEDS ASSESSMENT

A - Coastal Corridor

Segment A1 US 17, Port of Virginia, Norfolk Southern Heartland Corridor, Norfolk Southern Coal Corridor, CSX National Gateway Corridor, CSX Coal Corridor, Amtrak, Norfolk International Airport, Newport News/Williamsburg International Airport

Segment A2 US 17, Rappahannock River

Segment A3 US 17

B - Crescent Corridor

Segment B1 I-81, US 11, I-381, Norfolk Southern Crescent Corridor, Short Line Railroads

Segment B2 I-81, US 11, I-581, Norfolk Southern Crescent Corridor, Short Line Railroads, Roanoke Regional Airport

Segment B3 I-81, US 11, Norfolk Southern Crescent Corridor

Segment B4 I-81, US 11, Norfolk Southern Crescent Corridor

Segment B5 I-81, US 11, Virginia Inland Port, Norfolk Southern Crescent Corridor, Short Line Railroads, Shenandoah Valley Regional Airport

C - East-West Corridor

Segment C1 I-64, US 60, Amtrak, CSX Coal Corridor

Segment C2 I-64, US 11, Amtrak, Norfolk Southern Coal Corridor

Segment C3 I-64, US 250, Route 60, Charlottesville-Albemarle Airport, Amtrak, Norfolk Southern Coal Corridor

Segment C4 I-64, US 250, US 60, Port of Richmond, James River, Amtrak, CSX Coal Corridor, Norfolk Southern Coal Corridor, Richmond International Airport

Segment C5 I-64, US 60, I-664, I-564, I-264, I-464, Port of Virginia, York River, James River, CSX Coal Corridor, Norfolk Southern Coal Corridor, Amtrak, Norfolk International Airport, Newport News/Williamsburg International Airport

D - Eastern Shore Corridor

Segment D1 US 13, Port of Virginia, Bay Coast Railroad and Barge, Norfolk Southern, CSX, Amtrak, Norfolk International Airport, Newport News/Williamsburg International Airport

Segment D2 US 13, Bay Coast Railroad and Barge

E - Heartland Corridor

Segment E1 US 460, Coalfields Expressway, Norfolk Southern Heartland Corridor

Segment E2 US 460, Norfolk Southern Heartland Corridor, Roanoke Regional Airport

Segment E3 US 460, Norfolk Southern Heartland Corridor, Lynchburg Regional Airport

Segment E4 US 460, James River, Norfolk Southern Heartland Corridor, Amtrak, Richmond International Airport

Segment E5 US 460, Port of Virginia, James River, Norfolk Southern Heartland Corridor, Amtrak, Norfolk International Airport, Newport News/Williamsburg International Airport

F - North Carolina to West Virginia Corridor

Segment F1 US 220, Norfolk Southern

Segment F2 US 220, Norfolk Southern, Roanoke Regional Airport

Segment F3 US 220

G - North – South Corridor

Segment G1 VA 234, Prince William County Parkway

Segment G2 VA 234 and 659, Bi-County Parkway, Northstar Boulevard, Washington Dulles International Airport

H - Northern Virginia Corridor

Segment H1 I-66, US 50 and VA 55, Virginia Inland Port, Norfolk Southern Crescent Corridor

Segment H2 I-66, US 50, WMATA Orange Line, Virginia Railway Express, Amtrak, Washington Dulles International Airport, Ronald Reagan Washington National Airport

I - Seminole Corridor

Segment I1 US 29, Norfolk Southern Crescent Corridor, Amtrak, Lynchburg Regional Airport

Segment I2 US 29, Norfolk Southern Crescent Corridor, Amtrak Charlottesville Albemarle Airport

Segment I3 US 29 and VA 28, Norfolk Southern Crescent Corridor, Amtrak

Segment I4 US 29, US 50 and VA 28, WMATA Orange Line, Virginia Railway Express, Amtrak, Washington Dulles International Airport

J - Southside Corridor

Segment J1 US 58, CSX National Gateway

Segment J2 US 58

Segment J3 US 58, Port of Virginia, CSX National Gateway, Norfolk International Airport, Newport News/Williamsburg International Airport

K - Washington to North Carolina Corridor

Segment K1 I-95, I-85, US 1 and US 301, CSX National Gateway Corridor

Segment K2 I-95, I-195, I-295, US 1 and US 301, Port of Richmond, James River, CSX National Gateway Corridor, Amtrak, Richmond International Airport

Segment K3 I-95, I-395, I-495, US 1, WMATA Blue and Yellow Lines, Virginia Railway Express, Port of Alexandria, CSX National Gateway Corridor, Amtrak, Ronald Reagan Washington National Airport

L - Western Mountain Corridor

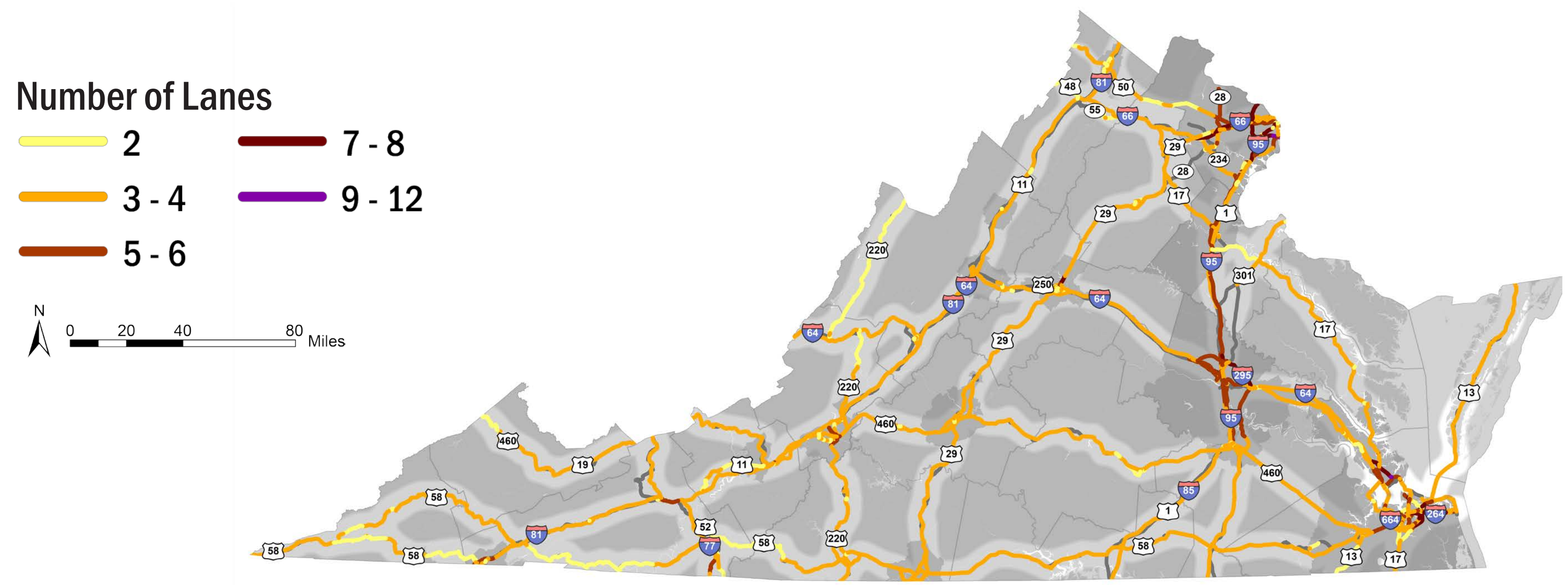
Segment L1 I-77, US 52

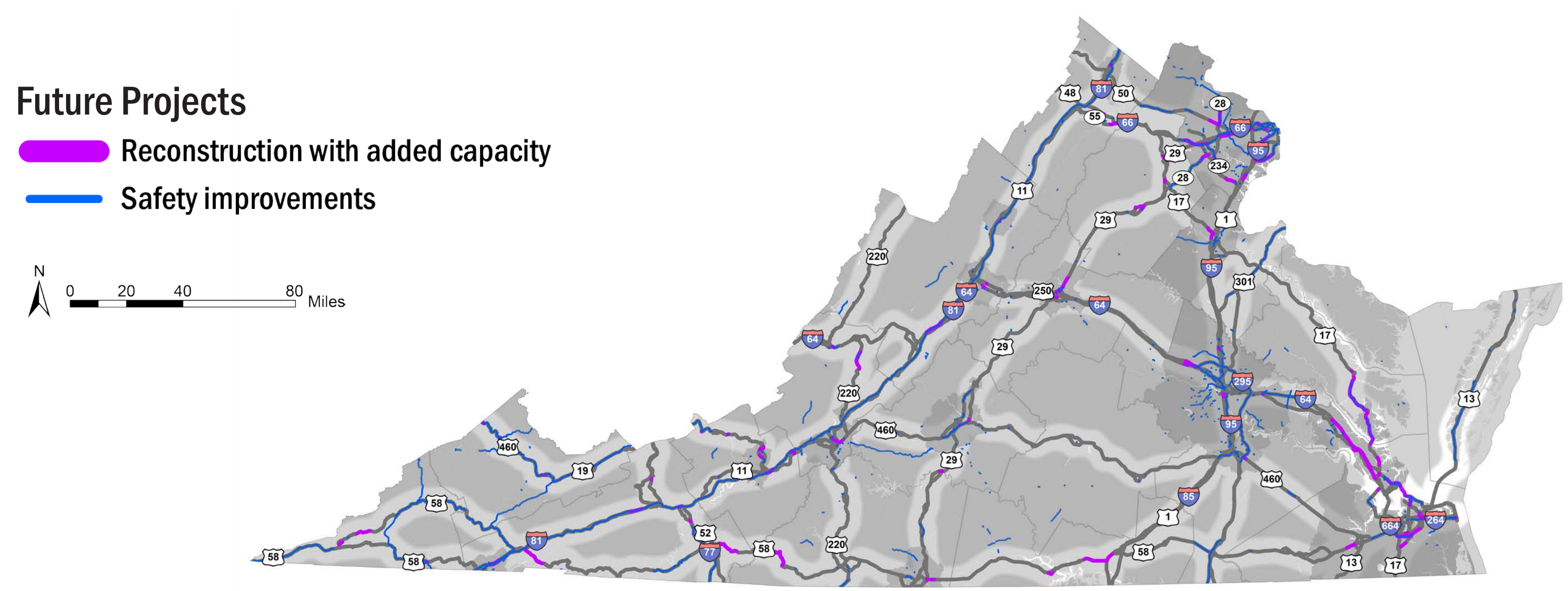
Segment L2 I-77, US 52 and US 11

Roadway Characteristics

The Virginia Department of Transportation (VDOT) provided data on the existing roadway facilities that have been identified as CoSS components. The map to the right shows the number of lanes (in both directions) in each CoSS component roadway facility in the Commonwealth. As shown, the widest roadways are located primarily in and near major urban areas.

The segment profiles also outline some of the significant planned safety or capacity improvements identified in VDOT's Six-Year Improvement Program, these locations are highlighted in the map to the right.





Demographics and Economic Trends

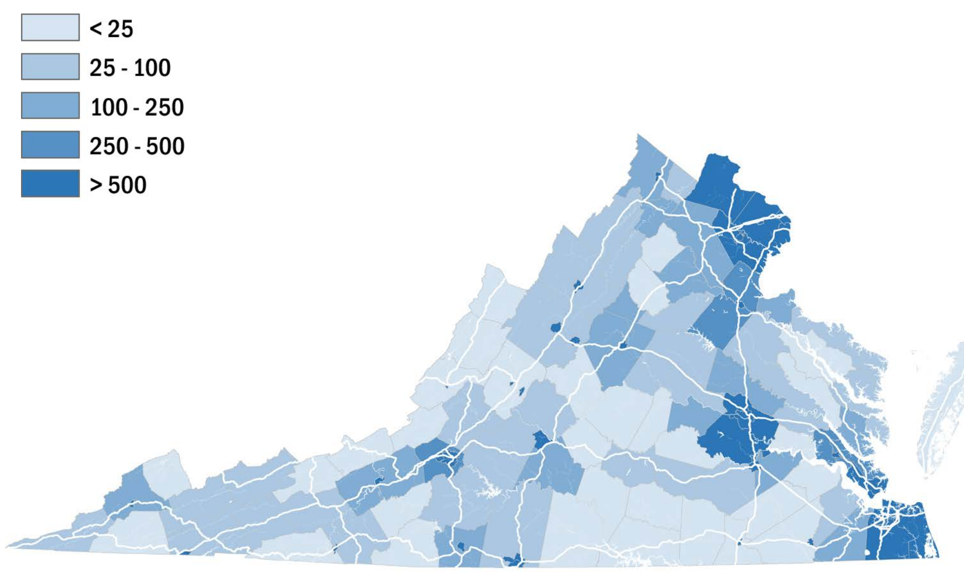
Population

Existing and future demographics are based on Intercensal Estimates from the Weldon Cooper Center for Public Service, Demographics Research Group. The data show a 2012 total population of 8,185,867 residents, and a 2025 total population of 9,203,977 residents, for a growth of approximately 12.4 percent. Projected growth varies significantly by jurisdiction, with the highest growth occurring near Fredericksburg (Stafford and Spotsylvania Counties show growth over 50 percent) while other counties are projected to decrease in population by 2025.

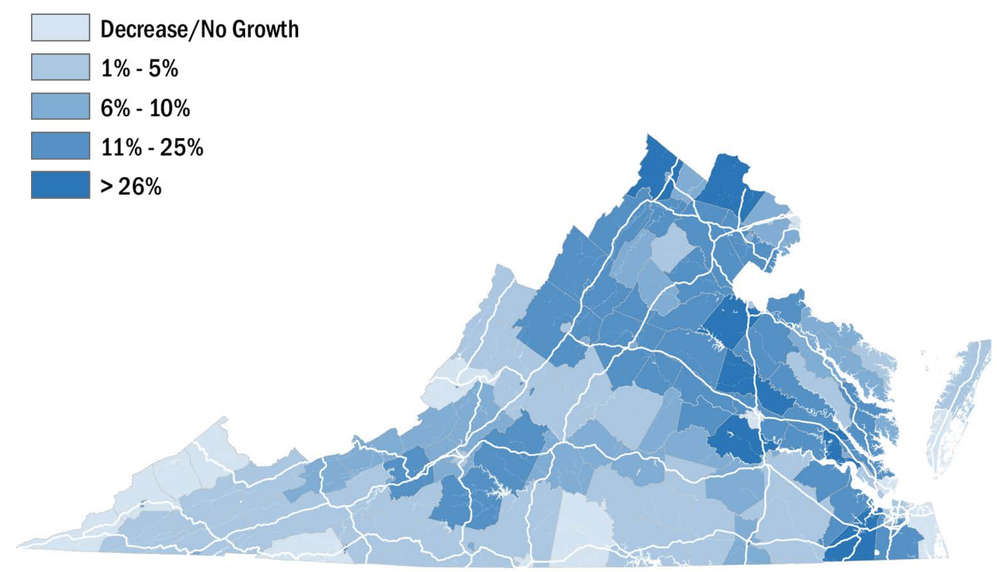
Employment

Existing and future employment data were developed based on national data available from IHS Global Insight. In 2012, the Commonwealth included approximately 3,787,000 jobs. By 2025, this number is forecast to increase by over 12 percent to a total of 4,246,000. As shown in the map, employment growth is projected to vary considerably across the Commonwealth - some jurisdictions are projected to lose jobs, while others are projected to grow by more than 50 percent. Additional details about demographic and economic trends in each of the regions of Virginia can be found in the appropriate Regional Networks Needs Assessment Reports.

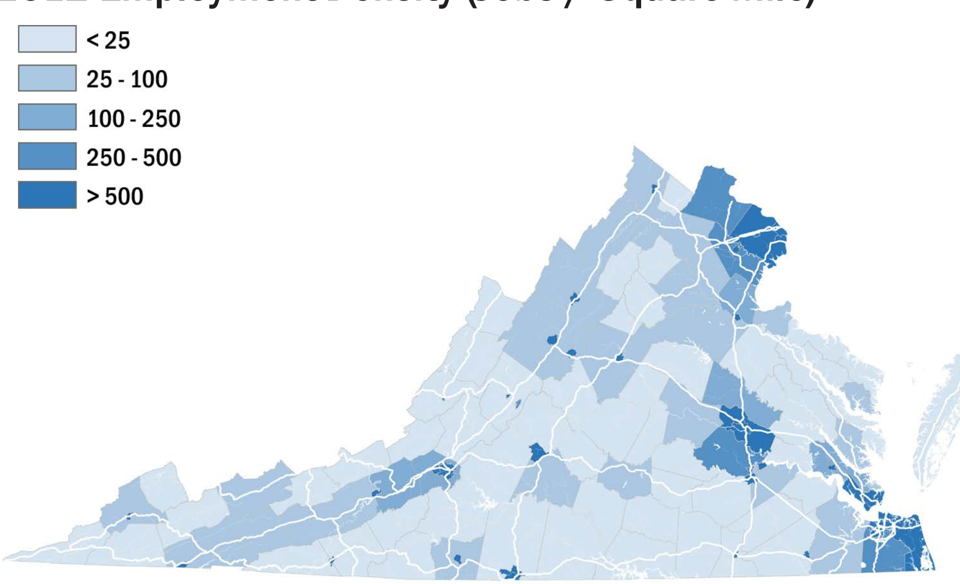
2012 Population Density (Persons / Square Mile)



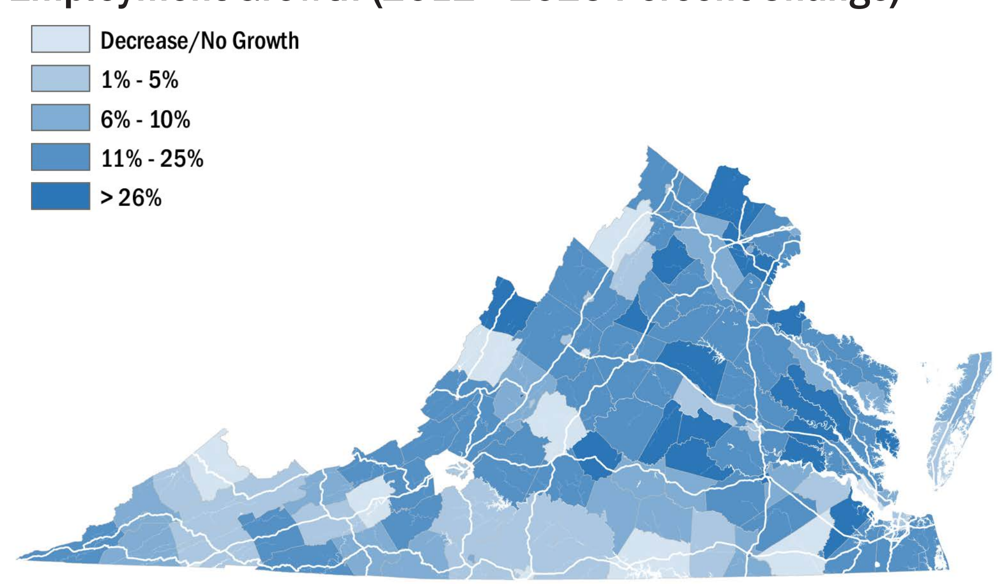
Population Growth (2012 - 2025 Percent Change)



2012 Employment Density (Jobs / Square Mile)



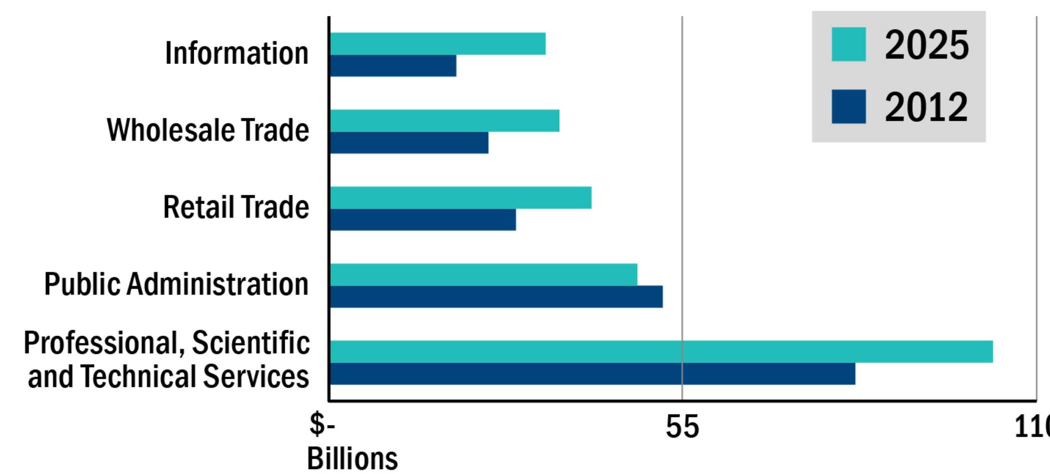
Employment Growth (2012 - 2025 Percent Change)



Economic Output

Economic Output is the total value of all goods and services produced in an economy within a given timeframe. It is a common indicator used in economic analysis to determine whether an economy is growing or contracting by comparing output during two different points in time. Unlike Gross Domestic Product, it includes the value of salaries. The total Economic Output of the Commonwealth is expected to increase by more than 31 percent between 2012 and 2025, representing a growth of almost $270 billion in annual economic output. The graph highlights the top five industries in the Commonwealth by their Economic Output based on data from IHS Global Insight. In 2012, Government was the largest single contributor to Virginia's Economic Output; however, by 2025, this industry will be overtaken by Profession, Scientific and Technical Services, Retail Trade, and Wholesale Trade. Additional data about individual regions can be found in the appropriate Regional Networks Needs Assessment Reports.

Top Five Industries in Virginia



Industry Clusters

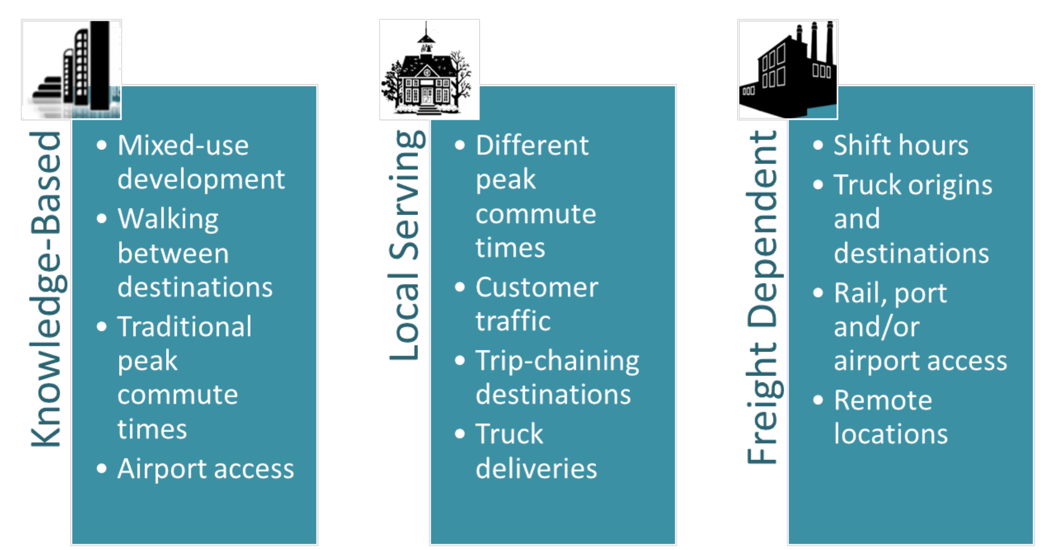
A framework to generally categorize core economic clusters is included as a meaningful and appropriate way to link economics and transportation for a statewide plan. The economic output by industry cluster for individual MPO areas along each corridor are detailed in each CoSS report.

The three industry clusters are:

- Knowledge-Based – those industries that tend to rely on skilled labor and serve a broader market than Virginia
- Local Serving – generally those industries that serve the local population
- Freight-Based – those industries for which the majority of industry output is dependent on freight transportation (also referred to as freight dependent)

Additional data about the industry clusters can be found in the appropriate Regional Networks Needs Assessment Reports.

Three Industry Clusters



Passenger Demand

Passenger demand for the VMTP Needs Assessment for the CoSS was focused on demand for intercity travel. The travel that occurs within cities and urban areas is covered primarily by the Needs Assessment developed for each of the Commonwealth's 15 Regional Networks. The analysis conducted for the CoSS is focused on identifying the current demand for intercity travel, and the locations where there may be significant overlap between that demand and more localized traffic. This analysis was developed based on a relatively new type of data, which quantifies demand based on location data collected from millions of mobile devices instead of relying on the more traditional methods of periodically surveying residents and drivers. This more accurate "big data" analysis captures a wider range of trips within the Commonwealth, including infrequent trips that might be overlooked by traditional survey methods. The dataset was collected and developed by StreetLightData based on personal travel in February, April, June, and September of 2014, with a focus on trips in Virginia and several of the surrounding states. It is important to note that through traffic for trips from further afield (i.e. Florida to Massachusetts) are not included in this dataset. Also, this dataset only provides relative demand, not an accurate total number of trips.

Quantifying Inter-City Travel

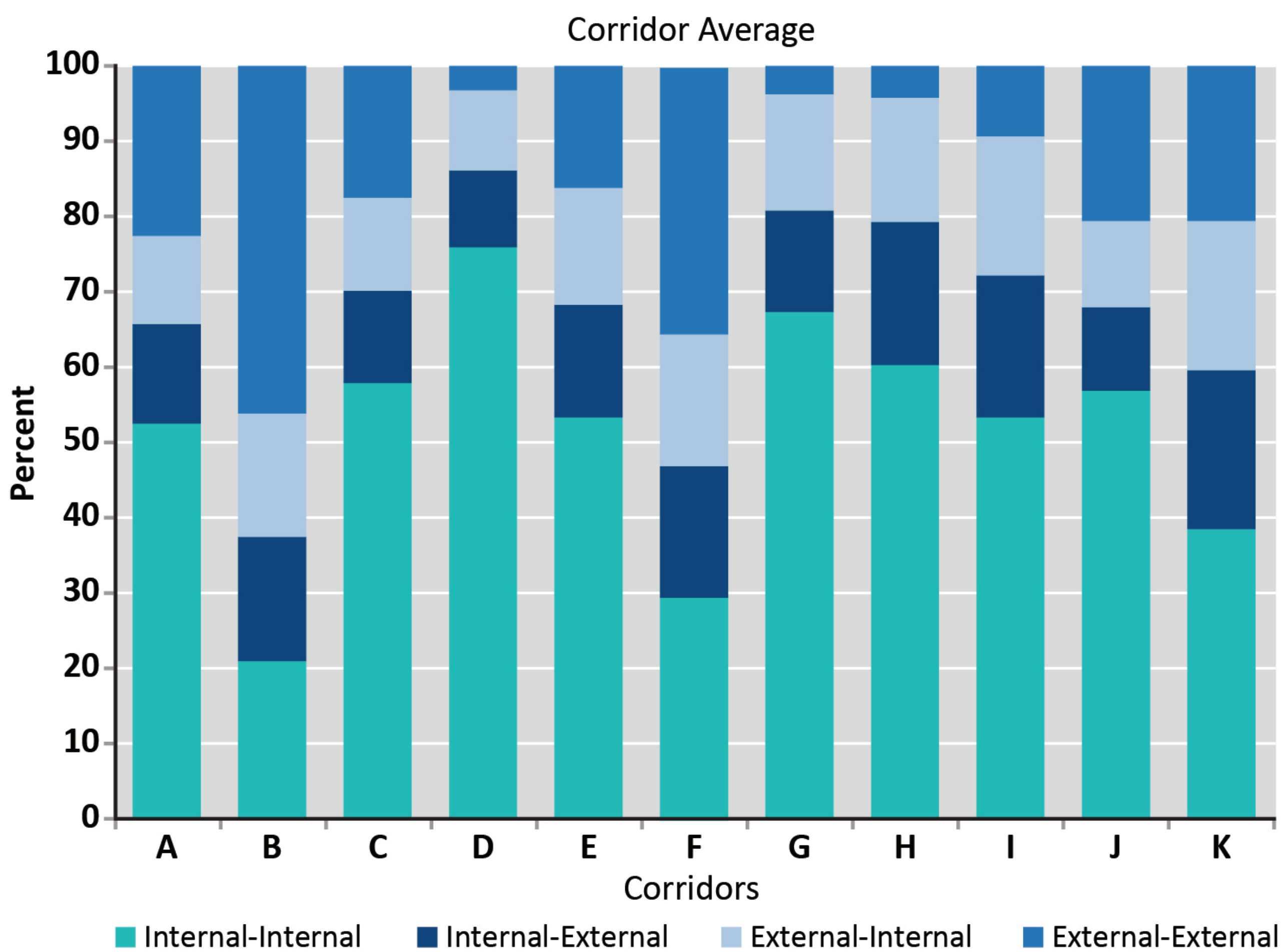
Personal travel demand data were aggregated to the MPO areas in Virginia to quantify the relative demand between each of Virginia's 15 major urban areas. This allowed for the identification of the highest demand origin-destination pairs within the Commonwealth, as shown in the trip table on this page. For the purposes of this analysis, the entire Metropolitan Washington Region was considered as a single urban area.

Based on this analysis, the highest demand origin-destination pairs in Virginia are all within the "urban crescent" and include:

- Fredericksburg Area – Metropolitan Washington Region: 17.6 percent of statewide passenger demand
- Tri-Cities Area – Richmond Area: 11.3 percent of statewide passenger demand
- Richmond Area – Hampton Roads Area: 9.3 percent of statewide passenger demand
- Richmond Area – Metropolitan Washington Region: six percent of statewide passenger demand
- Hampton Roads Area – North Carolina: 4.3 percent of statewide passenger demand
- Richmond Area – Fredericksburg Area: 4.2 percent of statewide passenger demand

Origin \ Destination	Metro Washington Region	Bristol Area	Danville Area	Hampton Roads Area	Central Virginia Area	Fredericks-burg Area	Kingsport Area	Harrisonburg-Rockingham Area	Richmond Area	Tri-Cities Area	Winchester -Frederick Area	Roanoke Valley Area	New River Valley Area	Staunton-Augusta-Waynesboro Area	Charlottesville-Albemarle Area	North Carolina	Tennessee	Kentucky	West Virginia	Maryland	Delware	Pennsyl-vania
Metropolitan Washington Region			0.01%	0.84%	0.11%	9.07%		0.28%	3.04%	0.38%	1.65%	0.05%	0.03%	0.14%	0.43%	0.25%	0.01%		1.89%			
Bristol Area	<0.01%				<0.01%		0.02%	0.01%	<0.01%		<0.01%	0.04%	0.01%	<0.01%		0.02%	0.84%	<0.01%	0.02%	0.01%		
Danville Area	0.01%			0.03%	0.18%	<0.01%		0.01%	0.03%	0.01%	<0.01%	0.08%	0.01%	0.01%	0.02%	0.30%	0.01%		<0.01%	<0.01%		<0.01%
Hampton Roads Area	0.86%		0.04%		0.05%	0.42%		0.04%	4.62%	0.62%	0.01%	0.02%	0.01%	0.07%	0.16%	2.20%	0.01%		0.02%	0.39%	0.09%	<0.01%
Central Virginia Area	0.11%	<0.01%	0.18%	0.06%		0.01%		0.07%	0.31%	0.04%	0.02%	0.69%	0.05%	0.11%	0.31%	0.15%	0.01%		0.04%	0.03%	<0.01%	<0.01%
Fredericksburg Area	8.52%		<0.01%	0.51%	0.02%			0.02%	2.18%	0.20%	0.10%	0.01%	0.01%	0.04%	0.19%	0.19%	<0.01%		0.05%	0.73%	0.04%	0.02%
Kingsport Area		0.02%														<0.01%	0.29%	0.01%	<0.01%			<0.01%
Harrisonburg-Rockingham Area	0.28%	<0.01%	0.01%	0.03%	0.07%	0.03%			0.15%	0.01%	0.15%	0.14%	0.03%	0.59%	0.15%	0.06%	0.03%		0.11%	0.13%	0.01%	0.04%
Richmond Area	3.04%	<0.01%	0.03%	4.66%	0.31%	1.97%		0.18%		5.65%	0.07%	0.14%	0.03%	0.32%	0.94%	0.76%	0.01%		0.05%	0.70%	0.04%	0.02%
Tri-Cities Area	0.32%		0.01%	0.68%	0.07%	0.17%		0.02%	5.63%		0.01%	0.02%	<0.01%	0.03%	0.03%	0.31%	<0.01%		0.01%	0.15%	0.03%	0.01%
Winchester-Frederick Area	1.46%	0.01%	<0.01%	0.02%	0.03%	0.07%		0.16%	0.09%	0.01%		0.05%	0.01%	0.08%	0.02%	0.03%	0.02%		0.38%	0.25%	0.01%	0.06%
Roanoke Valley Area	0.07%	0.02%	0.09%	0.03%	0.70%	<0.01%		0.16%	0.15%	0.01%	0.04%		1.03%	0.20%	0.05%	0.22%	0.05%	<0.01%	0.12%	0.02%	<0.01%	0.01%
New River Valley Area	0.01%	0.01%	0.01%	<0.01%	0.06%	0.01%		0.04%	0.03%		<0.01%	0.94%		0.05%	0.01%	0.06%	0.02%		0.06%	0.01%		<0.01%
Staunton-Augusta-Waynesboro Area	0.15%		0.01%	0.07%	0.10%	0.03%		0.62%	0.36%	0.02%	0.06%	0.19%	0.05%		0.90%	0.05%	0.01%		0.05%	0.04%	<0.01%	0.01%
Charlottesville-Albemarle Area	0.46%		0.02%	0.12%	0.27%	0.16%		0.20%	0.84%	0.03%	0.01%	0.08%	0.02%	0.92%		0.04%	<0.01%		0.03%	0.04%	<0.01%	<0.01%
North Carolina	0.28%	0.01%	0.29%	2.13%	0.16%	0.14%	0.01%	0.05%	0.67%	0.29%	0.03%	0.26%	0.07%	0.05%	0.04%			<0.01%	0.05%	0.19%	0.04%	0.02%
Tennessee	0.02%	0.87%	<0.01%	<0.01%	<0.01%	<0.01%	0.31%	0.02%	0.02%	<0.01%	<0.01%	0.04%	0.01%	0.01%	<0.01%			0.04%	0.02%	0.02%		0.01%
Kentucky		<0.01%					0.02%					0.01%				<0.01%	0.04%					
West Virginia	1.73%	0.01%	<0.01%	0.01%	0.03%	0.05%	<0.01%	0.11%	0.07%	0.02%	0.41%	0.13%	0.06%	0.05%	0.02%	0.04%	0.02%			0.60%	0.01%	0.04%
Maryland		<0.01%	0.01%	0.38%	0.05%	0.74%		0.12%	0.71%	0.14%	0.28%	0.02%	0.01%	0.05%	0.06%	0.17%	0.01%	<0.01%	0.65%			
Delware			<0.01%	0.13%	0.01%	0.06%		0.01%	0.05%	0.03%	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.04%	<0.01%		0.01%			
Pennsylvania				<0.01%	0.01%	0.01%		0.05%	0.02%	<0.01%	0.06%	0.01%	<0.01%	0.01%	<0.01%	0.01%	0.01%		0.04%			

Internal and External Passenger Demand



Together, these six origin-destination pairs account for more than half of the total intercity passenger demand in Virginia. The individual CoSS reports provide analysis of the major destinations for travel originating in each of the MPO areas, particularly highlighting the portion of that passenger demand that might use each of the CoSS segments.

Intercity and Local Traffic

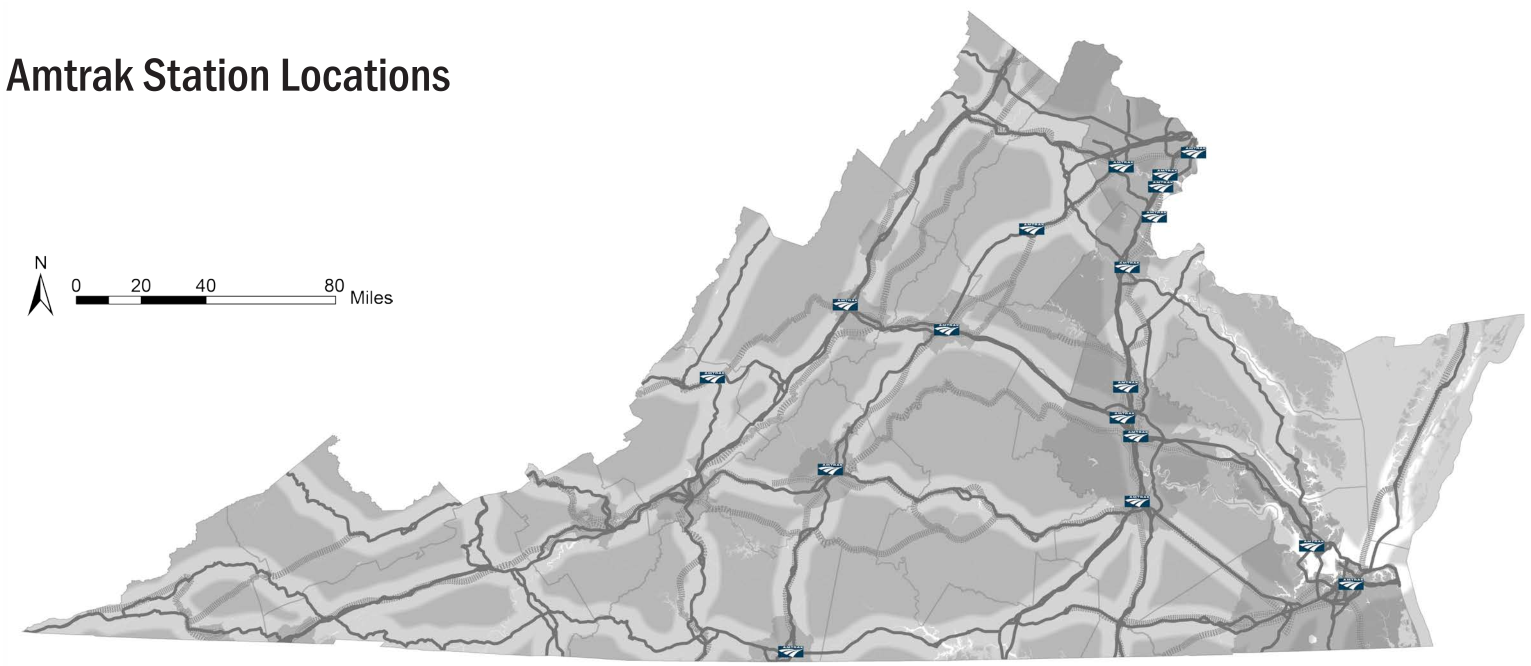
The majority of the CoSS pass through major urban areas at some point along their length. At these locations, intercity traffic is likely to conflict with local traffic, especially during peak periods and in areas with high levels of congestion. The same StreetLight data were used to analyze the traffic on the CoSS component roadways within the urban areas to determine the relative proportions of intercity and local traffic served by the facilities.

Traffic on the CoSS component facilities was divided into four categories:

- Internal-Internal: local trips with both start and end point inside the MPO Area
- Internal-External: trips with a starting point in the MPO Area, but destined for somewhere outside the MPO Area
- External-Internal: trips starting outside the MPO Area and destined for the MPO Area
- External-External: through trips with neither start nor end point in the MPO Area

Of these four categories, only the last is strictly through traffic which passes through the MPO area solely because it represents the shortest path to the ultimate destination. The individual CoSS reports provide analysis of the types of traffic found on the CoSS component roadways in each MPO area. Generally speaking, roadways in the larger MPO areas (such as the Hampton Roads Area and Northern Virginia) carry a larger proportion of local traffic. In addition, Interstates tend to carry more through traffic than other types of facilities. The graph below shows the category averages for each CoSS, and includes traffic in all of the MPO Areas along a CoSS (Western Mountain Corridor (Corridor L) is not included because it does not pass through any MPO Areas). As shown, Crescent Corridor (Corridor B) and North Carolina to West Virginia Corridor (Corridor F) include the highest portion of through traffic.

Amtrak Station Locations



Amtrak Station Annual Boardings, 2014

Station	Annual Boardings + Alightings
Alexandria	180,409
Ashland	27,977
Burke Centre	5,535
Charlottesville	132,410
Clifton Forge	2,432
Culpeper	14,257
Danville	7,741
Fredericksburg	111,999
Lorton	274,445
Lynchburg	86,302
Manassas	29,104
Newport News	112,661
Norfolk	41,843
Ettrick (Petersburg)	29,383
Quantico	36,976
Richmond Main Street	40,834
Richmond Staples Mill	358,615
Staunton	6,823
Williamsburg	61,074
Woodbridge	29,418
Total Virginia Station Usage	**1,590,238**

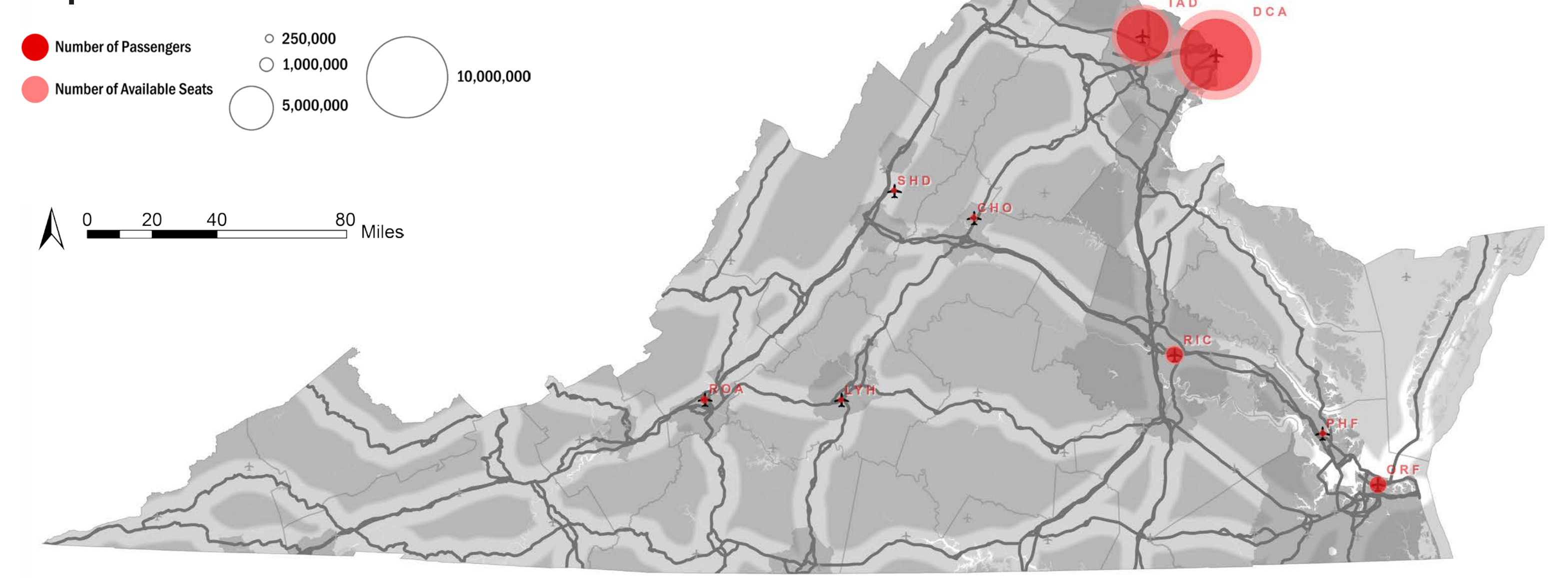
Rail Passenger Demand

Annual passenger rail demand at Amtrak stations throughout the Commonwealth is shown in the table below. These values represent annual boardings, by station, in 2014. As indicated, the top five stations account for approximately two-thirds of the passenger rail boardings and alightings in Virginia.

Airport Passenger Demand

Passenger data for Virginia airports are based on the number of boardings (enplanements) at each airport, as well as the available number of seats for flights originating at each airport, as reported in the United States Department of Transportation's T100 Domestic Segment dataset for 2014. According to this data, there were 17.6 million boardings, out of a total 22.1 million available seats, at Virginia's commercial service airports. Ronald Reagan Washington National Airport serves nearly half of the air passengers in the Commonwealth and has the largest number of available seats. Four out of every five passengers using airports in Virginia utilize either Dulles International Airport or Ronald Reagan Washington National Airport; four out of every five available seats on flights from Virginia are provided at these two airports, as well.

Airport Demand



Freight Demand

Rail Freight Origin-Destination Pairs

		Destination: Virginia	Destination: Other States
Origin	Virginia	14% / 13%	10% / 10%
Origin	Other States	47% / 46%	30% / 32%

Percentages represent 2012 / 2025 values.

		2012		2025	
Corridor	Corridor Name	Tonnage (in millions)	Value (in Billions)	Tonnage (in millions)	Value (in Billions)
A	Coastal Corridor (US 17)	--	--	--	--
B	Crescent Corridor (I-81)	70	$47	78	$61
C	East-West Corridor (I-64)	44	$5	46	$7
D	Eastern Shore Corridor (US 13)	23	$14	23	$17
E	Heartland Corridor (US 460)	62	$47	70	$61
F	North Carolina to WV Corridor (US 220)	3	$1	3	$1
G	North-South Corridor (VA 234)	--	--	--	--
H	North Virginia Corridor (I-66)	1	$1	1	$2
I	Seminole Corridor (US 29)	53	$39	63	$51
J	Southside Corridor (US 58)	34	$26	36	$32
K	Washington to NC Corridor (I-95)	53	$25	59	$32
L	Western Mountain Corridor (I-77)	--	--	--	--

Truck Freight Origin-Destination Pairs

		Destination: Virginia	Destination: Other States
Origin	Virginia	10% / 10%	21% / 21%
Origin	Other States	23% / 24%	46% / 45%

Percentages represent 2012 / 2025 values.

		2012		2025	
Corridor	Corridor Name	Tonnage (in millions)	Value (in Billions)	Tonnage (in millions)	Value (in Billions)
A	Coastal Corridor (US 17)	119	$181	163	$265
B	Crescent Corridor (I-81)	160	$264	213	$383
C	East-West Corridor (I-64)	149	$246	208	$393
D	Eastern Shore Corridor (US 13)	34	$51	51	$80
E	Heartland Corridor (US 460)	80	$89	108	$130
F	North Carolina to WV Corridor (US 220)	85	$163	113	$262
G	North-South Corridor (VA 234)	4	$2	5	$4
H	North Virginia Corridor (I-66)	26	$30	34	$45
I	Seminole Corridor (US 29)	33	$32	42	$45
J	Southside Corridor (US 58)	92	$147	125	$226
K	Washington to NC Corridor (I-95)	122	$172	170	$252
L	Western Mountain Corridor (I-77)	117	$225	158	$334

Truck and Rail Freight

Truck and rail freight travel demand for Virginia's highways and railroads were obtained from IHS Transearch data from 2012 and 2025. Freight flows between jurisdictions were assigned to specific corridors using the Transearch network (for truck freight) and the ORNL network (for rail freight). These assignments included 12 corridors with truck facilities and nine corridors with freight rail facilities. Freight traveling along a particular corridor for any leg of its trip is counted toward the total corridor tonnage and value; freight value and tonnage can therefore be included in multiple categories. For this analysis, freight flows were summarized by state outside of Virginia and by County/City within the Commonwealth. Based on these summaries, a number of important statistics were calculated including the total amount of freight on a corridor (by value and tonnage), the average value per ton, and the amount of freight with an origin or destination along each Corridor segment. In addition, this analysis identified the major origins, destinations, and origin-destination pairs for freight on each Corridor segment.

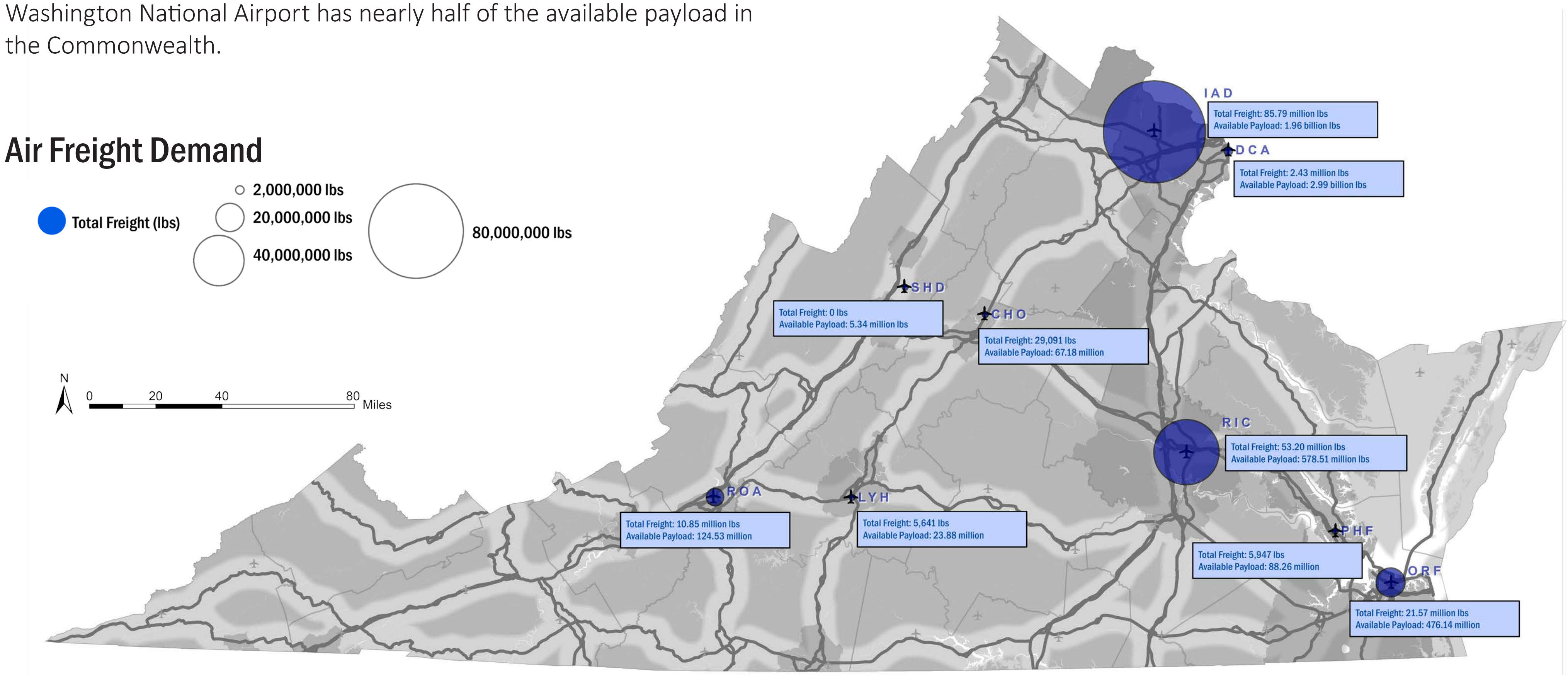
More than 1.3 billion tons of freight worth over $1.8 trillion was transported along the CoSS in 2012. The vast majority of this freight is carried by truck (89 percent by value and 74 percent by tonnage). By 2025, these totals are expected to increase to almost 1.8 billion tons worth $2.7 trillion, representing increases of 28 and 50 percent, respectively. The proportion to be carried by truck is forecast to be even higher in 2025 than under the current conditions. On average, truck freight is 2.5 times more valuable per ton than rail freight. The Crescent Corridor (Corridor B) carries the largest amount of freight by both rail and truck, although truck freight is forecast to increase to similar levels on the East-West Corridor (Corridor C) by 2025.

A large portion of both rail and truck freight is through traffic, with both its origin and destination in another state. This represents almost one-third of rail freight and almost half of truck freight traveling on the CoSS. Rail freight also includes a large portion of freight destined for Virginia, led particularly by freight destined for the port facilities in the Cities of Norfolk, Newport News, and Chesapeake. The only Virginia jurisdiction that produces a significant portion of rail freight on the CoSS is Wise County, a coal producing area.

Air Freight

Freight data for Virginia airports include freight and mail tonnage originating at each airport, as well as the available payload for trips originating at each airport, as reported in the United States Department of Transportation's T100 Domestic Segment dataset for 2014. According to this data, there are 173.9 million pounds of freight, including mail, departing from Virginia's commercial service airports, utilizing 6.3 billion pounds of available payload. Nearly half of the air freight in Virginia passes through Dulles International Airport, while Ronald Reagan Washington National Airport has nearly half of the available payload in the Commonwealth.

Air Freight Demand



Port Freight

According to the Virginia Port Authority, The Port of Virginia handled 67.3 million tons of cargo worth $71.5 billion in 2014 . This cargo passes through one of six facilities: the Newport News Marine Terminal, the Norfolk International Terminals, the Portsmouth Marine Terminals, the Virginia International Gateway, the Port of Richmond, and the Virginia Inland Port. Approximately two-thirds of the freight passing through The Port of Virginia travels by truck, with approximately one-third of freight traveling by rail.

Traffic Conditions

Traffic Volume and AADT

In 2014, there were approximately 15.5 billion vehicle miles traveled (VMT) on the CoSS component roadways on an average weekday. By 2025, VDOT predicts that this number will increase by approximately 14 percent to over 17.6 billion VMT daily. As shown, The Washington to North Carolina Corridor (Corridor K) has the highest existing and future VMT and accounts for over one-third of the CoSS VMT in Virginia. While the highest total growth in VMT is forecast to occur on Corridor K, the highest percentage growth is forecast to occur on the North-South Corridor (Corridor G); this percentage growth is indicative of the fact that construction of primary facilities in Corridor G has not yet been completed. As shown on the Change in Traffic Volume map, the largest increases in traffic volume are forecast to occur near the urban areas.

VDOT also provided data regarding the percentage of heavy truck traffic on CoSS facilities throughout the Commonwealth. As shown on the Percent Trucks map, the highest percentages of truck traffic occur primarily in the western portions of the state, especially along Corridor K and the Western Mountain Corridor (Corridor L).

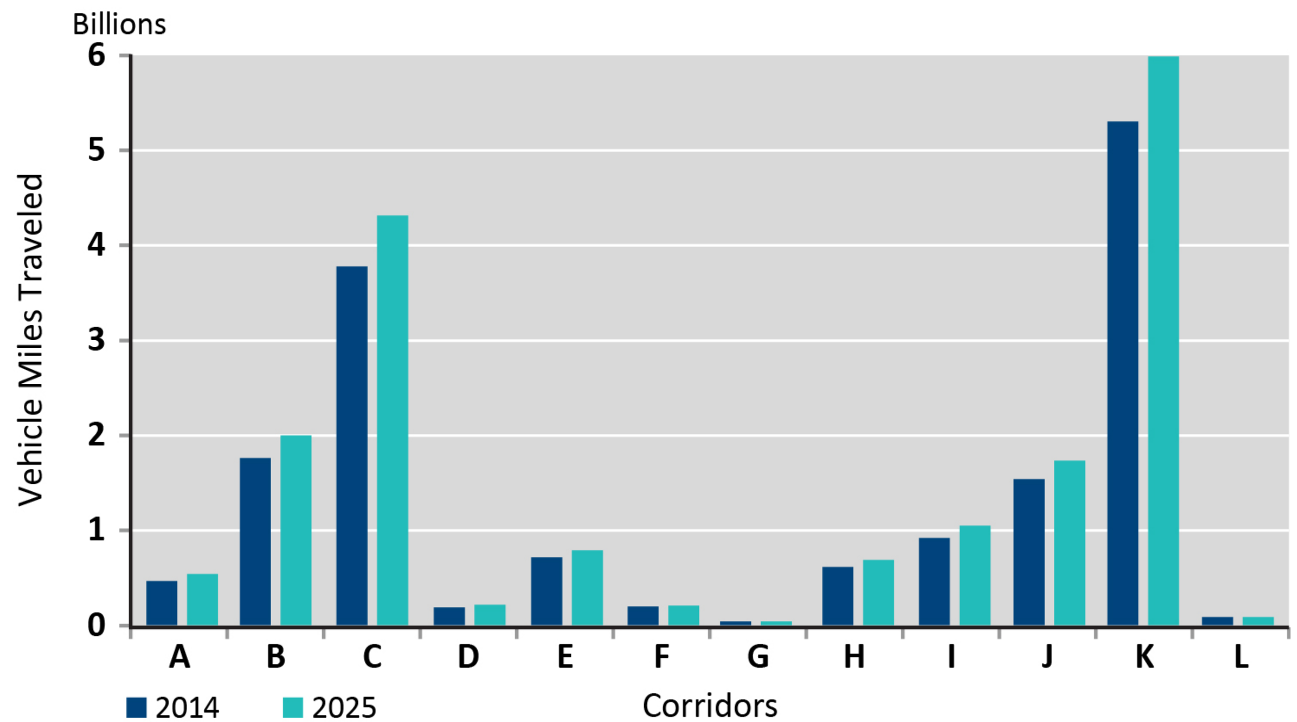
Traffic Distribution

Detailed traffic counts from VDOT's Traffic Monitoring System (TMS) of continuous traffic counting stations were provided for the year 2014. The TMS counts provide 15-minute traffic counts on major roadway facilities throughout the year. The counts from TMS stations on the CoSS component roadways (198 count stations) were used for analysis and each station had counts for at least 200 days in the year 2014. These count stations were each assigned to a CoSS segment, and profiles of traffic levels – both for all traffic and heavy truck traffic – were produced. Two types of profiles were developed and analyzed for each segment: a time of day distribution which identified peaking periods throughout an average day, and a monthly profile which identified peak periods throughout the year.

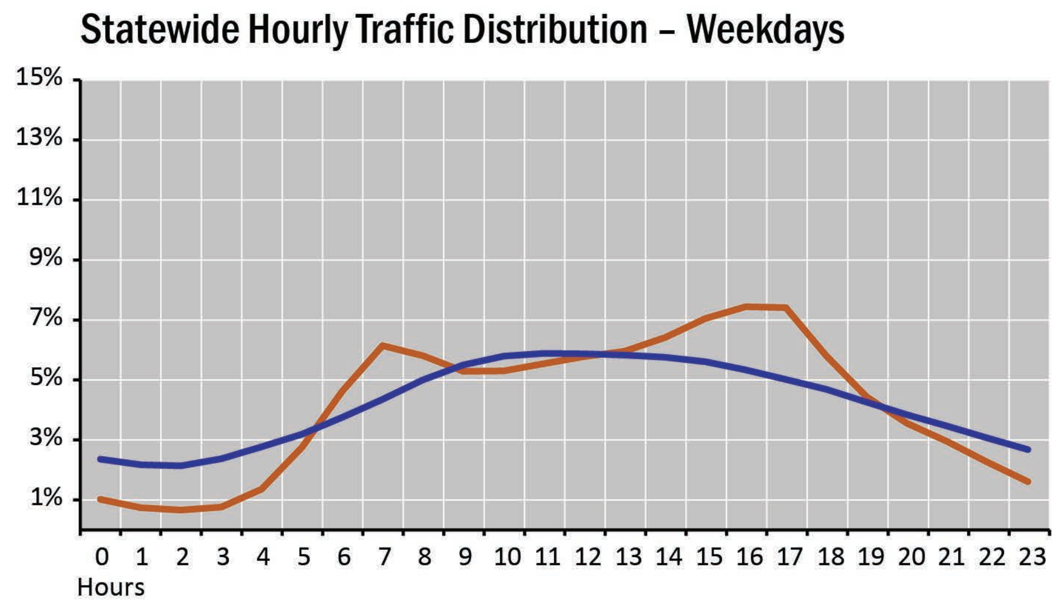
The statewide averages of these profiles are highlighted in the graphs. Weekday traffic in the state shows two distinct peak periods: an evening peak beginning at 4 p.m. and a less-busy morning peak beginning at 7 a.m. While this pattern was observed in many CoSS segments, it was not true in all areas, especially in those that included high levels of truck traffic and/or were located far from a major urban area. Truck traffic on average and throughout the state tended to show a single midday peak; on average, the peak hour for weekday truck traffic in Virginia begins at 10 a.m. Weekend traffic for both general traffic and trucks shows a single midday peak, and often has very stable levels throughout the afternoon hours. On the weekends, truck traffic tends to peak earlier in the day than general traffic.

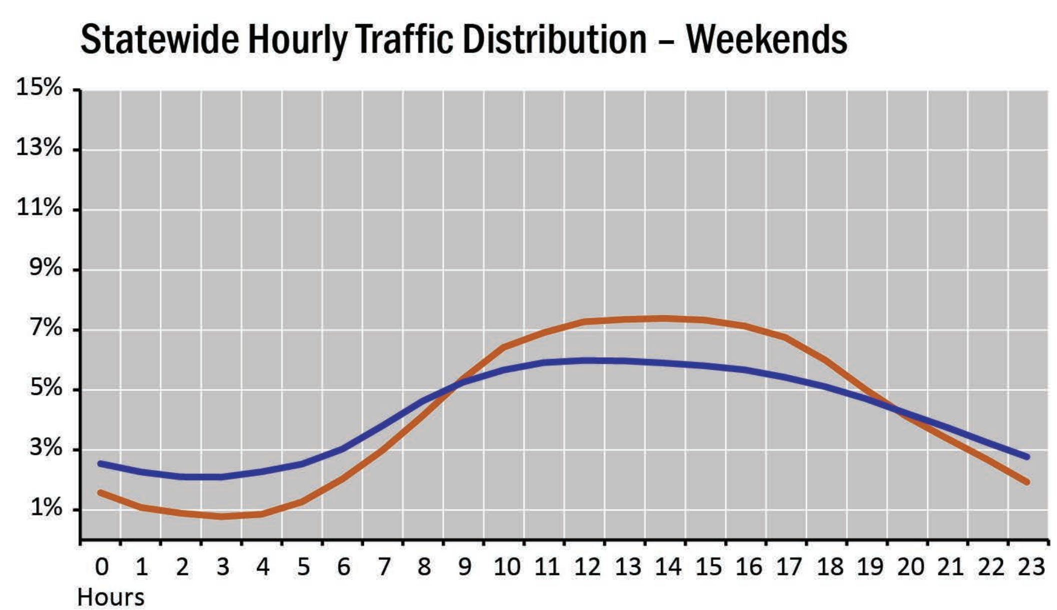
On average, weekday traffic varies by as much as 29 percent throughout the year. The high point for general traffic generally occurs during the summer, with August being the highest traffic month on average. Throughout the Commonwealth, traffic tends to be at its lowest levels in January. Truck traffic tends to vary somewhat less than general traffic with a high point in the summer (June is the highest month on average), and the lowest volumes in January. Weekend traffic follows similar peaking patterns across the year, with a summer high point (June, on average) and a January low. Weekend truck traffic is somewhat less predictable, with an average variation of 24 percent between the peak in June and the low point in July.

Traffic Volume

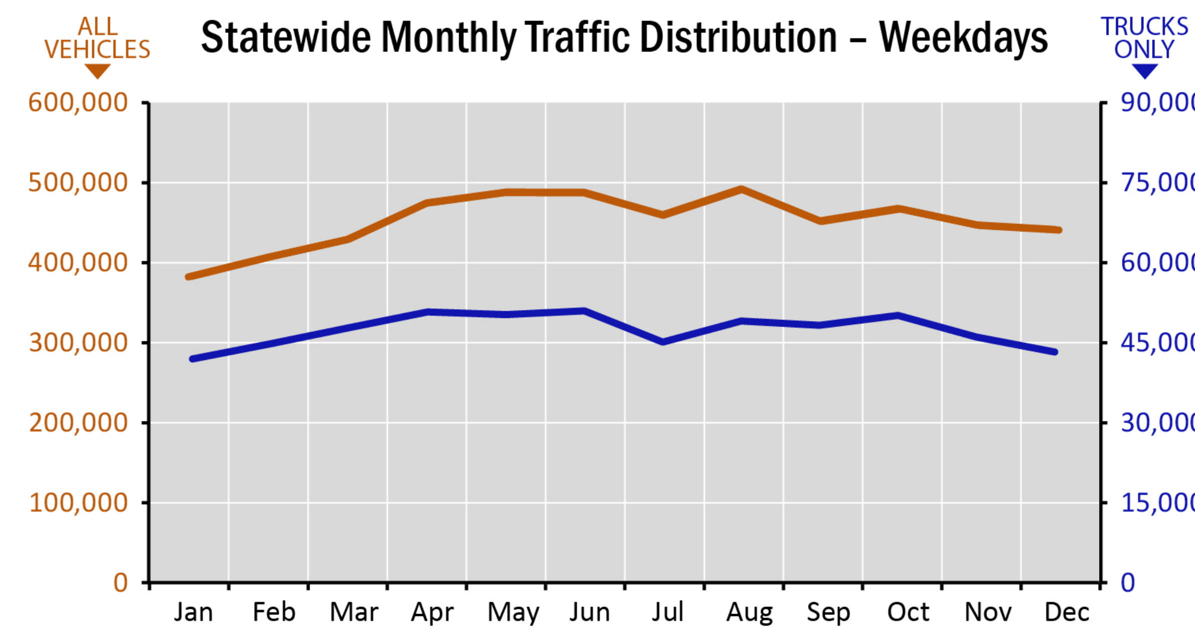


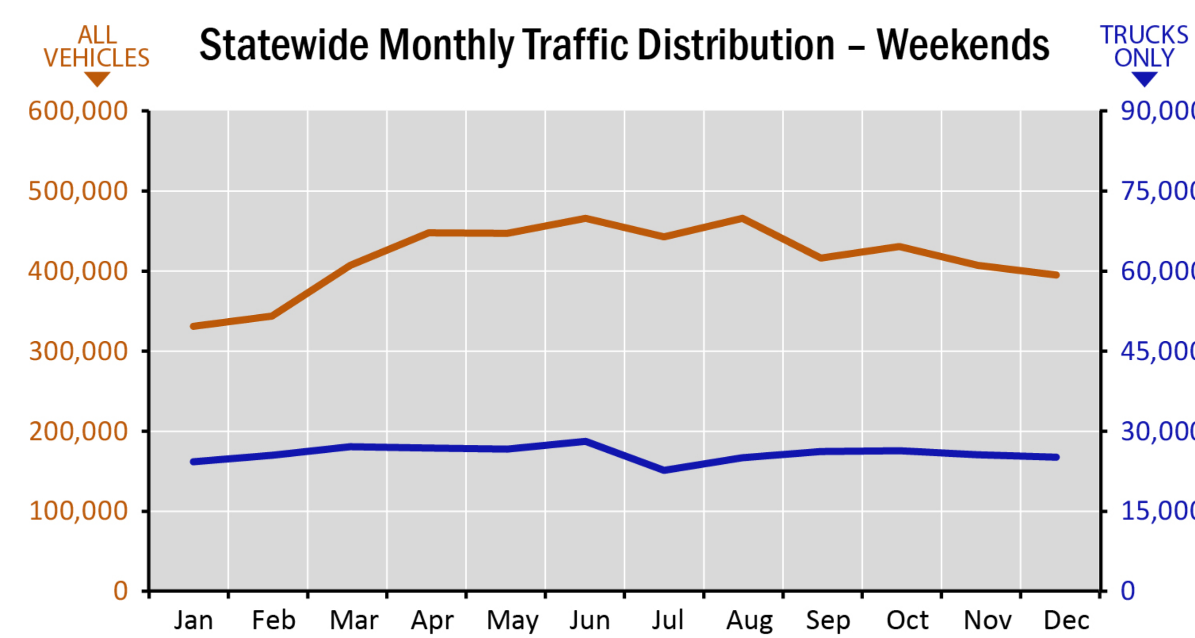
Time of Day Traffic Distribution



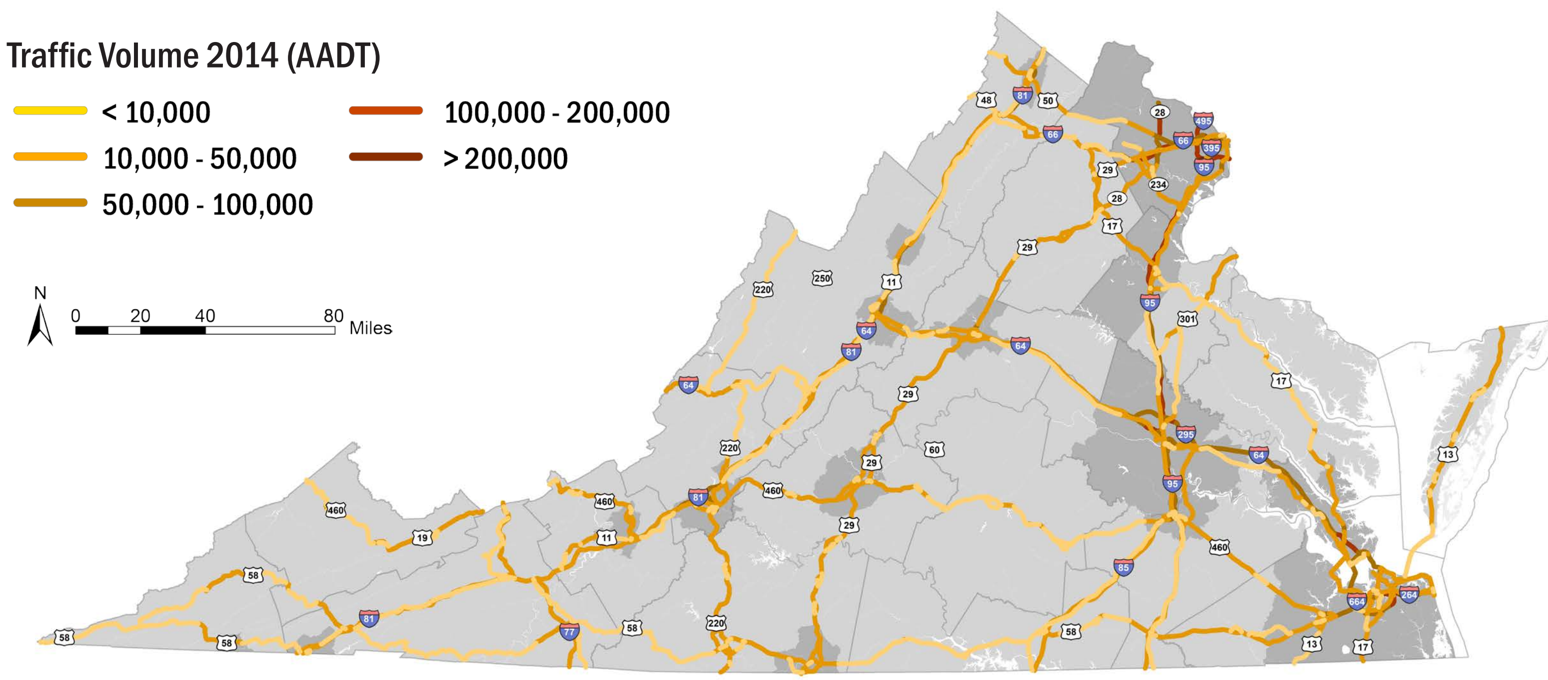


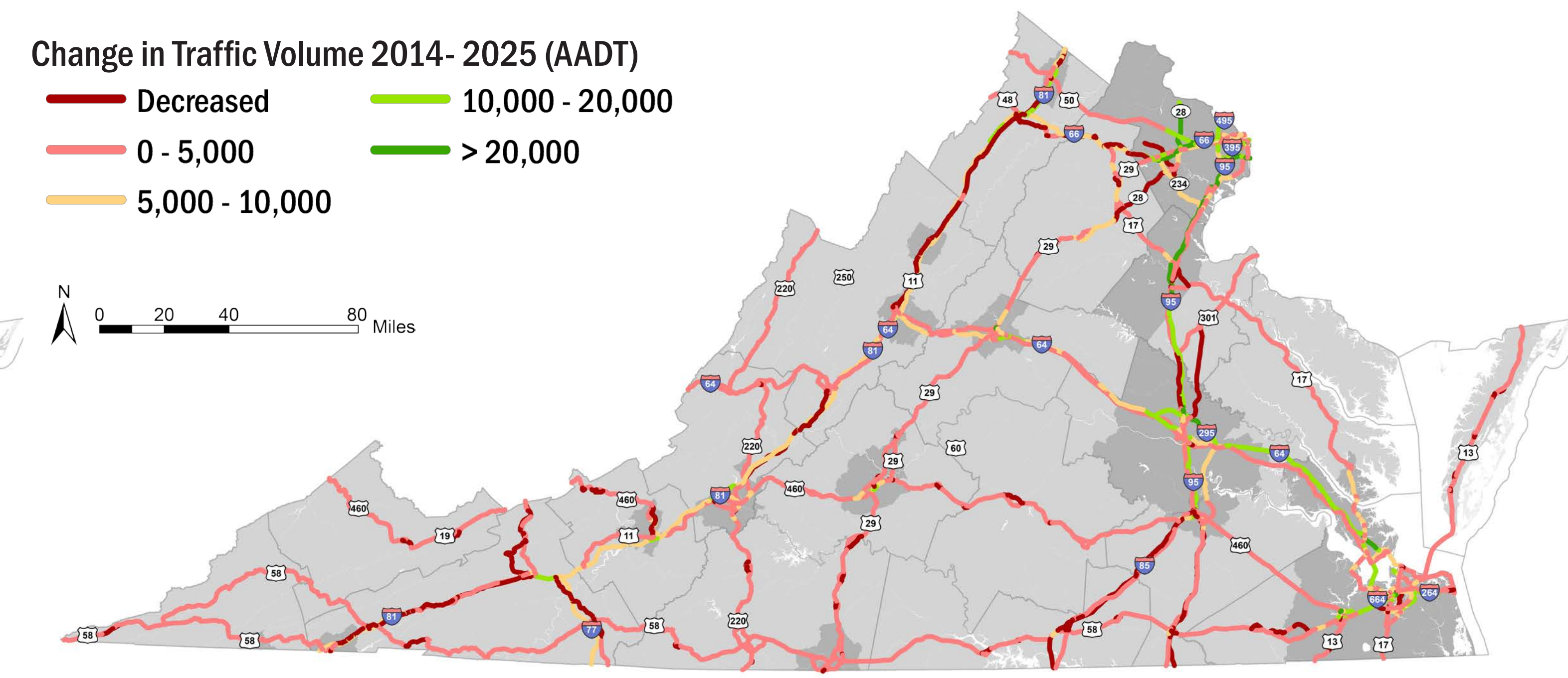
Monthly Traffic Distribution

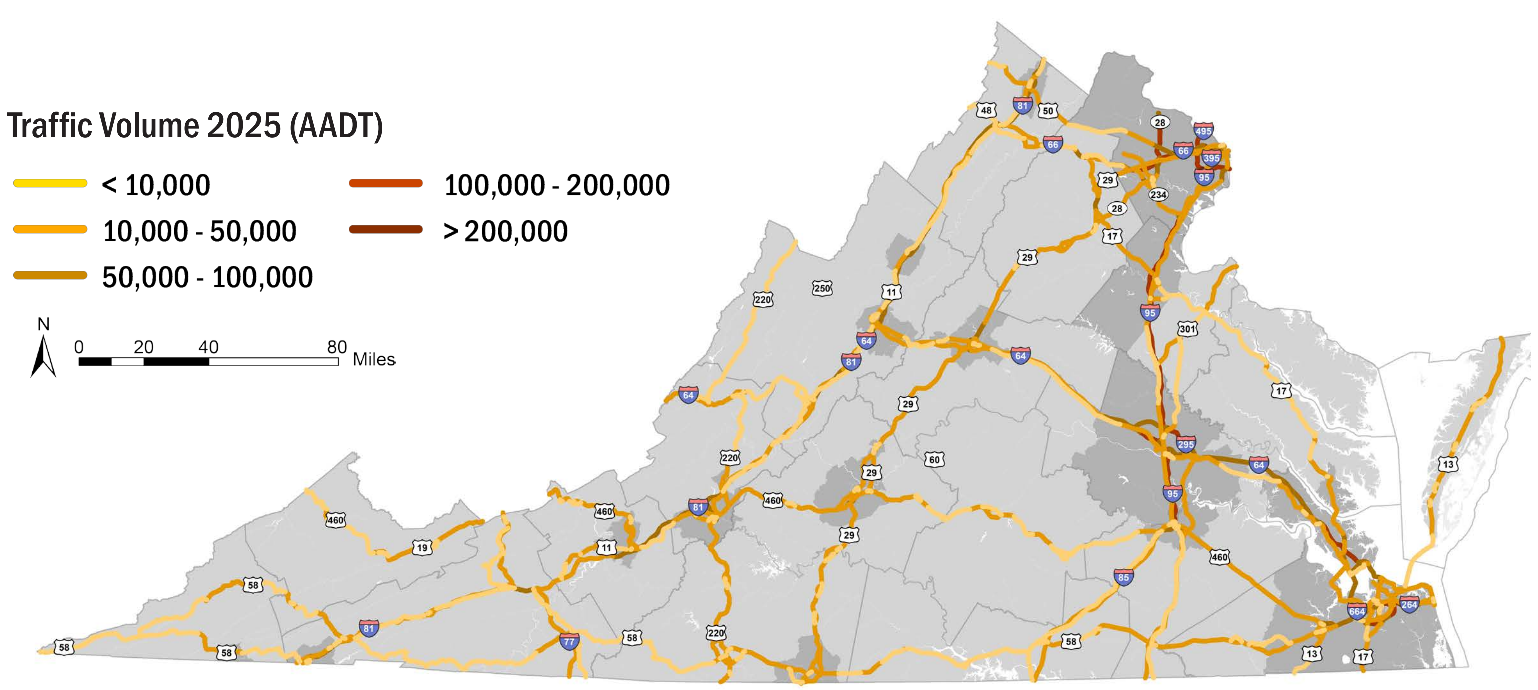


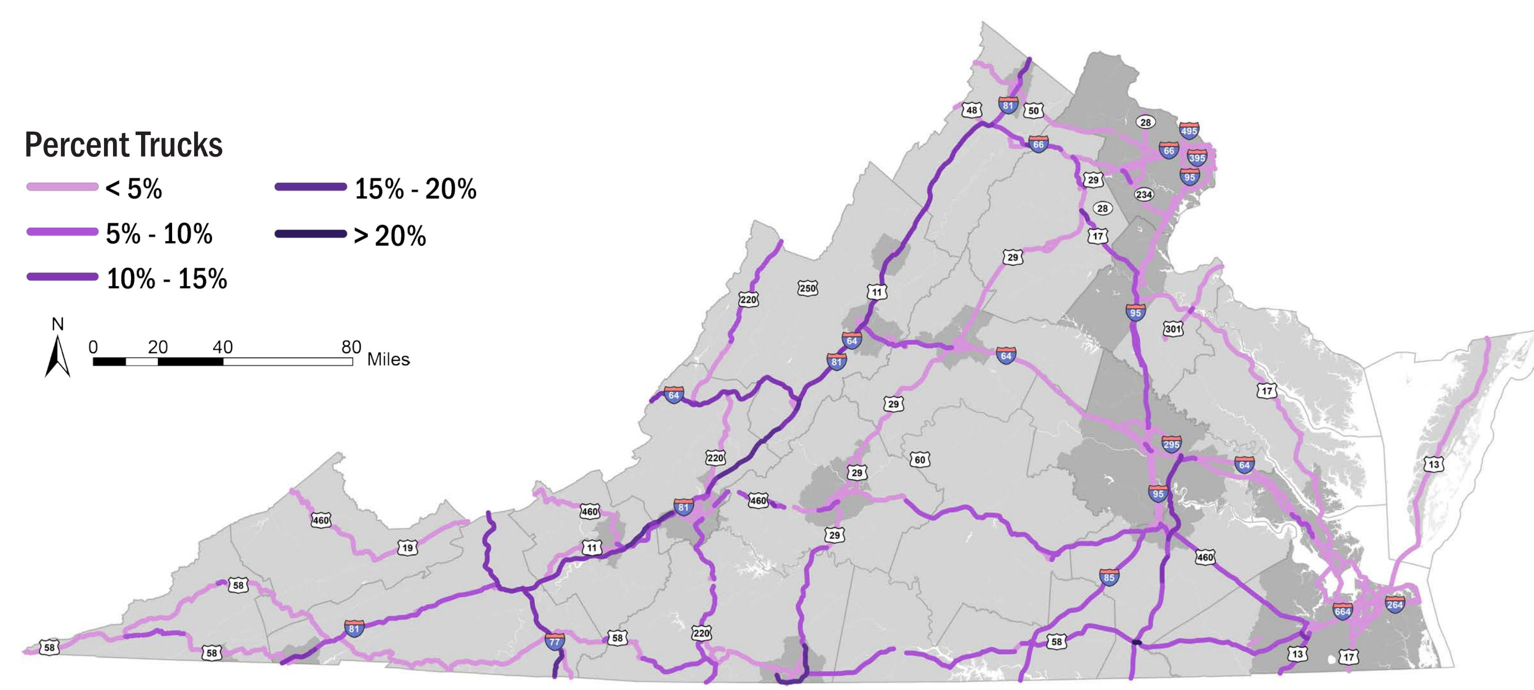


METHODOLOGY, DATA SOURCES, AND PROFILES









Redundancy and Mode Choice Needs

Redundancy

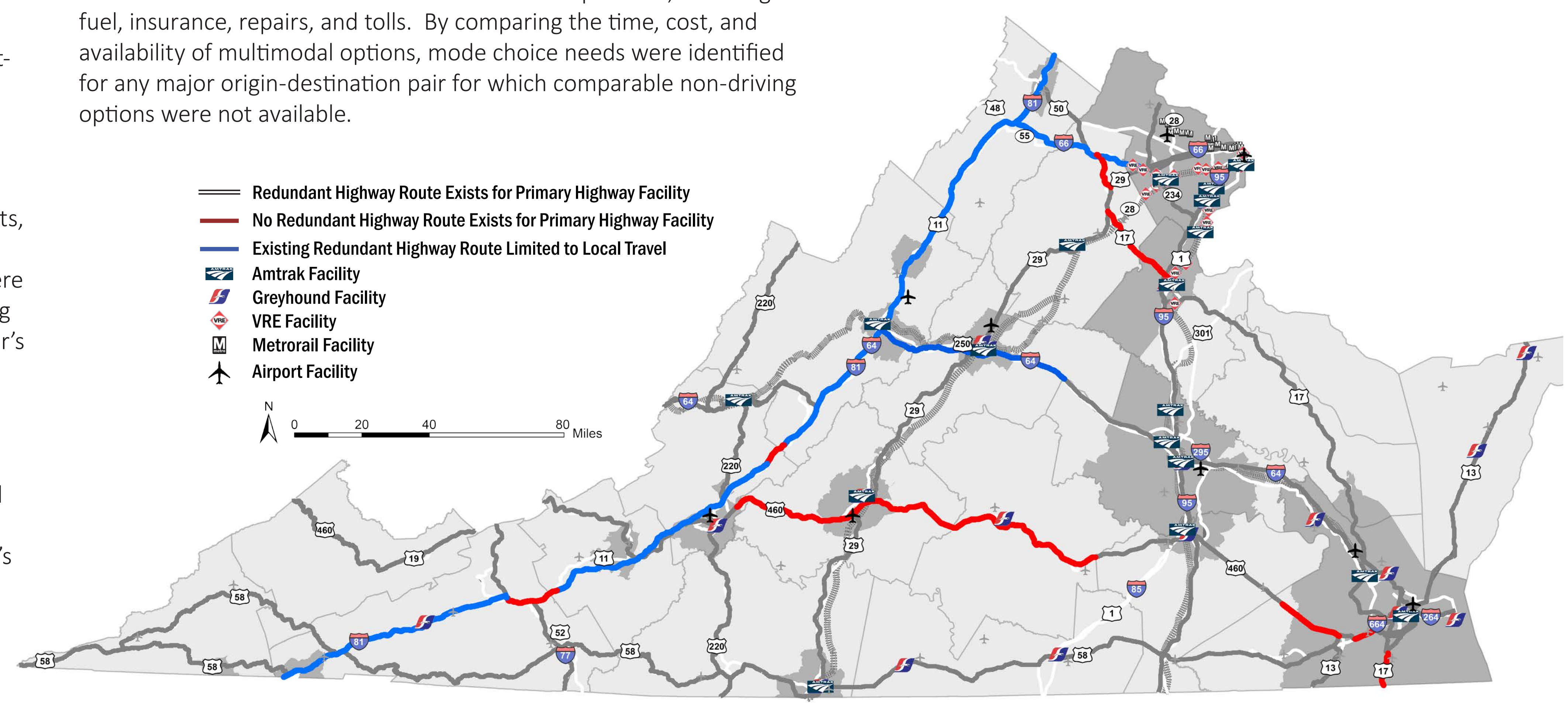
Needs for redundant paths were identified between major centers of activity based on the level of demand between each origin-destination pair. Any origin-destination pair that accounts for at least one percent of the inter-city passenger travel (bi-directional) in the Commonwealth (as shown on Page 8) was identified as having high enough statewide demand to consider a redundant highway path as a need. Those segments that met this demand threshold and did not already have a redundant highway path were identified as having a need in this category. In some cases, a parallel route did exist, but did not provide comparable travel times to the primary route or served significantly more local travel than intercity travel making the route unlikely to support significant intercity travel. In these cases, availability of a redundant path was noted as limited to local travel or use as a short-distance detour for incidents causing temporary congestion on the primary route.

Mode Choice

Available mode choice was compared through travel times, fare costs, and frequency of intercity bus, train, and air service for the major origin-destination pairs served by each segment. These services were compared to a similar automobile trip using the same segment along the primary route and, where available, a similar trip using a corridor's parallel facility. Travel times, fare costs, and service frequency for intercity bus and train service were obtained through the online booking websites offered by Megabus, Greyhound, and Amtrak, as well as the websites of transit services operating commuter buses between major activity centers. While these bus services were used as a sample dataset, this measure does not include all long-haul bus services offered in Virginia. This dataset is representative of Virginia's long-haul bus services, but may not be fully accurate for any given time or location due to the variability in services offered. Travel times, fare costs, and service frequency for air travel was based on a one-way trip and obtained through the travel search engine Kayak in June 2015. For intercity bus, train, and air service, all sample trips were based on the same day, Wednesday, August 19, 2015. Travel times for automobiles were based on routing information for one-direction travel available on Google Maps, using uncongested times to avoid any temporary congestion issues. Travel costs for automobile trips were based on the 2014 federal standard mileage rates for business miles, 56 cents per mile, as defined by the Internal Revenue Service. This mileage rate includes fixed and variable costs for automobile operation, including fuel, insurance, repairs, and tolls. By comparing the time, cost, and availability of multimodal options, mode choice needs were identified for any major origin-destination pair for which comparable non-driving options were not available.

Park-and-Ride

Park-and-ride needs were identified using data collected over 18 months from March 2011 to December 2012 as part of VDOT's 2013 Park and Ride Lot Inventory and Usage Study. The Park-and-Ride Lot Inventory and Usage Study data included capacity and utilization data for 292 park-and-ride lots throughout the Commonwealth, including some unofficial lots. Transit access to each park-and-ride lot was noted in this study as well. Utilization of the park-and-ride lots was aggregated to the county level and compared to the overall park-and-ride utilization rate for the Commonwealth (76 percent) to identify jurisdictions where park-and-ride capacity was constrained.



Safety Needs

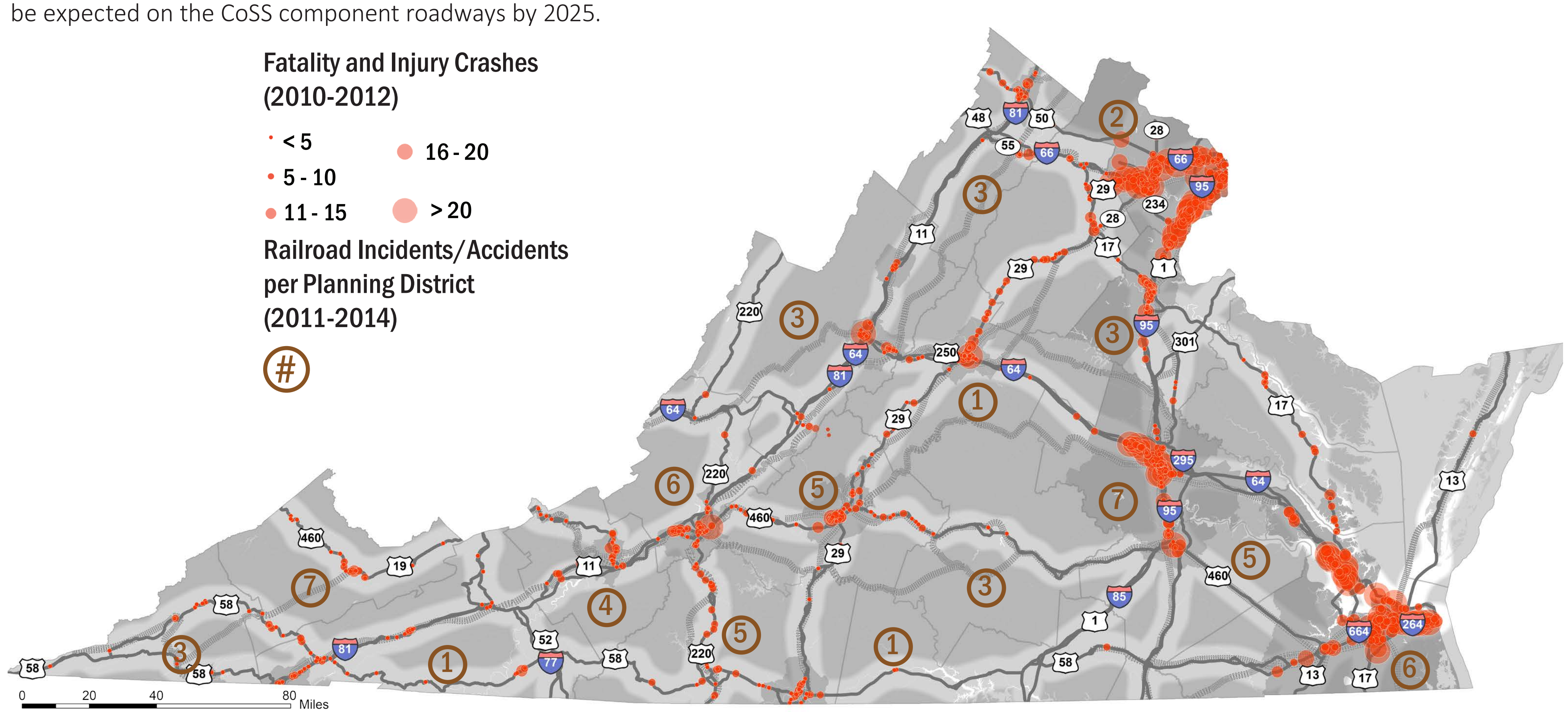
All highway safety data were provided by VDOT's Traffic Engineering Division and are based on the most recent STARS analysis. Using methodology outlined in the Highway Safety Manual, each roadway segment and intersection was ranked based on its potential for safety improvement (PSI) based on the number of fatal and injury crashes observed between 2010 and 2012. The top 100 segments and top 100 segments in each VDOT district were included for analysis as part of this Needs Assessment. Segments and intersections on the CoSS component roadways were identified, and clusters of crashes were identified. These locations were identified as having Safety Needs, although the threshold for number of crashes varied based on observed conditions on each Segment.

Corridor	Crashes (2010-2012)	Crashes per million VMT	2025 Crashes (assuming constant crash rate)
A	763	1.65	889
B	643	0.37	734
C	1,423	0.38	1,624
D	156	0.85	179
E	802	1.14	901
F	185	1.00	204
G	286	9.06	349
H	546	0.91	618
I	1,454	1.60	1,669
J	920	0.60	1,039
K	1,704	0.32	1,926
L	14	0.19	16
Total	**8,896**	**0.57**	**10,149**

Two specific roadway safety metrics were calculated for each segment: total number of crashes (including all fatal and injury crashes), and the number of crashes per vehicle miles travelled (VMT, in millions). While the former metric gives an idea of the scale of the safety issues on a given segment, the latter normalizes for differences in traffic levels and length between individual segments. As shown in the table, The Washington to North Carolina Corridor (Corridor K) has the highest total number of fatal and injury crashes, while the North-South Corridor (Corridor G) has by far the highest rate of crashes. If these crash rates remain constant over time, the total number of crashes in each corridor will likely increase based on predictions of increased VMT in each of the CoSS. Based on these assumptions, an additional 1,253 crashes would be expected on the CoSS component roadways by 2025.

Rail Safety

Rail crash data were obtained from the Federal Railroad Administration Office of Safety Analysis and include all incidents except those occurring in a rail yard for the years 2011 to 2014. Rail crash data are displayed by jurisdiction to identify areas where rail safety issues are substantial.



Congestion Needs

Delay Measure	Statewide Threshold	Statewide Total Delay
Person-Hours per Mile	>100	176,048 person-hours
Freight Ton-Hours per Mile	>250,000	451,605478 ton-hours

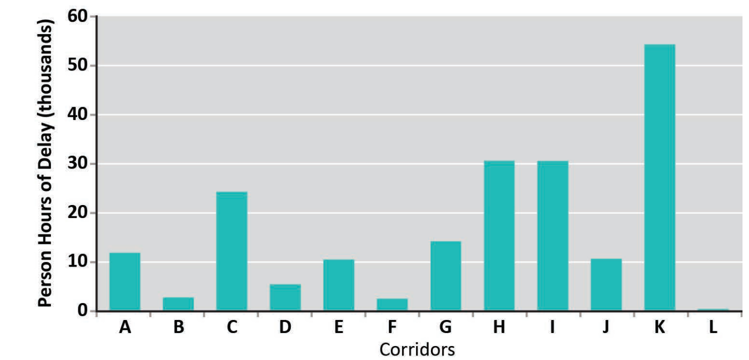
Congestion was identified using two performance measures designed to capture the effects of congestion as experienced by roadway users. Using the same speed data as in the reliability measures, the total daily person-hours of delay (for passengers) and ton-hours of delay (for freight) were calculated for CoSS component roadways in the Commonwealth. The actual speed data for 2014 were provided by INRIX for most locations on the CoSS component facilities.

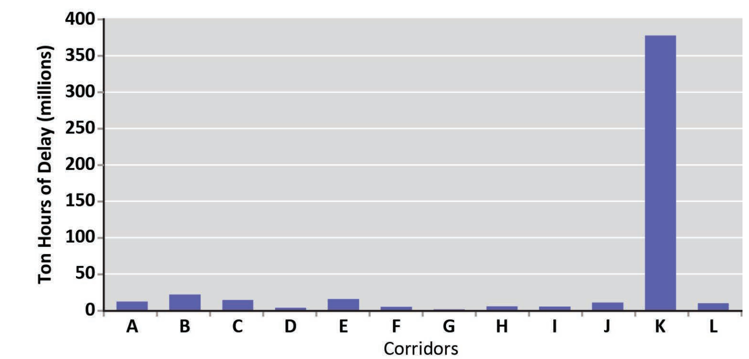
On each link, delay was calculated for each weekday hour by comparing the average travel time to the travel time when traveling at the reference speed for that link (comparable, although not identical, to the speed limit). The delay was then multiplied by the number of people or freight-tons traveling on that link during that hour and then summed to a daily total. A statewide-average auto occupancy of 1.1 was assumed for passenger vehicles. More detailed analysis of freight travel patterns was used to calculate accurate tons-per-truck values for each CoSS segment. Because longer links, by definition, will have a higher total delay than a similarly-congested short link, the total person-hours and ton-hours calculated were divided by the link length in order to calculate the final performance measures.

After reviewing the results as shown in the maps, statewide thresholds for passenger and freight congestion were identified. Any location with values above these statewide thresholds was identified as having Congestion Needs.

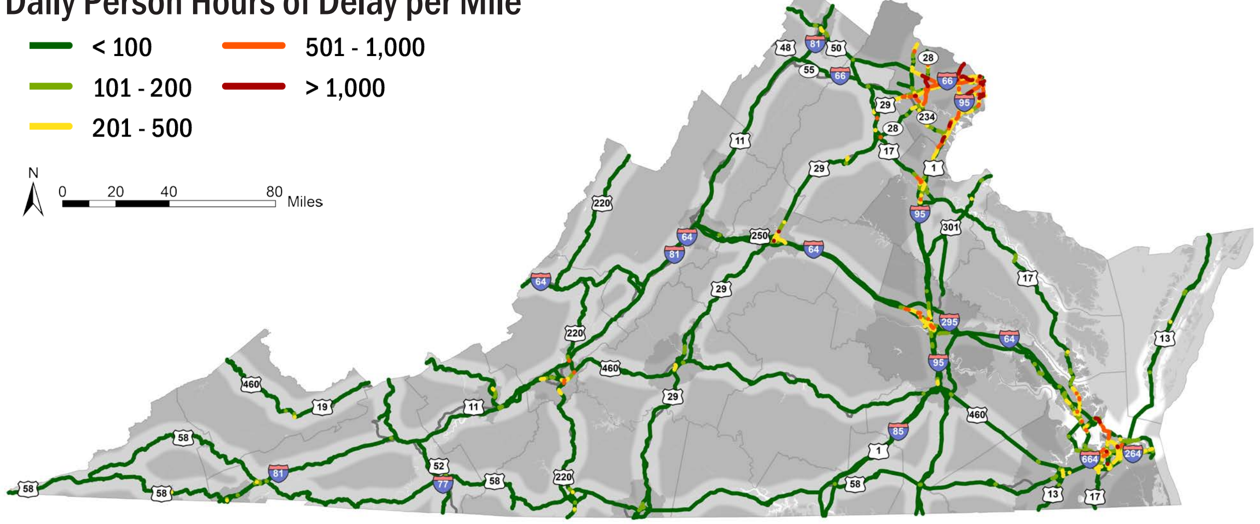
As shown in the maps, many of the areas with Congestion Needs are in the major urban areas including Northern Virginia, Hampton Roads, and Richmond (similar to Reliability Needs). Other areas that were identified as having Congestion Needs include Charlottesville (primarily passenger congestion), the Crescent Corridor (Corridor B) near Roanoke and Blacksburg/Christiansburg, near Bristol and Abingdon, and around the Inland Port near Winchester (all primarily freight delay). The graphs show the total delay by corridor. As shown, The Washington to North Carolina Corridor (Corridor K) experiences the greatest congestion delay, by far, for both passengers and freight.

In addition, a small subset of bottleneck needs was identified based purely on railway geometric constraints. These included railroad segments with physical limitations such as height restrictions limiting double-stacking, tunnels, bridges.

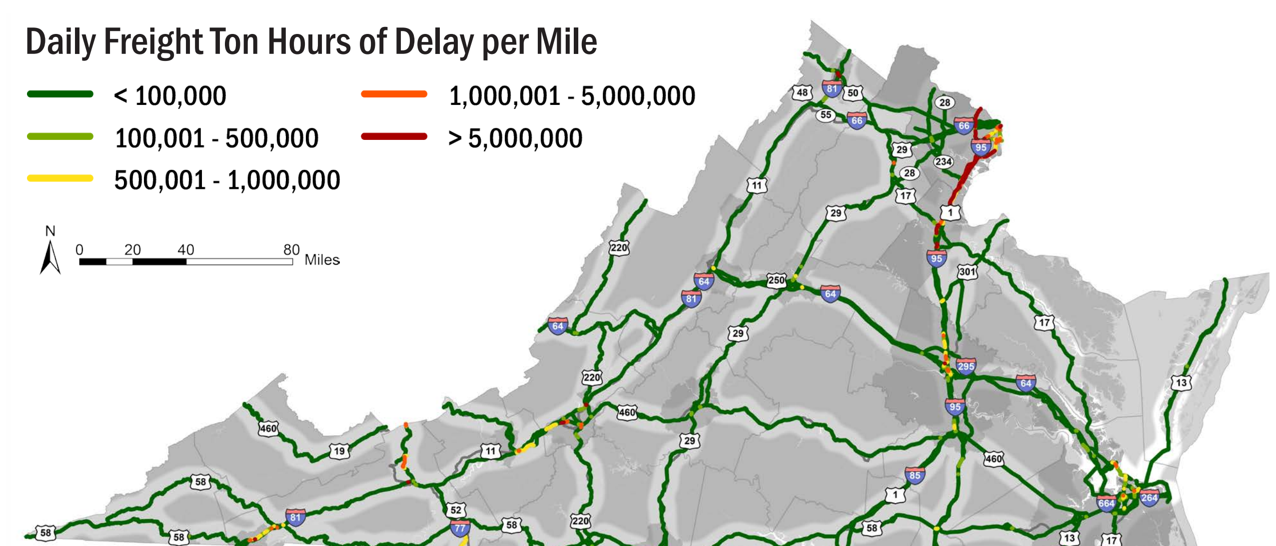




Daily Person Hours of Delay per Mile



Daily Freight Ton Hours of Delay per Mile



Reliability Needs

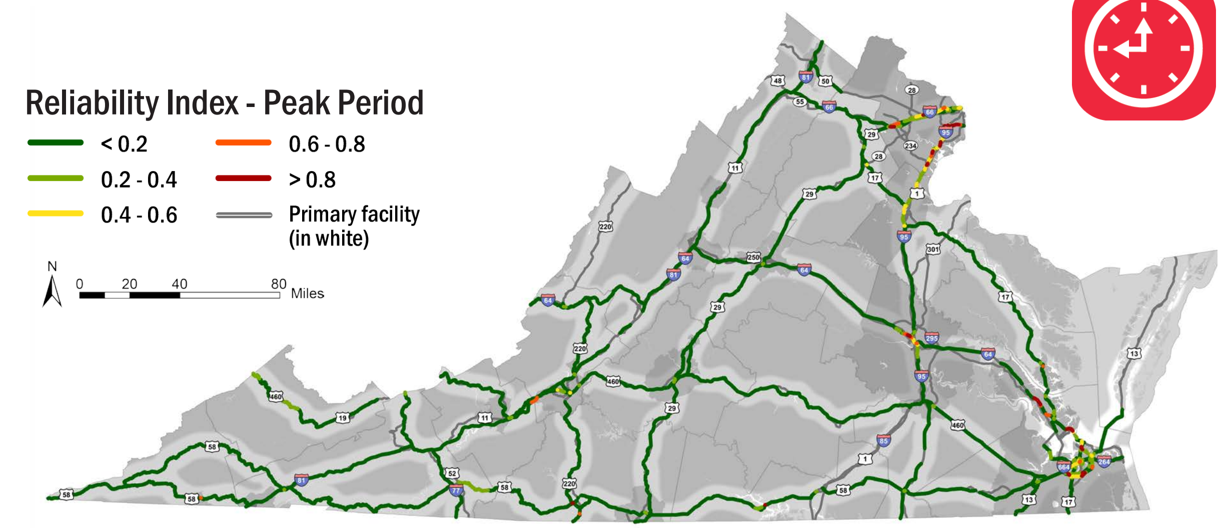
Roadway reliability was calculated based on actual speed data for 2014 as provided by INRIX. These data covered most locations on the CoSS component facilities and provide speed for 15-minute increments throughout the day for all of 2014. Reliability was calculated for each roadway link (as defined by INRIX) by direction, based on the 90th percentile travel time. Based on this assumption, only events that occur at least ten percent of the time would be identified as reliability issues. A buffer index was calculated independently for each weekday and weekend hour according to the formula below:

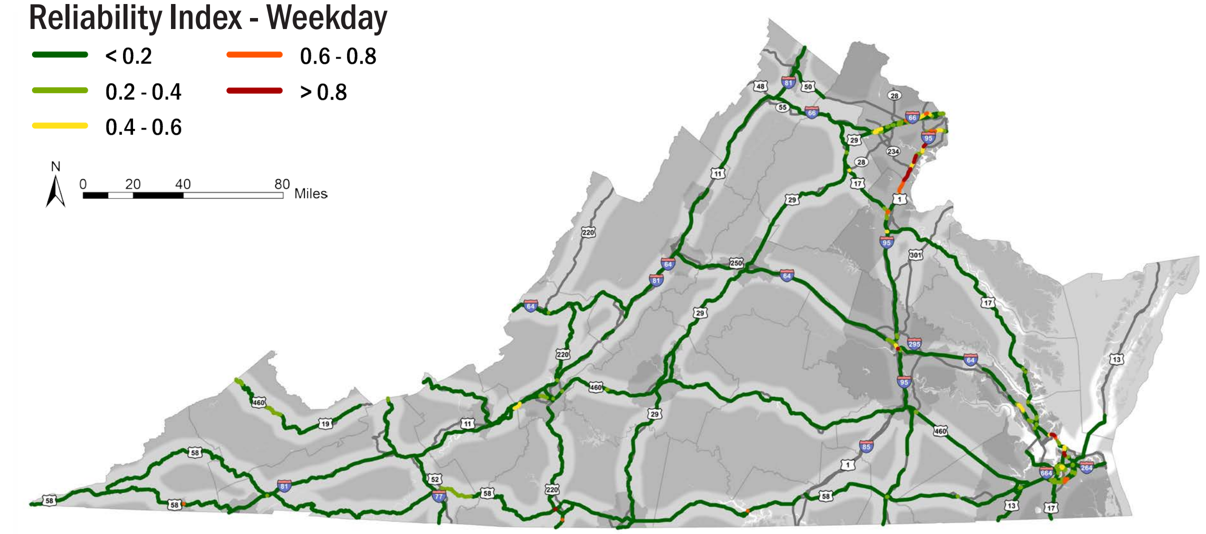
$$\frac{\text{(90th\% Travel Time)-(Median Travel Time)}}{\text{(Median Travel Time)}}$$

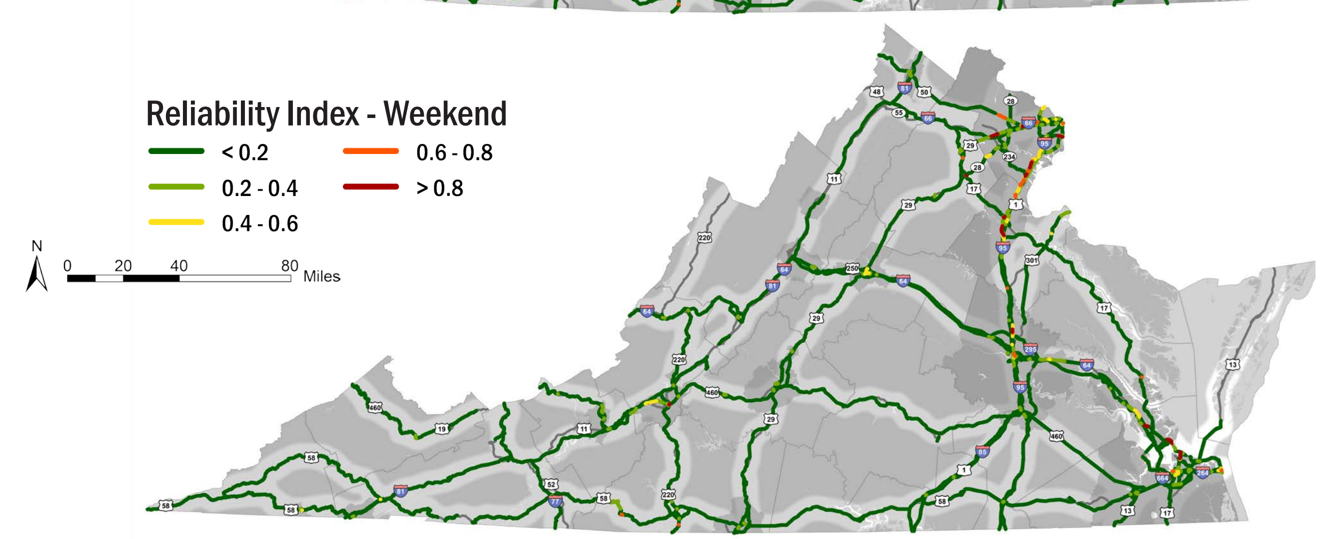
This number effectively calculates the percent of additional time that a driver should include in trip planning in order to arrive punctually 90 percent of the time. For example, a buffer index with a value of 0.4 indicates that for a trip that usually takes 20 minutes, an additional 40 percent, or eight minutes should be planned. This calculation produced 48 buffer indices for each CoSS component link (24 for weekday, 24 for weekend). By initially computing the buffer indices separately for each hour of the day, the effects of recurring congestion were effectively removed from this analysis as much as possible (Congestion was measured separately using a different set of performance measures). These hourly buffer indices were then aggregated using a weighted average (weighted based on the portion of traffic occurring during each of the included hours) to calculate three Reliability Indices:

These three Reliability Indices were calculated for all CoSS components for which the required data were available. Based on a review of the results, separate thresholds were identified for each Reliability Index; locations with Reliability Index values above these statewide thresholds were identified as having Reliability Needs. As shown on the maps, the majority of the Reliability Needs are identified in the major urban areas including Northern Virginia, Hampton Roads, and Richmond although some were identified in other areas such as near Roanoke, Charlottesville, and Danville.

Reliability Index	Hours Included	Statewide Threshold
Weekday Peak	Weekday, 7–9 a.m. and 5–7 p.m.	0.80
Weekday	All Weekday hours (M–F)	0.40
Weekend	All Weekend hours (Sat & Sun)	0.60







Passenger Rail Reliability

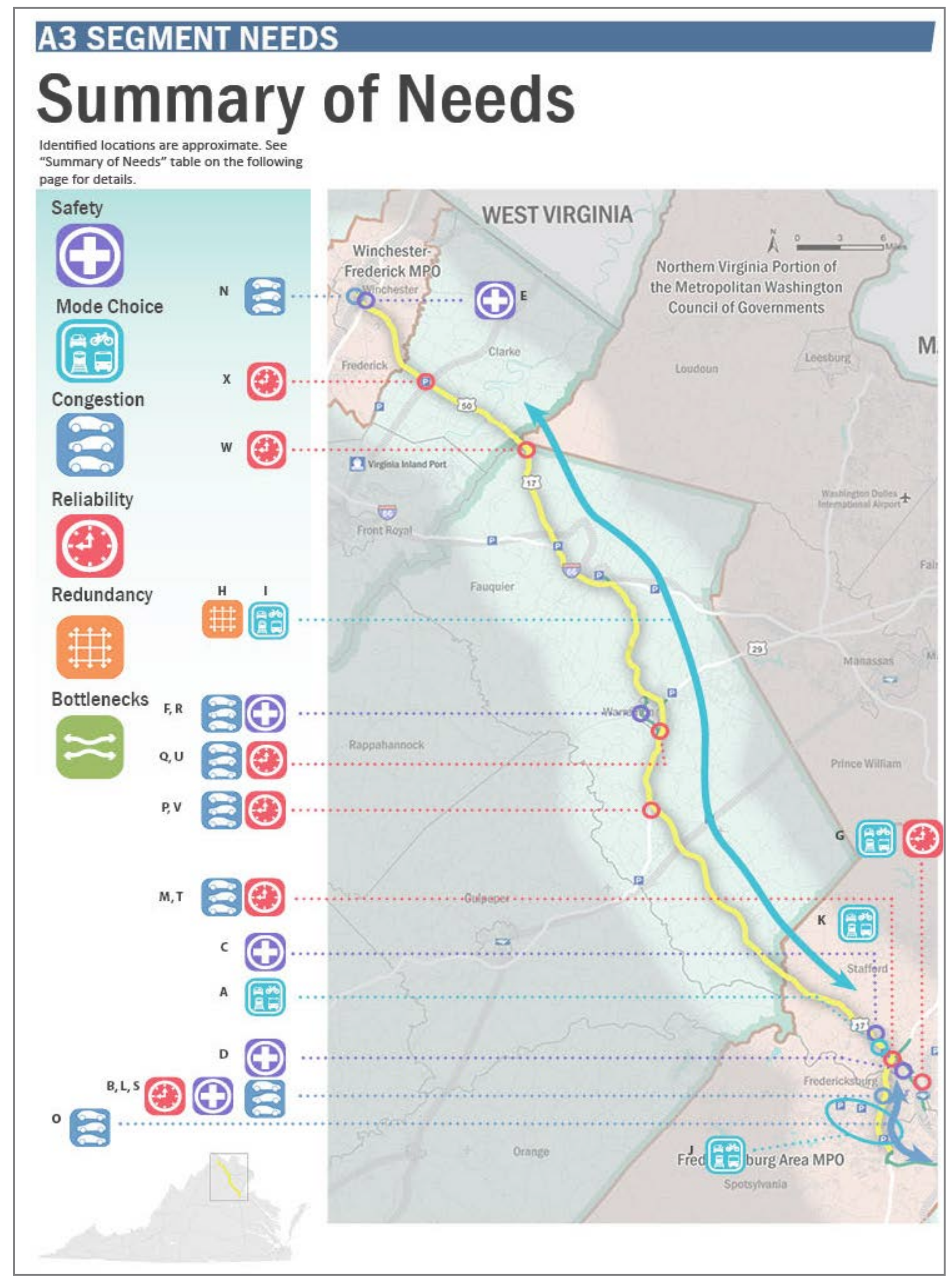
Departure delays at Amtrak were calculated from data available for 2014 in the Amtrak Status Maps Archive Database (ASMAD). ASMAD is not affiliated with Amtrak, but does archive status data from www.amtrak.com daily. Total delay by station was calculated by multiplying the average departure delay by the number of passengers using a station annually. An average delay of 25 minutes is experienced at Amtrak stations statewide, accumulating over 270,000 hours of delay annually. While Clifton Forge Station has the highest average delay in the Commonwealth, the Staples Mill Station in the Richmond area has the highest levels of total delay.

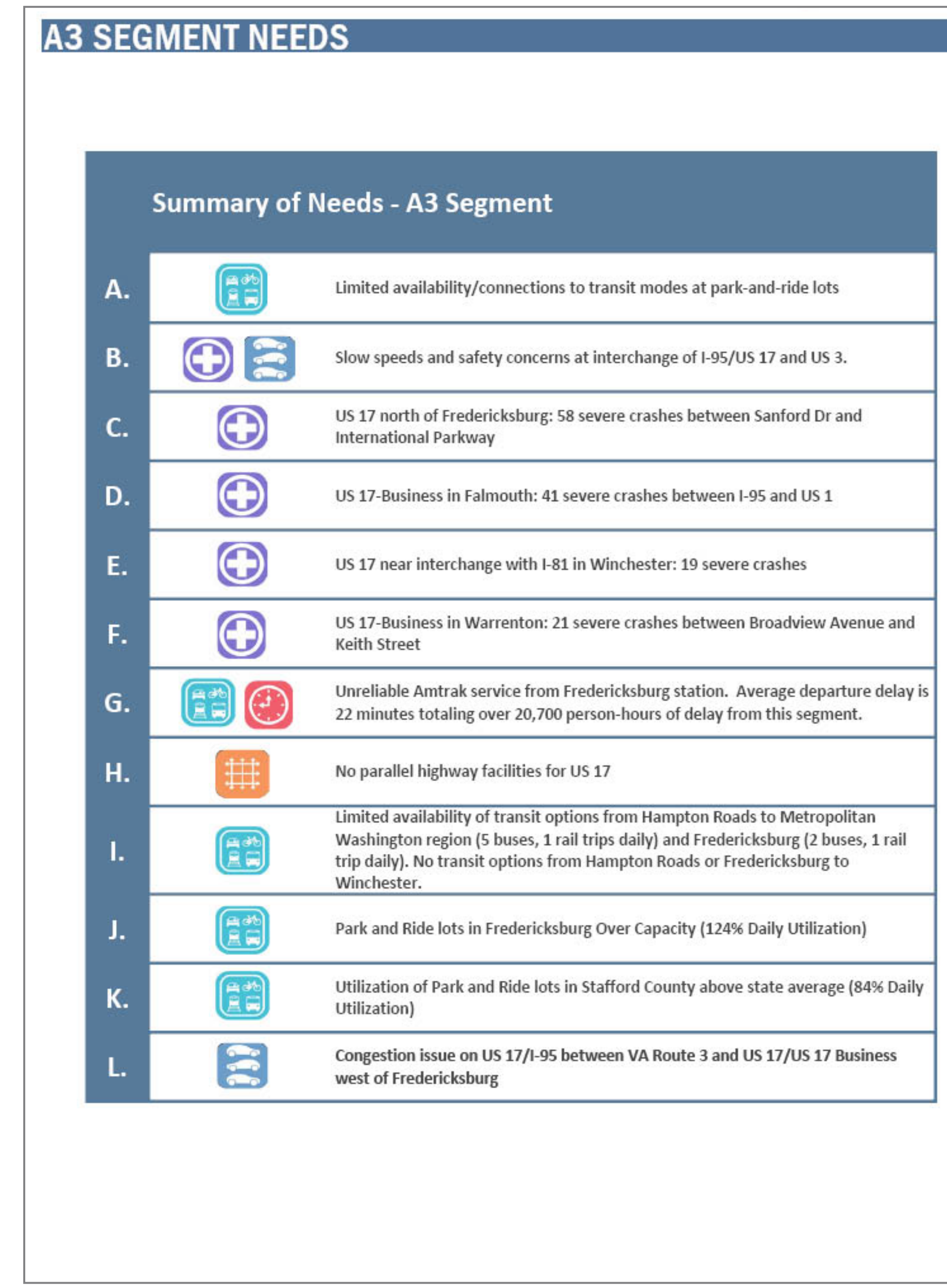
Station	Average Departure Time Delay (mins)	Total Annual Hours of Delay
Alexandria	23	35,169
Ashland	20	4,704
Burke Centre	14	641
Charlottesville	32	35,522
Clifton Forge	74	1,496
Culpeper	31	3,686
Danville	34	2,225
Fredericksburg	34	8,282
Lorton	22	20,724
Lynchburg	8	19,249
Manassas	23	16,208
Newport News	31	7,413
Norfolk	2	1,557
Ettrick (Petersburg)	1	216
Quantico	21	6,462
Richmond Main Street	26	9,015
Richmond Staples Mill	27	79,571
Staunton	73	4,151
Williamsburg	23	11,530
Woodbridge	15	3,748
Total Virginia Station Usage	**25**	**271,568**

Summary of Needs

CoSS Needs for each Corridor segment were developed using the methodologies outlined in this report. All of the identified needs for each Corridor segment are outlined and summarized in a Summary of Needs, which highlights each of the CoSS Needs categories using a distinct color. These summaries (example shown at right) include both a map and a list with text descriptions of each need. The map and list are tied together through the use of a unique identifier for each need. The approximate location of each need is shown on the Summary of Needs Map along with the icons associated with each of the CoSS Needs categories. More information about each need, including a more detailed and specific geographic location can be found in the Summary of Needs list under the appropriate identifier. For needs that address a larger geographic area or an entire segment, appropriately colored lines were used to denote the scale of the need. These lines do not represent specific facilities or construction projects, and are only meant to convey the need as a segment-wide concern. These Summaries of Needs outline the intercity travel needs that should be addressed by the Commonwealth's transportation network. As such, projects applying for consideration under HB2 must demonstrate that they can meet one or more of these needs.

Sample "Summary of Needs" Pages




A3 SEGMENT NEEDS

Summary of Needs - A3 Segment		
A.		Limited availability/connections to transit modes at park-and-ride lots
B.		Slow speeds and safety concerns at interchange of I-95/US 17 and US 3.
C.		US 17 north of Fredericksburg: 58 severe crashes between Sanford Dr and International Parkway
D.		US 17-Business in Falmouth: 41 severe crashes between I-95 and US 1
E.		US 17 near interchange with I-81 in Winchester: 19 severe crashes
F.		US 17-Business in Warrenton: 21 severe crashes between Broadview Avenue and Keith Street
G.		Unreliable Amtrak service from Fredericksburg station. Average departure delay is 22 minutes totaling over 20,700 person-hours of delay from this segment.
H.		No parallel highway facilities for US 17
I.		Limited availability of transit options from Hampton Roads to Metropolitan Washington region (5 buses, 1 rail trips daily) and Fredericksburg (2 buses, 1 rail trip daily). No transit options from Hampton Roads or Fredericksburg to Winchester.
J.		Park and Ride lots in Fredericksburg Over Capacity (124% Daily Utilization)
K.		Utilization of Park and Ride lots in Stafford County above state average (84% Daily Utilization)
L.		Congestion issue on US 17/I-95 between VA Route 3 and US 17/US 17 Business west of Fredericksburg