Final

Virginia Statewide Multimodal Freight Study, Phase I

Report

Prepared for
Virginia Department of Transportation
Multimodal Transportation Planning Office

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Executive Summary

Why a Statewide Multimodal Freight Study?

Virginia was founded as a trading colony, and freight movement remains a critical part of the Commonwealth's economy. The movement of freight – raw materials, intermediate products, and finished goods – currently supports over $350 billion of Virginia's Gross State Product annually. To accommodate the movement of freight, Virginia hosts one of the nation's leading seaports, two national freight railroads and numerous local and regional railroads, four major cargo airports, and some of the nation's most heavily used truck corridors.

Over the next two decades, the forecast is for significant growth in the demand for freight movement into, out of, within, and through Virginia. Some of the Commonwealth's freight infrastructure is well-positioned to accommodate this growth. But much of its infrastructure will be challenged – from normal wear and tear, from growth in the amount, type, and location of freight movement, from increased passenger traffic over shared highways and rail corridors, and from environmental pressures associated with higher freight volumes and/or denser settlement patterns in and around major freight facilities and corridors. Almost 80 percent of Virginia's freight tonnage has an origin or a destination in another state – including 40 percent which is simply passing through Virginia on its way to and from other states – so growth and freight improvements in other states, or the lack thereof, could significantly affect conditions in Virginia.

In meeting these challenges – as with all its transportation and public policy challenges – Virginia faces the critical problem of how to meet the greatest need, and derive the greatest public benefit, from constrained funding.

The opportunity before the Commonwealth is to make freight investments that generate significant public benefits and offer a positive return on public investment for the Commonwealth's economy, transportation system, and environment. Efficient freight movement means lower costs for industries and businesses that depend on freight transportation, helping them (and Virginia's economy) grow and prosper, and making Virginia a more attractive place to do business. In turn, lower costs of transporting goods to market also benefits Virginia's consumers, in the form of lower prices. Taking a "systems approach" to freight movement – guiding it to the corridors, transportation modes, and travel time periods where the transportation system can provide the most capacity with the least cost and least environmental impact – can help offset the negative consequences of freight activities. Freight mobility improvements benefit passengers, and vice versa, because much of Virginia's transportation system is shared between them.

Over the past decade, Virginia has emerged as a national leader in addressing freight issues. Virginia has made, and continues to make, significant investments in its ability to move freight – by truck, rail, water, air, and "intermodally" among and between these modes. There are many studies, plans and programs underway to improve Virginia's interstate and state highways, its ports and marine terminals, its freight rail corridors and terminals, and its airports. Freight has been addressed by each of Virginia's modal transportation agencies, through multimodal planning activities, and by several of Virginia's Metropolitan Planning Organizations. These efforts address not only public projects within Virginia, but also public projects involving partnerships with other states, as well as partnerships with the private sector stakeholders that benefit directly from freight system improvements.

To build on and supplement these efforts, to place them within a larger multimodal investment context, and to establish a guiding framework for near-term and long-range freight policy and investment strategies, the Commonwealth of Virginia has undertaken the Virginia Statewide Multimodal Freight Study. The Study is designed to:

- Compile available freight information – which exists in multiple places, from multiple sources – and fill in gaps, to tell the story of the Virginia's entire intermodal freight transportation system;

- Identify current needs and projected future needs for each mode, for the system as a whole, and for designated multimodal corridors and subregions of critical interest;

- Develop an understanding of the contributions that freight makes to Virginia's economy, clearly understand the benefits and costs of improving – or failing to improve – Virginia's freight transportation system, and create a "return on investment" framework for decision-making;

- Form substantial, implementable recommendations and solutions for Commonwealth planning and programming;

- Address the critical roles that other levels of government and the private sector can and must play; and

- Be grounded in a comprehensive outreach effort that reaches a full range of public and private stakeholders.

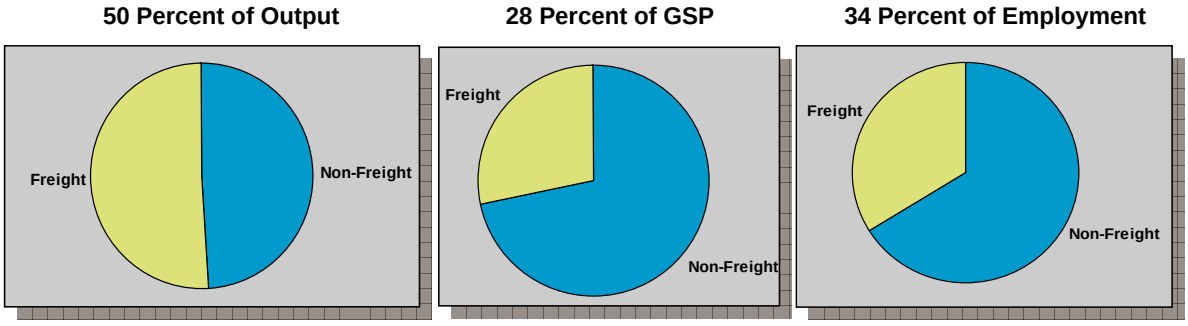
Phase I of the study, which is documented in this Report, primarily addressed tasks related to outreach, data collection, baseline forecasting, system inventory/analysis, and freight improvement opportunities. Phase II will develop analysis tools, analyze corridor and regional freight needs and alternatives, and evaluate infrastructure and policy alternatives based on public benefits and return on investment to the Commonwealth.

■ Freight Movement and the Virginia Economy

As of 2006, Virginia was home to 7.6 million residents, making it the 12th most populous state in the country. Virginia's economy employed 3.7 million people in 2006, accounting for 2.8 percent of all U.S. jobs. In 2005, the total output of Virginia's economy was around $658 billion. (Output is a measure of the total **value** of goods and services.) For the same period, Virginia's gross state product (or GSP) was $352 billion. (GSP is a measure of the total **value added** to goods and services because of Virginia activity.) Virginia accounts for almost three percent of the entire U.S. economy. If Virginia were a country, its economy would be equivalent in size to Sweden's or Turkey's, ranking as the 21st largest in the world.

Today, around 50 percent of Virginia's output, 28 percent of its gross state product, and 34 percent of its employment are from freight-related industries that depend heavily on the movement of raw materials, intermediate goods, and/or finished products.

Figure ES.1 Freight-Related Industry Contributions to Virginia's Economy
2005



Many different Virginia industries and businesses rely heavily on the efficient movement of goods. Producing industries like agriculture depend on freight movement to move farm products from fields to processing plants to wholesalers to retail outlets, in Virginia and throughout the U.S. and the world. Other producing industries, like transportation equipment manufacturers, also depend on freight movement to bring them the intermediate products – rolled or fabricated steel, tires, engine parts, etc. – they need to assemble their finished products. Wholesale and warehouse/distribution industries serve as the bridge between producers and consumers, making sure that needed goods are transported where – and when – they are needed. Finally, consumers of all kinds – from shoppers at grocery stores to power plants – rely on freight movement to deliver the goods and materials to the final point of sale or point of use. These freight-related businesses and industries generally fall into three "clusters":

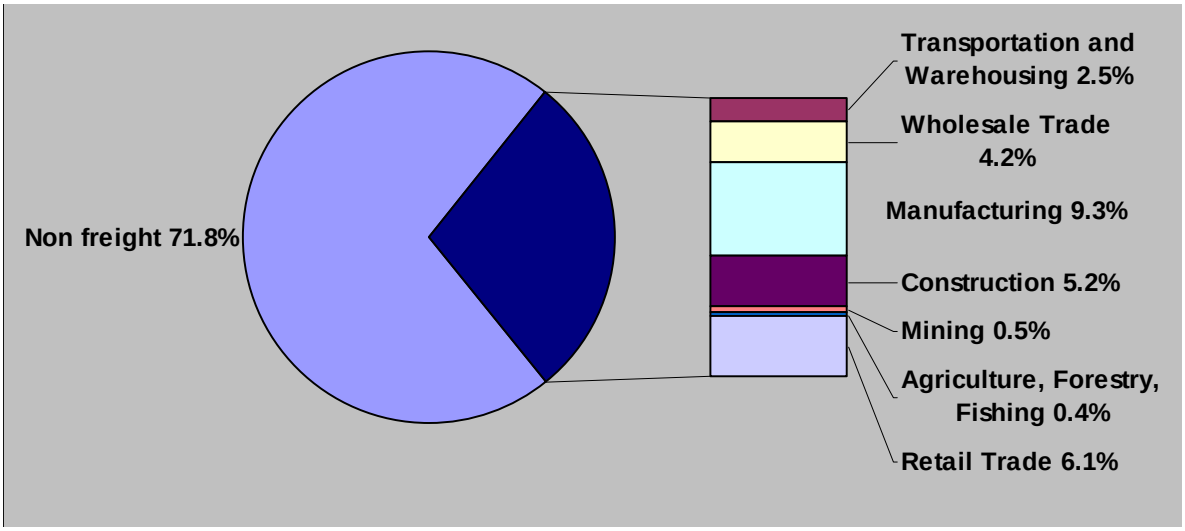
- The **goods movement cluster** includes industries and businesses that provide freight transportation services – such as truckers, railroads, marine shipping and air cargo shipping companies, wholesalers, and warehouse/distribution facility operators – engaged in domestic and international transportation. Benefiting from its location on the center of the East Coast, Virginia is a key U.S. gateway for international trade, exporting and importing goods destined for or originating from markets throughout the United States and the world. Exports from Virginia to other countries (based on the "origin of movement" export data series) have been on a steady growth trend, topping $12 billion worth of goods in 2005 and surging to above $14 billion in 2006. Overall, the goods movement cluster represents around seven percent of Virginia's GSP.

- The **freight intensive industries cluster** includes industries where the transportation of raw materials, intermediate products, and finished goods accounts for a major share of their cost of doing business – such as agriculture, tobacco, food products, construction, wood and paper, machinery, transportation equipment, energy, chemical products and mineral extraction. The freight intensive industries cluster represents around 15 percent of Virginia's GSP.

- The **retail cluster** includes consumer outlets – supermarkets, merchandise retailers, auto dealers, etc. – that require freight transportation services to stock their inventory. The retail cluster represents around six percent of Virginia's GSP.

Other industries, while they may depend on freight movement to some extent, are not considered freight-dependent. Nonfreight dependent industries include information, finance, personal and business services, education and health, leisure and hospitality, and government, and represent around 72 percent of Virginia's GSP.

Figure ES.2 Nonfreight- and Freight-Related Virginia Industry Sectors
By Share of Gross State Product, 2005



Virginia's population and economy are growing. The Virginia Employment Commission forecasts that Virginia population will increase 30 percent by the year 2030. Economic forecasts prepared by Global Insight Inc., as part of this study, suggest that, through the year 2035, freight industry output will increase 100 percent, freight industry GSP will increase 70 percent, and freight-related employment will increase 20 percent. (The forecasts assume increasing productivity per freight industry employee.)

The nonfreight sectors of Virginia's economy will grow even faster, consistent with overall U.S. trends, but even so, these forecasts point out that we will not be a 100 percent service economy. Today, even with rapid industrialization in China and other countries, and much attention paid to the outsourcing of U.S. manufacturing, the U.S. remains the world's leading manufacturing economy on a dollar value basis. The U.S., and Virginia, will continue to move raw materials, intermediate products, and finished goods – and the need for freight movement services will grow, not diminish, as Virginia's population grows and its economy expands.

■ Freight Demand and Projections

Understanding the volume and the value of freight demand is critical to addressing freight movement challenges and identifying opportunities. There are many different freight data sources and measures; each provides valuable information and comes with its own unique set of limitations.

One of the most comprehensive data sources available is a commercial data product known as TRANSEARCH, which incorporates a mix of public sector data (for rail, air, and water movements) and proprietary data (from trucking companies and logistics services). TRANSEARCH provides estimates of freight tonnage and units moving between different geographic areas (counties, business economic areas, and states), by different transportation modes (truck, rail, water, and air), distinguished by commodity type. Virginia owns several years of TRANSEARCH data, the most recent being year 2004, with forecasts to year 2035. In Phase I of this study, TRANSEARCH Was supplemented by adding international waterborne data, and in Phase II further enhancements will be made.

According to available data, in 2004, Virginia's multimodal transportation system handled around 915 million tons of freight worth more than $2.1 trillion. This includes freight associated with trucking, rail, air, domestic water, and international water; it also includes freight moving inbound to, outbound from, within, and through the Commonwealth. On the basis of tonnage, trucking handled around 74 percent, followed by rail at 20 percent, water at 6 percent, and air at less than 1 percent. On the basis of value, trucking handled around 94 percent, rail handled around 4 percent, and air and water handled around 2 percent.

In interpreting these numbers, it is important to remember that much of Virginia's freight is handled by different transportation modes, or handled multiple times, on its end-to-end journey from origin to destination, and the data counts each different "leg" of the end to

end trip separately. For example, most waterborne commodities and nearly all airborne commodities generate corresponding truck moves – so a large part of the trucking numbers are due to the support they provide for other transportation modes. Also, tonnage and value measures do not reflect the fact that air, water, and rail tend to specialize in longer-distance freight movement, while a large part of trucking is shorter-distance local service.

Figure ES.3 Virginia Freight Tonnage and Value by Mode
2004

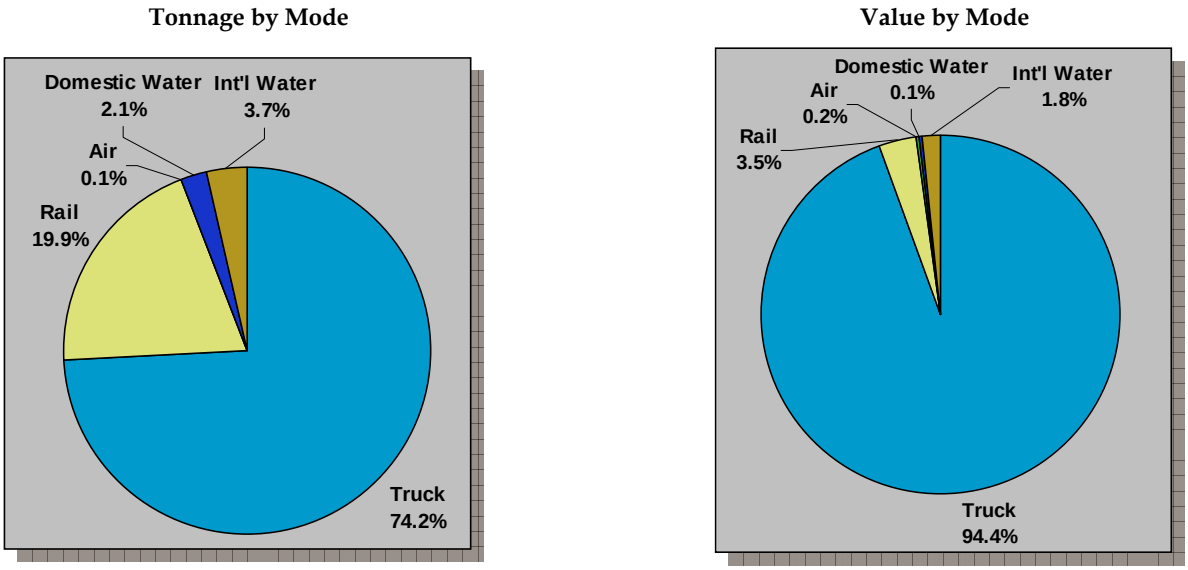
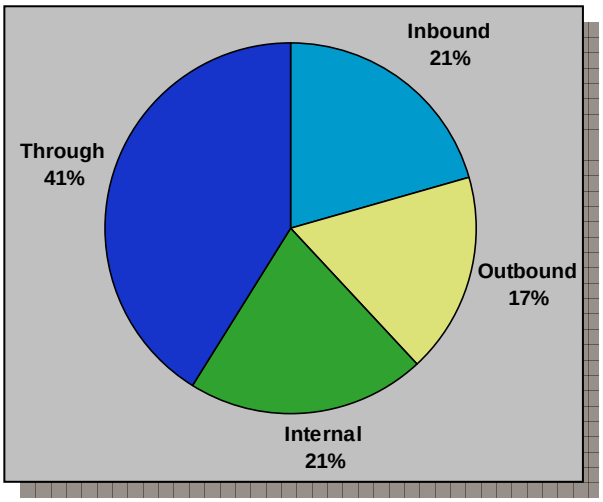


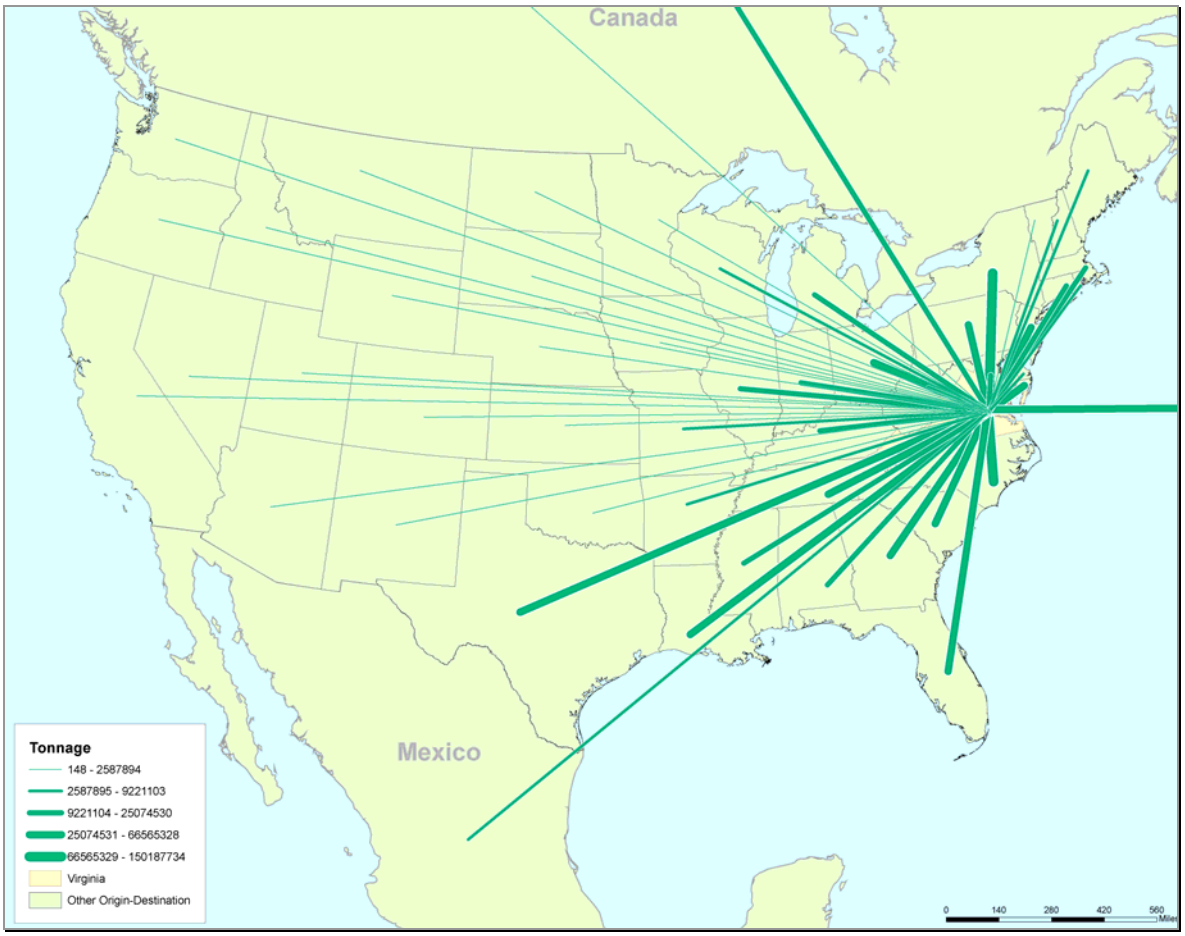
Figure ES.4 Virginia Freight Tonnage by Direction and Type
2004



Virginia's geography places it at the center of the Mid-Atlantic corridor, and positions it at a major "crossroads" for goods moving between the west/southeast/south and the north-eastern U.S. Around 40 percent of Virginia's freight tonnage is pass-through tonnage, moving to and from other states without being handled in Virginia, and most of this is moved by truck. (Through trucking is discussed in more detail later in this Report.)

The remaining 60 percent of Virginia's freight tonnage are split more or less evenly between inbound tonnage (from other states or countries to Virginia), outbound tonnage (from Virginia to other states or countries), and internal (moving from one part of Virginia to another). The leading states sending tonnage to and receiving tonnage from Virginia are located in the northeast, southeast, and midwest, but cargo also moves to and from states west of the Mississippi (Louisiana and Texas) as well as Canada and Mexico. By tonnage, about one-half of Virginia's public and private terminal trade is with Europe and the Mediterranean; nearly 20 percent are with the east coast of Central and South America; about 10 percent are with the Far East; and around 20 percent are with all other parts of the world. By value, and by container trade, the Far East represents a substantially larger share of trade, and anticipated strong growth in this trade is a critical factor for Virginia.

Figure ES.5 Virginia Inbound and Outbound Freight Tonnage
2004

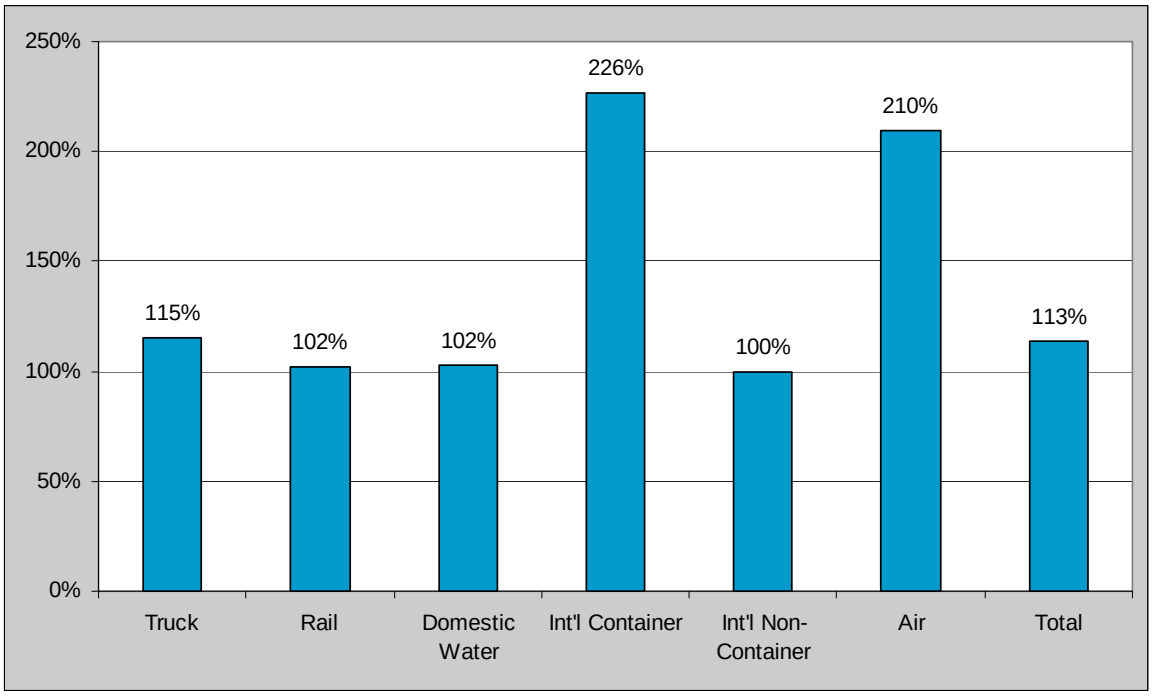


Virginia's transportation network and services must accommodate the mobility, logistics, and consumer needs of an increasing number of residents, workers, visitors, retirees, and businesses, and do so reliably, safely, and efficiently. Growth in population and economic drivers will lead to a greater demand for goods and more congested highways and airports. State, national, and global economic growth will put additional pressures on Virginia's railroads and ports to accommodate the increases in freight volumes that will accompany the mounting needs of businesses and consumer markets as well as increasing world trade.

Nationally, domestic freight tonnage – that is, tonnage moving between two points in the United States, including movements to and from international gateways (seaports, airports, and border crossings) – is expected to nearly double by 2035 based on the Federal Highway Administration's (FHWA's) recent Freight Analysis Framework-2 (FAF-2) release. International container traffic, which is a relatively low share of total system tonnage but a more significant share of its value, is expected to triple by 2035.

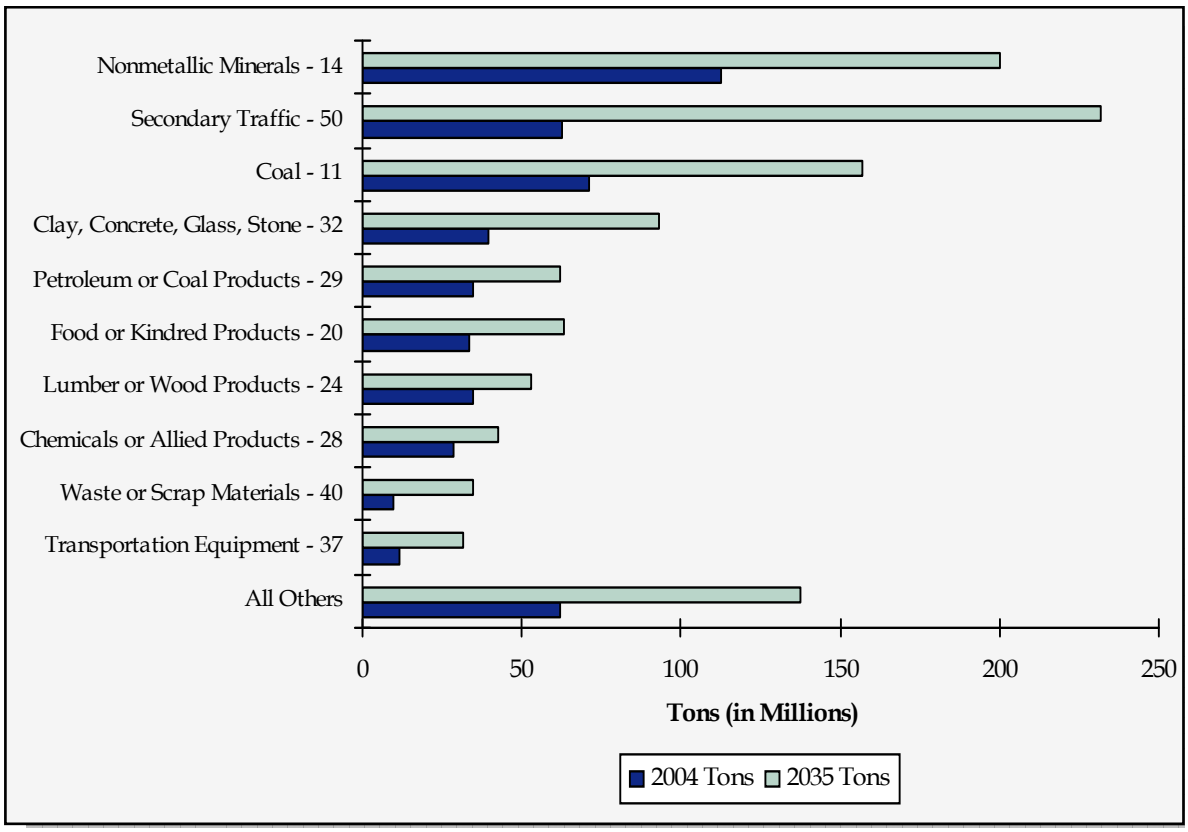
Virginia projections for the year 2035 were developed from the TRANSEARCH database and additional analysis of international waterborne traffic patterns. Total tonnage is projected to grow from 915 million tons to more than 1,950 million tons – an increase of 113 percent. The fastest growth is for international container and air cargo trades, each anticipated to increase more than 200 percent. Trucking, rail, domestic water, and noncontainerized international water, which handle the great majority of total tonnage, are anticipated to increase at rates between 100 percent and 115 percent.

Figure ES.6 Projected Growth in Virginia Freight Tonnage
2004 to 2035



Projected growth in Virginia freight tonnage is generally proportional to projected growth in the freight output of Virginia industries over the same period. However, the mix of commodities that make up this tonnage is likely to shift significantly. In 2004, the leading commodities by weight were nonmetallic minerals (industrial minerals other than metals or fuels), coal, "secondary traffic" (a class representing a mix of commodities that typically move in containers or dry van trucks and involve warehouse and distribution activities), clay/concrete, glass/stone, and so on. By 2035, secondary traffic is expected to become the Commonwealth's leading commodity by tonnage, overtaking nonmetallic minerals.

Figure ES.7 Virginia's Top Commodities by Weight
2004 and 2035



Note: Due to limitations in the data, this figure does not include waste shipments by truck and international waterborne commodities. These limitations will be addressed in Phase II. Through traffic was deliberately excluded in order to focus on commodities that are directly linked to Virginia's economy.

Secondary traffic already is the Commonwealth's leading commodity by value, and will retain this position through 2035. The next leading commodities on the basis of value include electrical equipment, transportation equipment, machinery, and other groupings.

■ Virginia's Multimodal Freight Transportation System

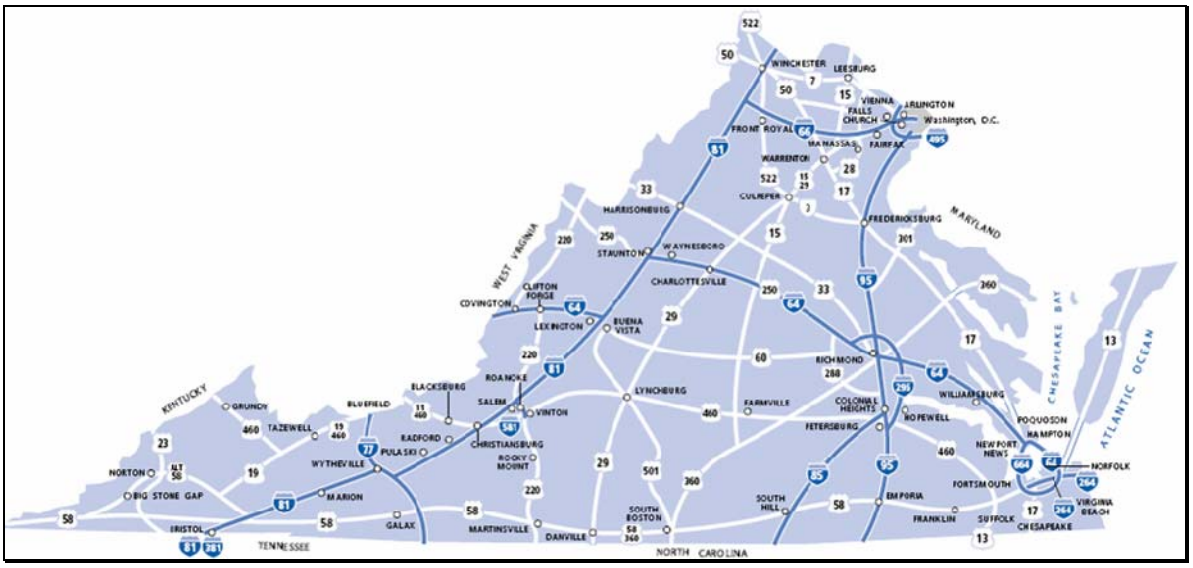
Highways

Virginia's state-maintained highway system is divided into the following categories:

- **Interstate –** More than 1,000 miles of 4- to 10-lane highways that connect states and major cities;
- **Primary –** More than 8,000 miles of two- to eight-lane roads that connect cities and towns with each other and with interstates;
- **Secondary –** More than 48,000 miles of local connector or county roads. (Arlington and Henrico Counties maintain their own county roads.); and
- **Urban –** More than 10,000 miles of urban streets, maintained by cities and towns with the help of state funds. (Virginia's cities are independent of counties.)

Within the larger highway system, there is a designated truck network linking major freight shipping and receiving areas and accommodating through state freight movement.

Figure ES.8 Virginia's Highway System

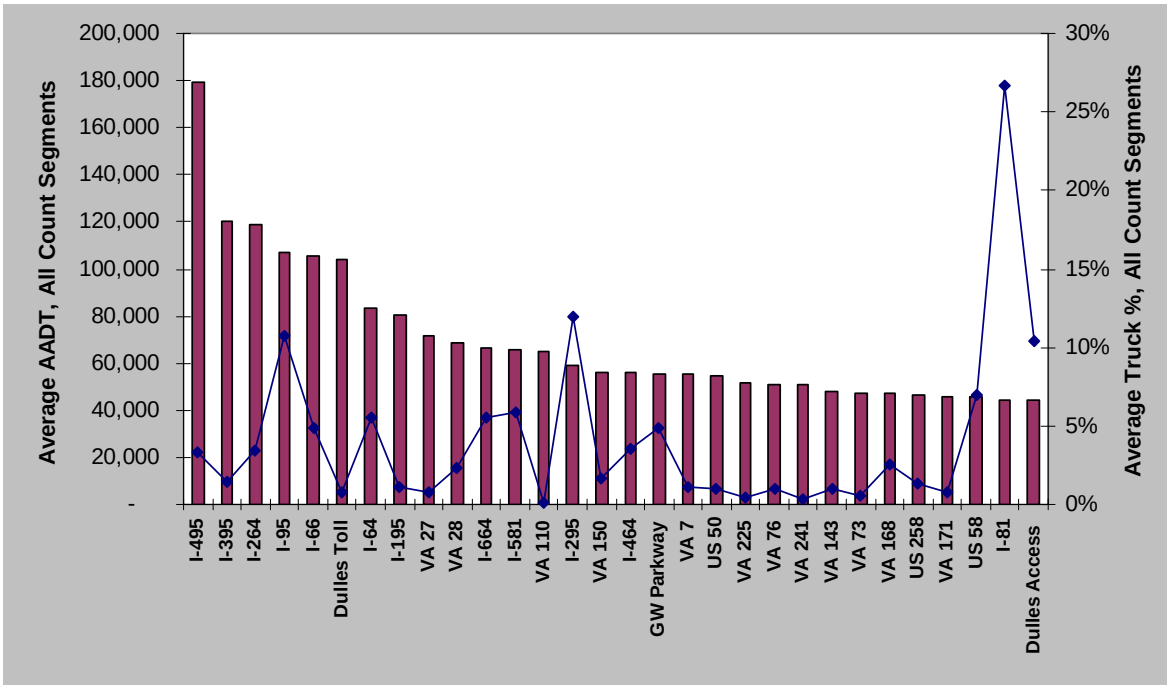


In 2004, Virginia's highway system accommodated 680 million tons of freight – the equivalent of 55 million loaded units, or a line of trucks going around the world nearly 30 times – moving more than 200 billion ton-miles. (A ton-mile is one ton of freight moving a distance of one mile.)

Virginia maintains a statewide vehicle count program on its major highways, including collection and/or estimation of truck counts and percentages. Many of these highways extend for long distances through Virginia, or traverse areas with very different land uses. Therefore, it is useful to look at each highway on a segment-by-segment basis, understanding that it may have areas of high truck counts and areas of low truck counts.

Figure ES.9 below shows the average Virginia AADT (all vehicle types) for all segments of a given route as columns, and the corresponding average truck percentages as points. Segment counts taken in a single direction on divided highways have been adjusted to represent bidirectional activity, for easier comparison with nondivided highway counts. All averages are weighted based on the length of the segment associated with the data.

Figure ES.9 Average Total AADT and Truck Percentages, All Count Segments
Virginia's Top 30 AADT Routes, 2005

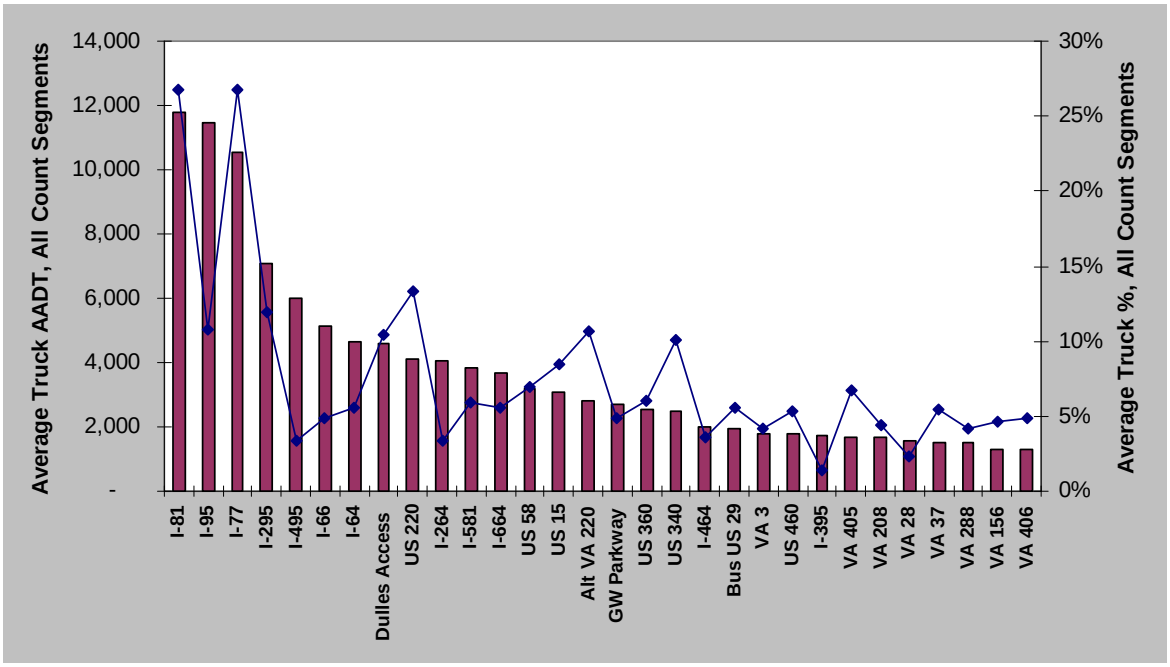


The top 10 routes on the basis of average AADT are: I-495 (the Capital Beltway); I-395; I-264; I-95; I-66; the Dulles Toll Road (VA 267); I-64; I-195; VA-27; and VA-28. Of these, only I-95 has a truck percentage exceeding 10 percent. Among other top 30 AADT routes, the highest average truck percentages are found on I-81 (27 percent), I-295 (12 percent), and the Dulles Airport Access Road (10 percent). Trucks actually represent a relatively low percentage of AADT on most of Virginia's most heavily used highways.

Figure ES.10 below shows Virginia truck AADT for all segments of a given route as columns, and the corresponding average truck percentages as points. The highest average truck AADT is found on I-81, followed closely by I-95 and I-77, all with averages

exceeding 10,000 trucks per day. Segments averaging over 4,000 trucks per day include I-295, I-495, I-66, I-64, the Dulles Airport Access Road, U.S. 220, and I-264. As previously noted, the truck percentage for I-81 is high (27 percent), as is the truck percentage for I-77; this reflects a combination of high truck volumes and lower "background" automobile traffic. Average truck volumes on I-95 are almost as high as for I-81, but the truck percentage is lower because the background traffic is so much higher, given that I-95 traverses much more densely populated areas than I-81. And despite their relatively low truck percentages, we see that "commuter corridors" such as I-495 and I-66 also are critical truck corridors.

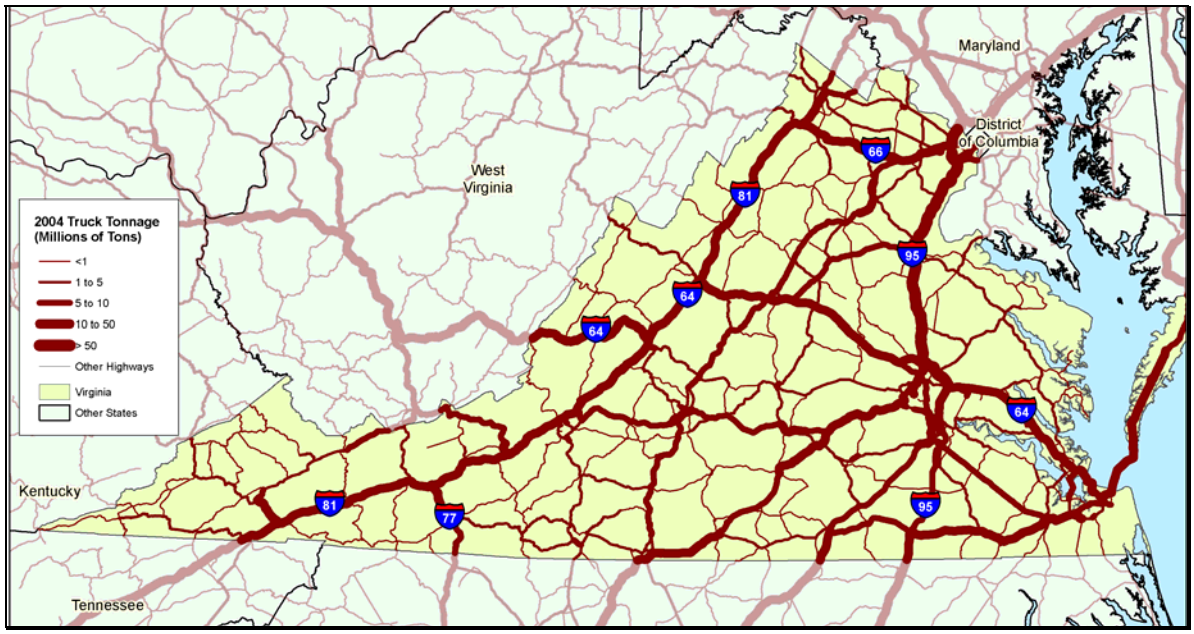
Figure ES.10 Average Truck AADT and Truck Percentages, All Count Segments
Virginia's Top 30 AADT Routes, 2005



Virginia's TRANSEARCH purchase included a set of "flow maps," where truck and rail origin-destination data was assigned to specific highway and rail system paths using national models. These flow maps are not consistent in every case with Virginia truck count data, but they are valuable in illustrating general characteristics, and particularly in describing how different types of trucks use Virginia's highway system.

Virginia-oriented truck trips – that is, trucks that are moving into, out of, and within Virginia, as opposed to passing through – represent around 57 percent of Virginia truck tonnage. According to TRANSEARCH, leading truck routes for this tonnage include: I-95, I-81, I-64, I-264, I-66, I-77, I-85, I-295, U.S. 29, U.S. 360, U.S. 460, U.S. 58, and U.S. 13.

Figure ES.11 Virginia's Inbound/Outbound/Internal Truck Tons
2004



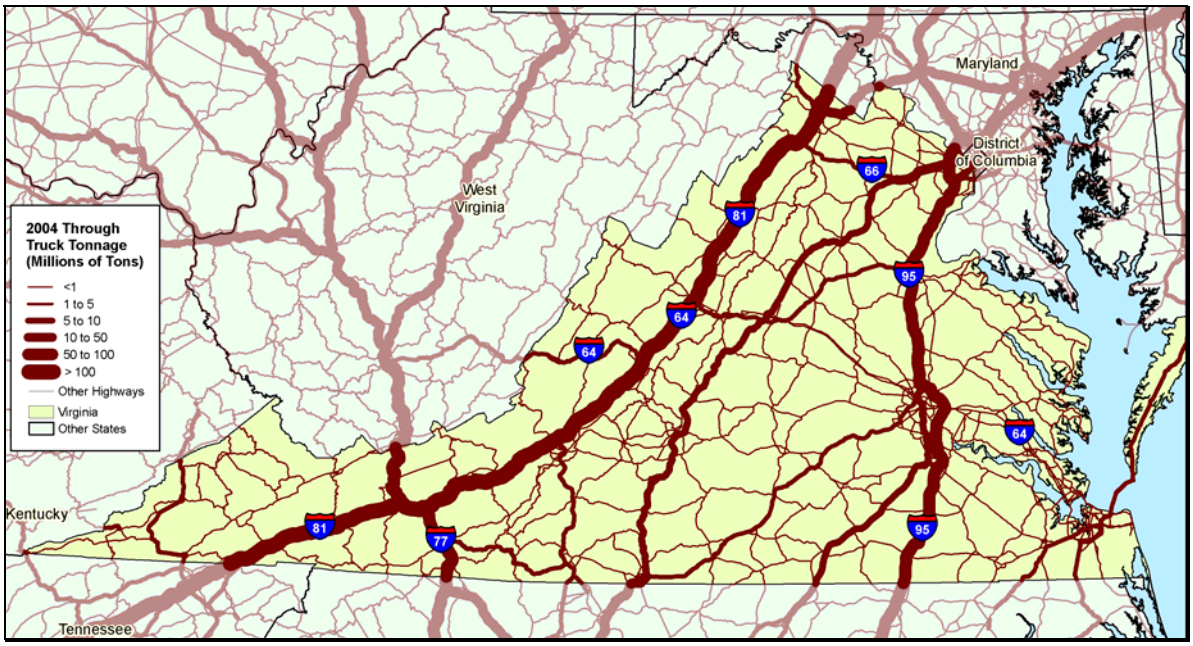
Through truck movements represent around 43 percent of Virginia truck tonnage. According to TRANSEARCH, the routing patterns for this tonnage tend to concentrate on a few key routes: I-81, I-95, and I-77, and to a lesser extent I-85 and U.S. 29. Previous studies by the Commonwealth – involving model estimation and field observation – have estimated that more than half of the trucks using I-81 are actually pass-through traffic. Recently, the Commonwealth performed a 24-hour truck survey at the two truck weigh stations on I-81, at Stephens City (near Winchester) and Troutville (near Roanoke). Preliminary results from these surveys generally confirm this finding. The Commonwealth plans to conduct similar surveys on other major truck routes.

Today, critical issues for Virginia's highway system include the following:

- **Roadway and bridge/tunnel condition.** Maintaining Virginia's truck network in a state of good repair and providing adequate dimensional capacities on its bridges and tunnels is essential. For instance, capacity constraints in the Hampton Roads Bridge Tunnel could act as a choke point for future shipping, and weight restrictions on inadequately maintained bridges will decrease the efficiency of the network.

- **Safety and emergency response.** Ensuring that truck routes are designed and maintained to provide for safe and secure operation, and that trucks operate in conformance with applicable regulations, is equally essential. One emerging safety issue is the growing use of roadway shoulders for overnight truck parking.

Figure ES.12 Virginia's Through Truck Tons
2004



- **System performance.** Trucking operations depend on highway capacity being available when needed. To the extent it is not available, their operations suffer, in the form of slower travel times, less reliable schedules, and higher costs. Within Virginia's urbanized regions – especially Northern Virginia, Hampton Roads, and Richmond – and on critical corridors, peak-period highway system performance is declining. Most of the decline is due to automobile traffic, which makes up the great majority of peak-period travel. Trucks contribute to the congestion, but also suffer from it. Virginia must find ways to preserve and improve the performance of its highways, through the appropriate combination of additional capacity and better utilization of existing capacity to accommodate both passenger and freight movement.

- **Intermodal connectivity.** Trucking is the "glue" that holds Virginia's freight system together. While some shippers and receivers have direct service by rail, water, or air, the majority depend on trucks to move their goods – picking up and delivering to rail terminals, seaports, or airports, moving to and from warehouse and distribution centers, or delivering door-to-door. Any deficiencies in Virginia's trucking system will have a direct ripple effect on other transportation modes, and throughout its economy as a whole.

- **Environment.** With increased trucking and increased population, the potential negative effects of freight activities are magnified. Factors such as truck emissions, fuel consumption, noise, and land use conflicts must be considered in freight system planning and regulation. Emerging issues such as climate change will require new and different approaches. Considering the potential growth of freight activities in the

coming decades, the Commonwealth will need to consider strategies that minimize their impact to the environment.

- **Industry support and partnership.** The trucking industry faces issues of driver attraction and retention, and the Commonwealth could be a partner in providing education and training. Similarly, there may be opportunities for the Commonwealth to expand the types of system information it provides to truckers – and for truckers, in turn, to provide more information on travel patterns and other issues back to the Commonwealth.

- **Time shifting.** In the off-peak periods, much of Virginia's highway system has excess capacity, apart from work zone-related delays. Many long-haul truckers whose schedules allow them to travel through Virginia's congested urban areas at night will do so. Perhaps more truck travel could occur at night, and perhaps some shorter-haul activity also could occur at night. However, much of the short-haul activity will continue to occur in daylight hours for several reasons: that is when most businesses are open, businesses are located in neighborhoods where off-peak/overnight deliveries would be disruptive, people do not want to receive deliveries at their homes at 3:00 a.m., and truck driver availability. Strategies to encourage greater use of off-peak highway capacity are an important opportunity, but must address not only the truckers, but also consider businesses and neighborhoods.

- **Mode shifting.** The Commonwealth has been active in exploring the potential to shift long-haul truck traffic to rail, to the extent this may prove feasible. Several background studies addressing I-81 have been performed, and another addressing truck-rail diversion currently is underway. The Commonwealth also has participated with its I-95 Corridor Coalition partners on the Mid-Atlantic Rail Operations Study, which considers diversion potential on both I-95 and I-81 routings. These opportunities hold promise, and determining the real benefits and associated costs is important to develop a basis for public investment decisions. Mode-shifting also applies to passengers – more transit use means fewer cars, which means more highway capacity is available for trucks.

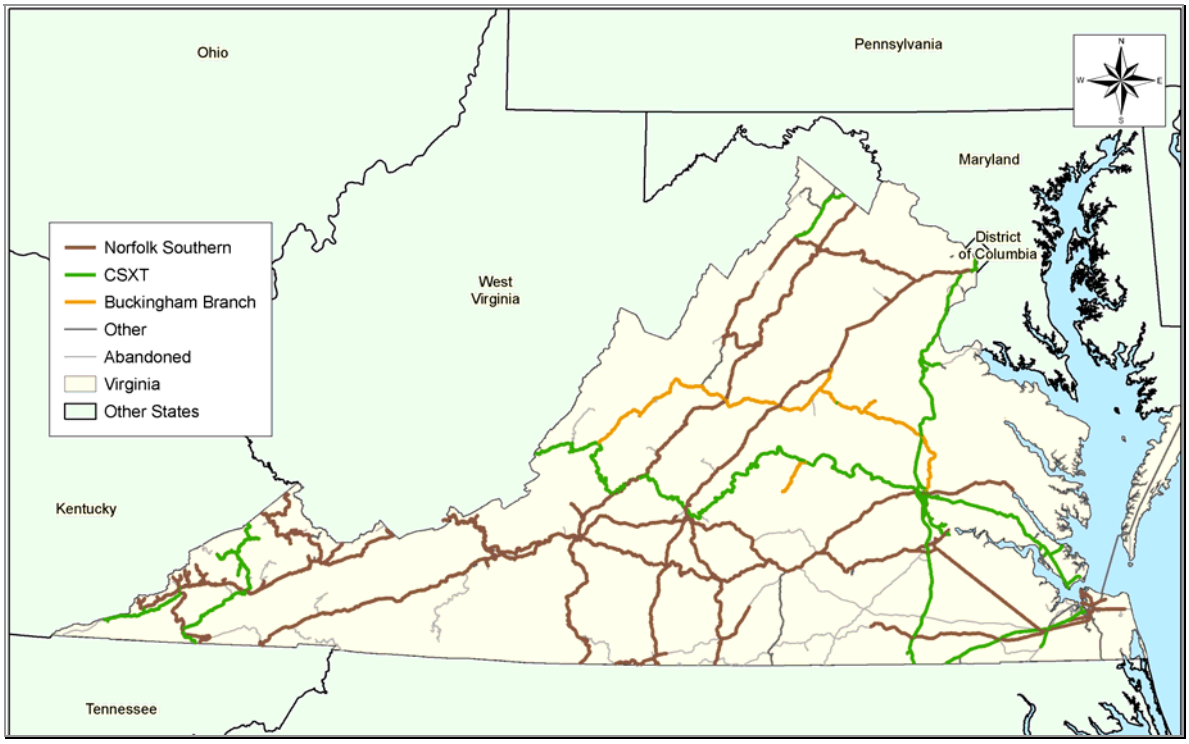
- **Funding.** Given that Virginia's funding for needed transportation improvements is highly constrained, and given that the private sector is a direct financial beneficiary of freight improvements, it stands to reason that partnership opportunities – where a portion of the private sector benefit is captured to support needed improvements – should be carefully considered. There also is a need to demonstrate a public sector benefit associated with investments in private sector infrastructure. Ensuring that pass-through traffic, which impacts the Commonwealth in terms of wear and tear on roads, congestion, etc., contributes its fair share to Virginia is a concern.

By 2035, the critical issue is: given the significant issues we face today, and the projected growth in population and nonfreight travel, how will Virginia deal with a projected doubling of truck tonnage?

Railroads

Virginia's rail system dates from the 1800s and has evolved continuously since then. Today, it consists of more than 3,200 miles, most of which are operated by two railroads – the Norfolk Southern Corporation (2,100 miles) and CSX (1,050 miles). (These two are considered "Class I" national railroads based on annual revenues.) Additionally, Virginia is served by five local railroads and two terminal and switching railroads. Two passenger systems – Amtrak and the Virginia Railway Express – utilize this trackage. Major lines run north-south and east-west, and important rail lines converge at key nodes: Norfolk, Richmond, Lynchburg, Roanoke, and Alexandria.

Figure ES.13 Virginia's Freight Rail System



TRANSEARCH data indicate that Virginia's freight railroads handled more than 180 million tons of freight in 2004. This includes inbound, outbound, internal, and pass-through shipments. According to the most recent data available (year 2005), Virginia's railroads originated over 66 million tons of freight and terminated almost 50 million tons of freight. In 2005, almost 60 percent of rail tonnage originated and terminated in Virginia was coal.

Freight railroads offer different types of services, and they use different types of equipment in each of these services.

- **Bulk services.** These utilize liquid or dry-bulk carrying railcars, preferably assembled in long "unit trains" consisting only of a single commodity and railcar type. Unit trains offer economies of scale because they involve long trains made up of a single railcar type, moving between major origins and destinations. Coal and grain are often moved in unit trains.

- **Intermodal services.** As defined by the railroads, intermodal means carrying containers (single-stacked on flat cars, or double-stacked in specially designed "well cars"), truck trailers (on flat cars), and even entire trucks (known as "piggyback" service). Some definitions also include "autoracks" (specialized two-level or three-level railcars carrying automobiles) as intermodal. Intermodal aims to provide a level of service comparable to trucking, with scheduled high-speed service.

- **Carload or "loose car" services.** Carload trains are made up of a mix of different types of railcars and commodities, coming from different origins and moving to different destinations. Smaller shippers and receivers who might use a few railcars per day or per week, or larger shippers and receivers who handle multiple types of commodities, are typical carload customers.

Figure ES.14 Examples of Bulk, Carload, and Intermodal Services



Virginia's TRANSEARCH flow maps show that the majority of inbound, outbound, and internal rail tonnage is moving in an east-west direction, between Appalachian coalfields and the port in Hampton Roads, roughly paralleling U.S. 460. Conversely, through tonnage tends to move in a north-south direction, on the CSX route paralleling I-95 and on the NS routes (the Shenandoah and the Piedmont) paralleling I-81. (There are some known anomalies in the TRANSEARCH routings of rail traffic, but the maps are useful for descriptive purposes.)

Figure ES.15 Virginia's Inbound/Outbound/Internal Rail Tons
2004

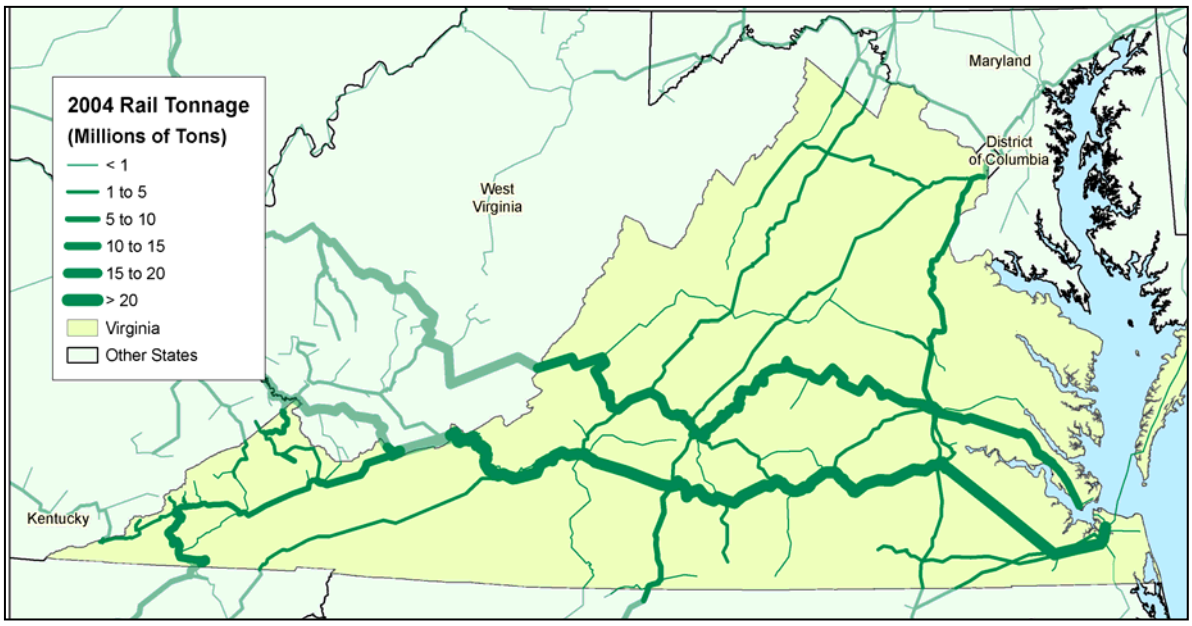
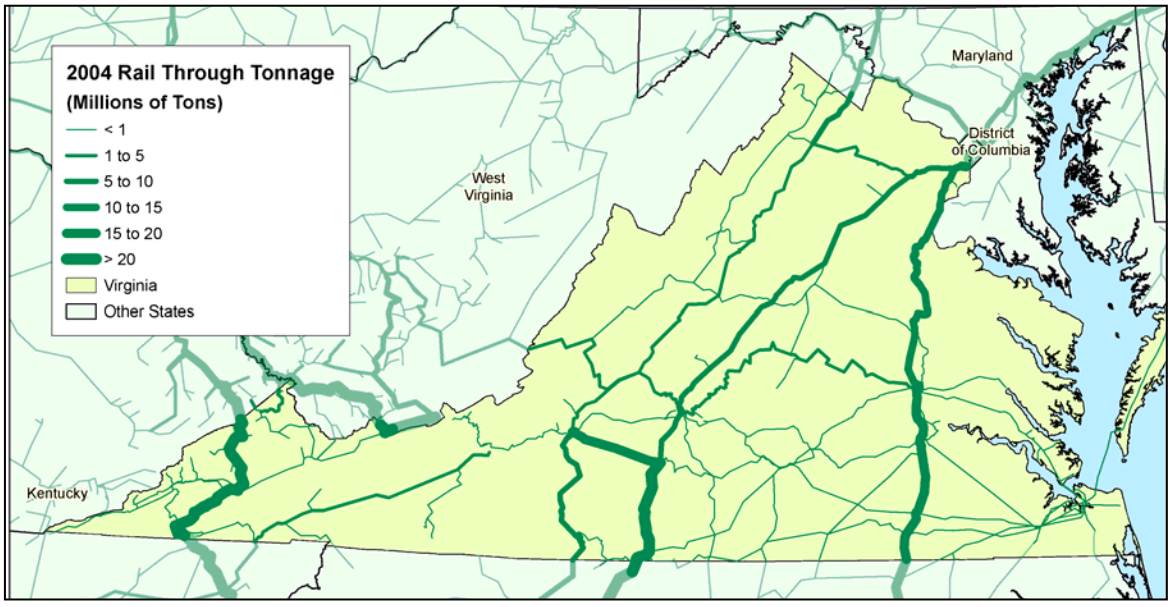


Figure ES.16 Virginia's Through Rail Tons
2004



Today, critical issues for Virginia's freight rail system include:

- Safety and security, particularly for at-grade road-rail crossings.

- **System preservation.** Without railroads, Virginia's truck tonnage would increase dramatically, and businesses that depend on rail would close their doors – so even though it is almost entirely in private hands, the Commonwealth's rail system is one of its primary transportation and economic assets.

- **System modernization and capacity improvements.** Over the past two decades, the nation's rail system has transformed much of its 19th century infrastructure to serve 21st century markets, with tracks and bridges that accommodate heavier railcars, and with improved double-stack intermodal corridors and railyards. Most of these investments have come from the rail companies themselves.

- **Public-private partnership opportunities.** There are some types of railroad improvement projects where public partnership may be appropriate. Generally, these are cases where the cost exceeds the investment ability of the railroad, and where the project generates a positive return to the public in the form of transportation, economic, and/or environmental benefits. Virginia currently is partnering with Norfolk Southern to develop the Heartland Corridor, which will upgrade an historic coal line between Hampton Roads and Columbus, Ohio to enable double-stack intermodal service. Other opportunities to upgrade rail lines paralleling I-81 and I-95 are under discussion.

- **Shortline assistance.** As the nation's rail system has evolved, many of its "last mile" connections to end users have moved from the Class I railroads to the shortlines, and in some cases these shortlines require public support for needed improvements. Virginia is meeting some of these needs through its Rail Enhancement Fund.

- **Port accessibility and service.** With strong anticipated growth in the movement of international shipping containers and other commodities through Virginia's ports, maintaining and improving rail service for marine terminals is critical. There are several projects advancing in this area.

- **Passenger operations.** In Virginia, passenger and freight rail service operate over the same tracks, potentially restricting the capacity of both. Virginia's freight rail system must accommodate growing levels of utilization by passenger rail service, safely and reliably.

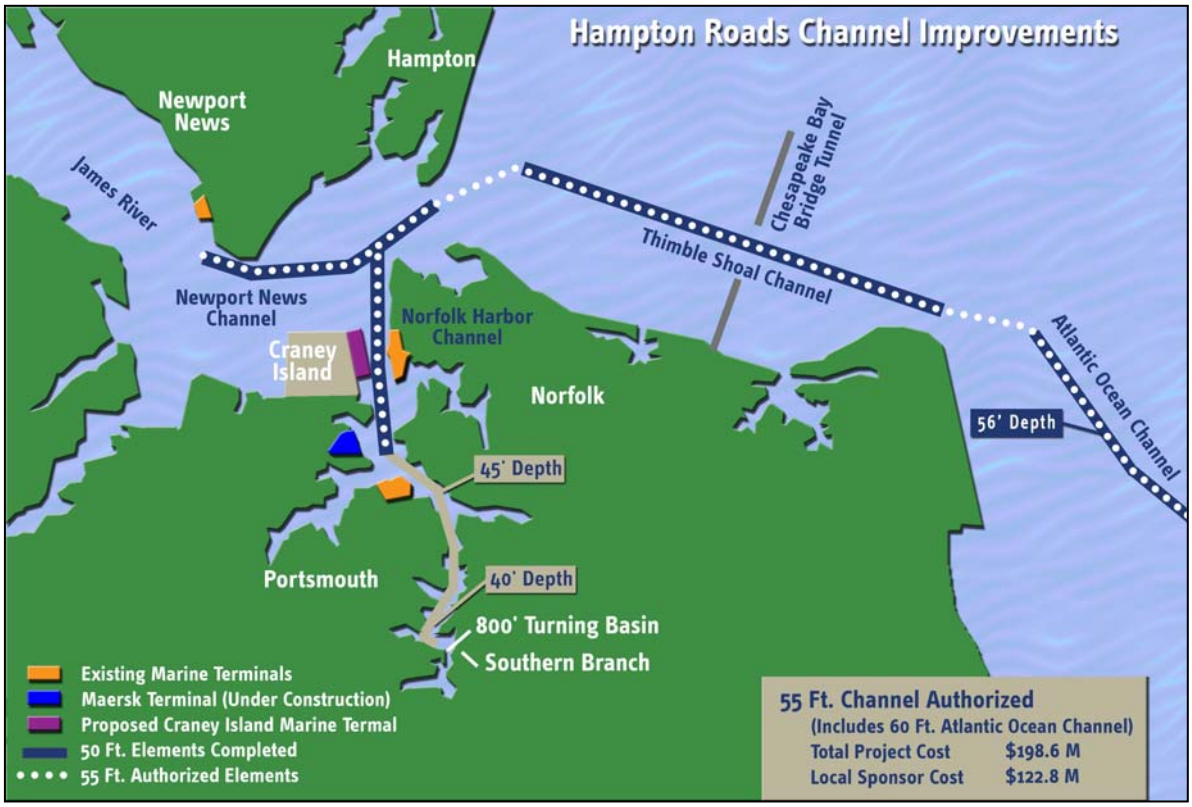
- **Multistate coordination.** Most rail freight travels long distances (e.g., greater than 500 miles), usually traversing multiple state lines. The success or failure of rail investments in Virginia may depend on corresponding investments in other states.

By 2035, the critical issue is: how can Virginia's rail system be preserved and upgraded to handle a projected doubling of tonnage, while also potentially relieving pressure on the highway system by diverting truck traffic to rail?

Ports

Virginia boasts the single best water transportation asset on the East Coast of the United States – the Chesapeake Bay and its tributaries. The Chesapeake Bay provides the deepest navigation channels for waterborne transportation of any U.S. Atlantic Coast port. Hampton Roads hosts the Virginia Port Authority's terminals (at Norfolk, Portsmouth, and Newport News), the new privately developed APM (Maersk) container terminal, the future Craney Island container terminal, and privately owned terminals handling coal and other commodities. The James River hosts the ports of Richmond and Hopewell, and the York and Appomattox Rivers also accommodate waterborne freight transportation facilities. Hampton Roads regularly ranks second or third (depending on the year) for container volumes among Atlantic Coast ports, and also is among the top 20 in the country for total tonnage.

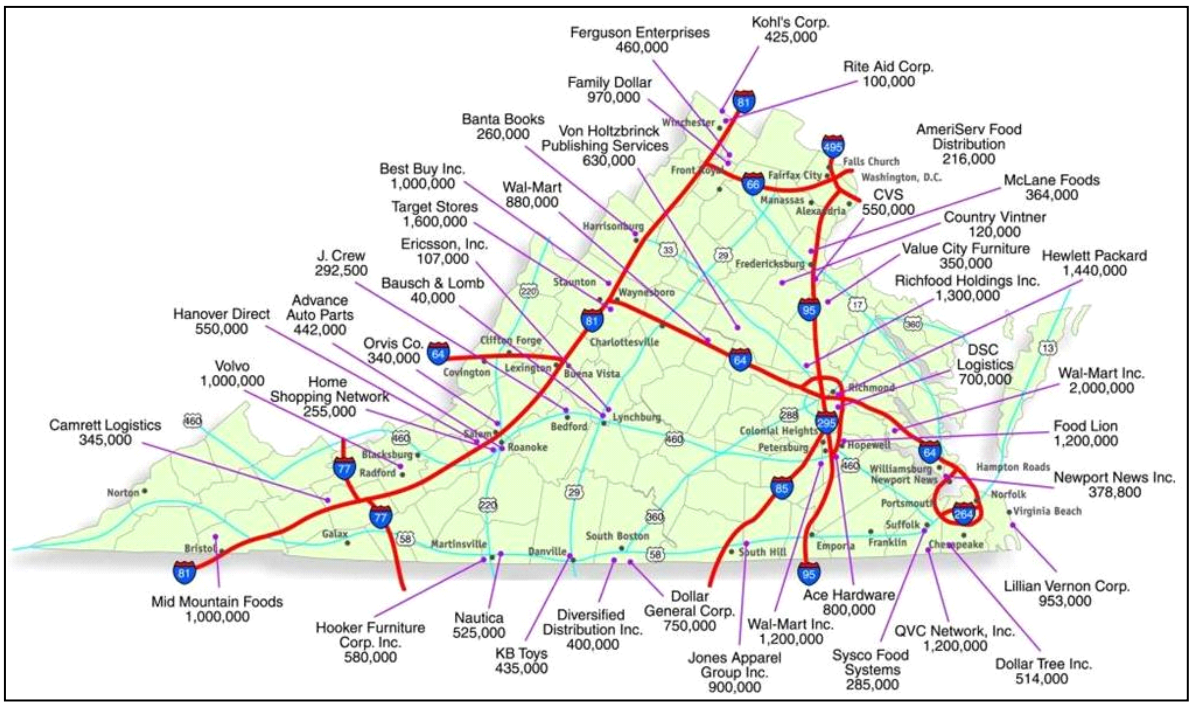
Figure ES.17 Virginia's Port Authority Marine Terminals and Channels



Virginia's ports are supported by an extensive and rapidly growing system of warehouse and distribution centers throughout the State, where containerized goods can be consolidated and distributed. This function is an essential part of the container logistics chain, and is both an economic development opportunity and a competitive advantage for

Virginia. Additionally, the Virginia Port Authority operates an "Inland Port" – supporting the truck and rail interchange of goods – at Front Royal.

Figure ES.18 Virginia's Distribution Centers and Square Footage



Today, the most significant port issues are:

- **Safety and security.** VPA and other U.S. ports are operating under heightened security procedures to ensure the safety and security of containers and other cargo.

- **Improving facilities to accommodate anticipated growth.** Port improvements tend to have very long lead times, especially if they involve channel deepening or landfill. Growth in international containers is conservatively forecast to triple over the next 30 years, and more aggressive forecasts envision VPA container traffic quadrupling. At the same time, international noncontainer traffic and domestic waterborne traffic is forecast to grow at a pace similar to truck and rail.

- **Preserving and upgrading the quality of landside access**, by truck and rail, to existing and planned future marine terminals.

- Planning for the additional warehouse and distribution facilities that will be needed to support container growth.

- **"Marine Highway" initiatives** that could potentially shift truck traffic to barges.

Through 2035, the critical issue is: how can Virginia best handle a tripling (or quadrupling) of container traffic, and a doubling of other tonnage, by improving port facilities and operations, while ensuring adequate landside access, safety and security, and environmental quality?

Airports

Virginia is served by four main cargo airports – Washington Dulles, Richmond, Norfolk, and Roanoke. In 2005, Washington Dulles (IAD) handled 303,012 metric tons of cargo which ranked it 23rd among all U.S. airports. Richmond, Norfolk, and Roanoke accommodated 49,614 metric tons, 31,791 metric tons, and 14,333 metric tons, respectively.

Figure ES.19 Virginia's Cargo Airports

Currently, Virginia's airports do not suffer from significant freight movement bottlenecks. Airport capacity and on-time arrival statistics indicate no undue stress on the air cargo network. Given that air cargo tonnage is projected to triple, opportunities to improve the quality of international and domestic services through Virginia's air cargo gateways will need to be explored. One possible opportunity is to capture more of the current "truck-air" market, which is Virginia traffic that is trucked to and from out-of-state airports like JFK that offer more frequent wide-body passenger flights to more destinations. In the future, growing passenger volumes will generate significant airport improvements on both the airside and ground access systems, and freight will benefit from them.

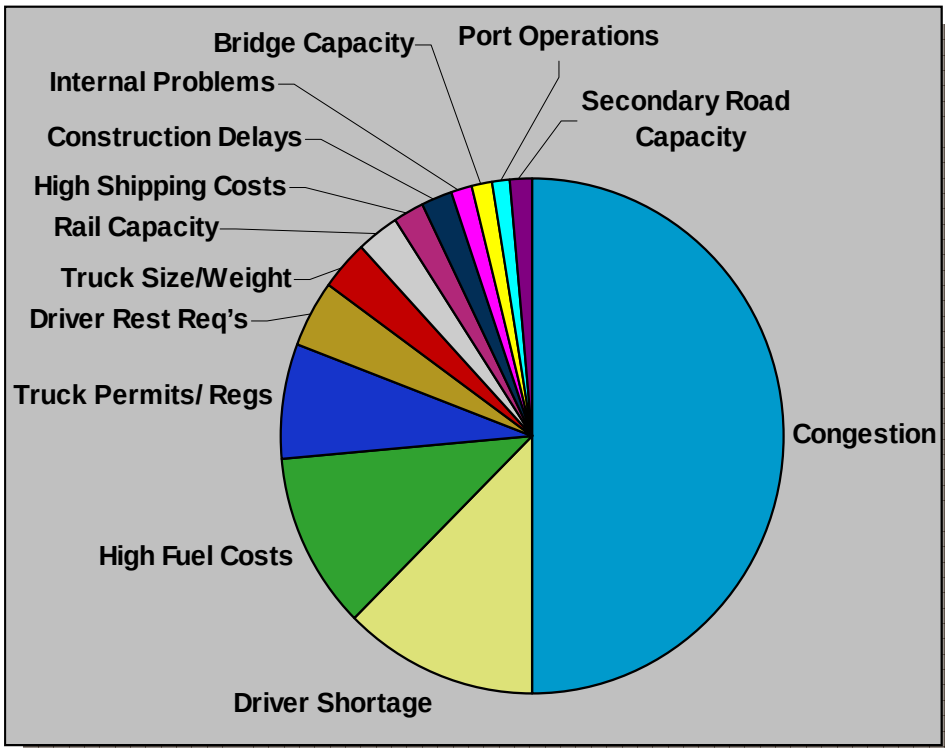
Through 2035, the critical issue is: how can Virginia best handle a tripling of air cargo traffic, within the context of growing passenger demand through Virginia's airports?

■ Stakeholder Input

Stakeholders across Virginia have a vital interest in the Commonwealth's freight transportation system. Over 180 stakeholders, representing a wide range of firms and organizations within Virginia, participated in a phone interview process. Manufacturing firms accounted for most of the interviewees, followed by distribution firms (trucking firms, wholesalers, etc.), and an assortment of retail, mining, agricultural, and other firms. Firms of all sizes were included, with 68 percent of interviewees representing firms with less than 250 employees and 11 percent representing firms with more than 1,000 employees.

When directly asked whether or not the freight system in Virginia is adequate for their needs, 63 percent of the respondents indicated that it is. Regionally, the proportion of "satisfied" responses varied from a high of 80 percent in the Blacksburg region to a low of 25 percent in the Northern Virginia region. Many respondents who indicated Virginia's freight system was adequate also reported they had concerns about some aspect of that system.

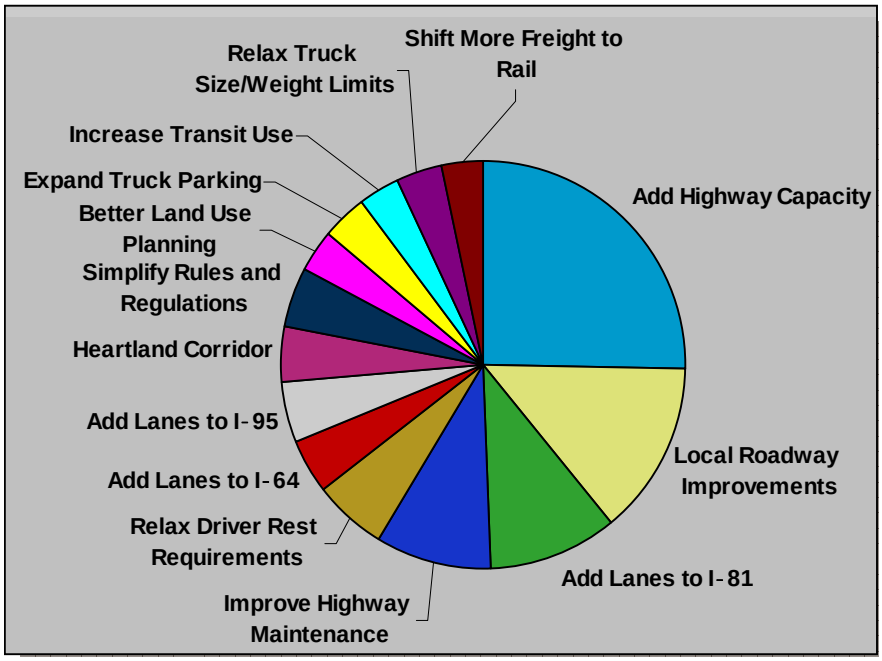
Figure ES.20 Freight Issues Reported by Stakeholders



The problem or bottleneck most often cited by respondents was highway congestion. There also are a number of other reported problems such as driver shortages, high fuel costs, and problems with permitting and regulations.

When asked about potential improvements, most respondents focused on adding highway capacity in one form or another – generically throughout the system, or locally in the vicinity of their facilities, or specifically on I-81, I-64, and I-95. Other trucking-oriented suggestions included: improving highway maintenance; relaxing driver hour of service requirements and size/weight limits; and expanding truck parking. Suggested rail improvements included construction of the Heartland Corridor and shifting more freight to rail. Finally, a few respondents identified better land use planning and increased transit use as strategies that could benefit freight transportation in the Commonwealth.

Figure ES.21 Freight Strategies Suggested by Stakeholders



Stakeholders were consistent in citing congestion as Virginia's top freight issue because so many of them depend on trucking, whether alone or in combination with rail, water, and air – and because congestion means higher costs, less reliability, and more difficulty in operating their businesses.

According to the FHWA studies, congestion adds $7 billion per year to shipper inventory costs. Cowan Systems, a trucking firm based in Maryland, reports that the "unpredictability of pickup or delivery can increase load cost by 50 percent to 250." UPS reports that in Maryland, the average UPS truck delivery is delayed 36 minutes, costing them $1.1 million annually.

Based on FHWA's Highway Economic Requirements System (HERS) model for Virginia, in 2005, trucks on Virginia's roads experienced an estimated 8.4 million hours of delay versus free flow conditions, with an equivalent cost of $278 million. The HERS model suggests that with average annual roadway maintenance and improvement expenditures of $2.7 billion per year – close to what Virginia currently spends – Virginia truck delay could increase to 14.0 million hours in year 2035, with an equivalent cost of $466 million in current dollars.

Multimodal Needs and Planned Improvements

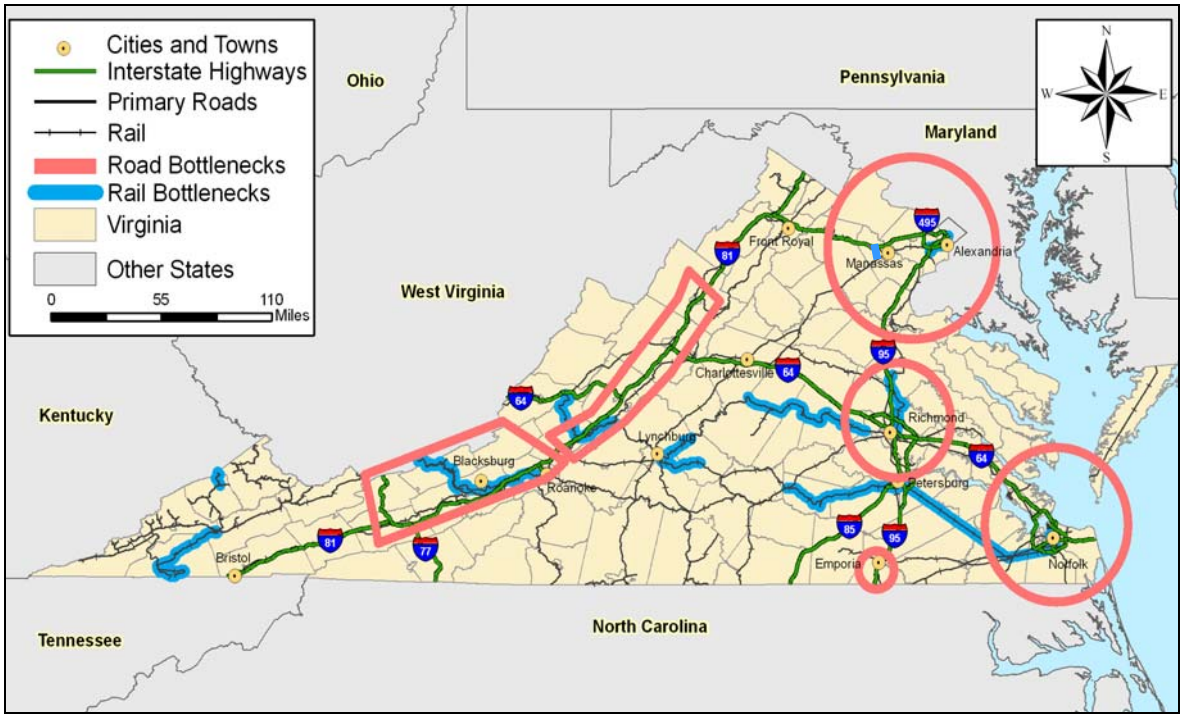
Multimodal Needs

Virginia's freight transportation system is performing, overall, at a level sufficiently high to support the Commonwealth's vibrant economy, and to accommodate high levels of global trade as well as pass-through traffic. The critical challenge will be to address current deficiencies, to maintain and improve levels of performance in the face of projected growth in freight volumes, and to ensure that Virginia's producers and consumers continue to benefit from safe, secure, and efficient freight movement.

Virginia's freight transportation system contains segments that are stressed or over subscribed to the point that they are defined as bottlenecks. Bottlenecks – whether existing or emerging – prohibit the efficient flow of freight through the system and across the Commonwealth. Bottlenecks are created by a combination of demand to utilize a transportation asset (both freight and passenger), the capacity of the asset, and fluctuations in the demand at different points in time. A bottleneck slows down the system regardless of its mix of passenger and commercial vehicle traffic. Currently, Virginia's primary freight bottlenecks generally correspond to:

- Major urbanized regions with high levels of congestion (Northern Virginia, Hampton Roads, Richmond);
- Major national through-travel corridors (I-95, I-81);
- Intersections of major highway arteries (I-495/I-95, I-77/I-81, I-64/I-295/I-95);
- Routes with few or no alternatives (Hampton Roads Bridge Tunnel, Monitor Merrimac Memorial Bridge Tunnel);
- Rail system points where infrastructure provides inadequate freight capacity or dimension, especially where growing freight and passenger needs must be accommodated over shared infrastructure; and
- Access into and out of heavily used marine terminal facilities, and links between marine terminals and related inland facilities and warehouse/distribution centers.

Figure ES.22 Selected Virginia Freight Bottlenecks



The Commonwealth has a wide range of initiatives underway that will address freight bottlenecks. Some are freight oriented, while others benefit both freight and passengers. Some focus on a single mode, while others are based on the concept of multimodal and cross-modal benefit.

Highway Improvements

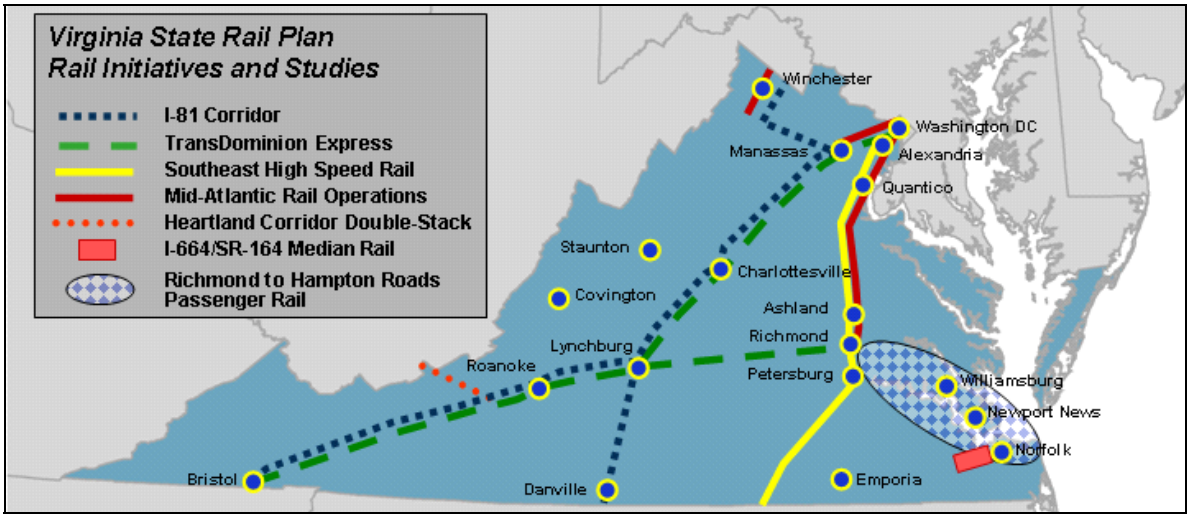
Much of Virginia's transportation planning energy and funding is focused on highway issues and solutions. Key projects and initiatives include: the I-81 Near-Term Safety Improvements and Corridor Improvement Study; the I-81 Freight Rail Study (which explores the potential to divert trucks to rail); various I-95/I-395/Capitol Beltway improvement projects, including HOT (high-occupancy toll) lanes and toll lanes; I-66 Improvements; Route 460 Location Study; I-64 Improvements; potential Hampton Roads Third Crossing; I-564 Port Connector; and the Route 29 Corridor Study Phases II and III.

Other opportunities and innovative strategies may include: truck toll lanes; congestion pricing; expanded use of HOT (high-occupancy toll) lanes; time-shifting strategies to encourage off-peak highway use for both freight and passengers; truck parking improvements; advanced truck information systems; and truck-to-rail modal diversion opportunities, to the extent feasible.

Rail Improvements

Today, at the system level, there are numerous rail chokepoints throughout the Commonwealth. Typical chokepoints include limited height and weight capability, insufficient mainline capacity, at-grade highway crossings, conflicts with passenger trains, and insufficient yard capacity. In 2004, the Virginia State Rail Plan (VSRP) identified a series of high-priority initiatives, including: the NS Heartland Corridor line between Hampton Roads and Columbus, Ohio; I-664/SR 164 Median Rail (providing service to the Virginia Port Authority's planned container terminal at Craney Island); upgrades to the CSX mainline line paralleling I-95 between Richmond and Washington, D.C.; and development of the NS corridors paralleling I-81 for high-speed intermodal service.

Figure ES.23 Virginia's State Rail Plan Initiatives and Studies



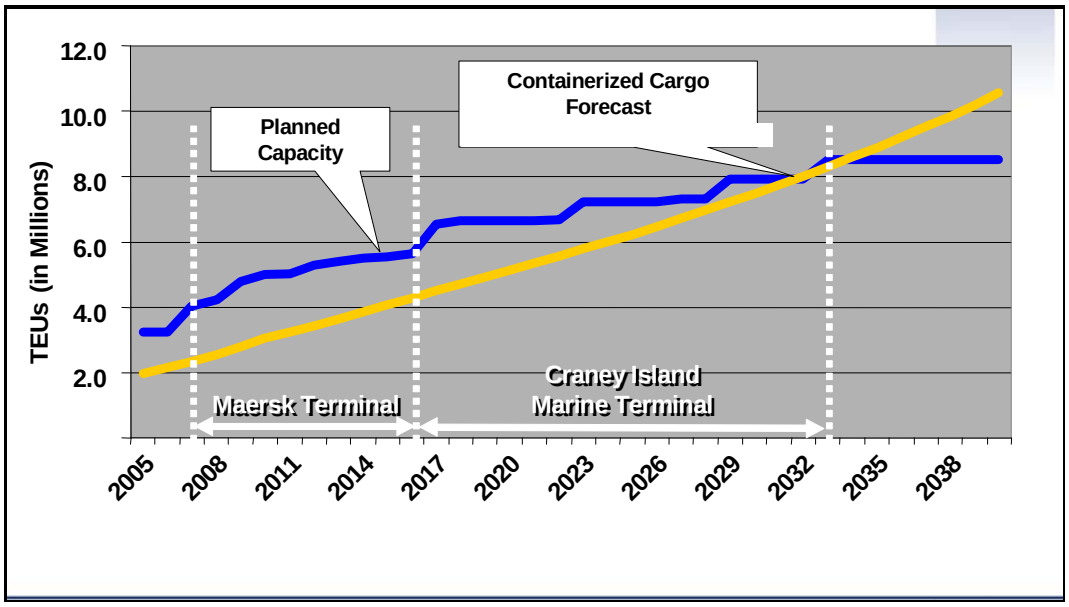
In addition to the Virginia State Rail Plan initiatives, other projects are being advanced through the Virginia Rail Enhancement Fund, a special fund dedicated for rail system improvements, including: Virginia's contribution to the Heartland Corridor; acquisition of the Commonwealth Railway as part of the I-64/Route 664 Median Rail project; APM (Maersk) Terminals Rail Yard Expansion; and other projects. Other opportunities and innovative strategies may include: multistate rail funding compacts for projects with multistate benefits; advanced rail technologies; intermodal logistics center development; utilization of short-haul rail; development of improved north-south rail markets and services; and the potential for competitive Class I rail access to port facilities.

Port Improvements

With respect to ports, the Virginia Port Authority is undertaking a very aggressive expansion plan under its VPA 2040 Master Plan. Currently, VPA handles around two million TEUs (20-foot equivalent units) of container traffic annually. The three

existing VPA terminals (Norfolk, Portsmouth, and Newport News) are increasing capacity through strategic capital projects, and the new privately developed APM (Maersk) terminal is under construction; when these are completed VPA should have the capacity to handle six million TEUs. Another 2 million TEUs of capacity will be provided by planned development of Craney Island. If these are implemented, VPA's marine facilities should be able to handle projected demand through 2035.

Figure ES.24 VPA Container Cargo Demand and Planned New Capacity



Source: VPA Master Plan. Forecast numbers prepared in 2005 and represent average increase over the forecast period.

Other port opportunities and innovative strategies may include: Upgraded on-dock rail capacity (to reduce truck moves between terminals and railyards, and encourage the use of rail); port-related intermodal park and distribution center growth; barges and "marine highway" initiatives; and support for implementation of information and security technologies such as electronic seals.

Airport Improvements

Finally, with respect to airports, each of Virginia's cargo airports makes significant investments according to its own capital improvements plan. Airside improvements such as runways, as well as landside access improvements, benefit freight as well as passengers. At Dulles, extension of Metro to Dulles Airport will free up capacity on the existing two-lane toll road for use by autos and trucks.

This study did not identify significant air cargo bottlenecks. However, positive opportunities for Virginia airports to be more competitive with out-of-state airports for

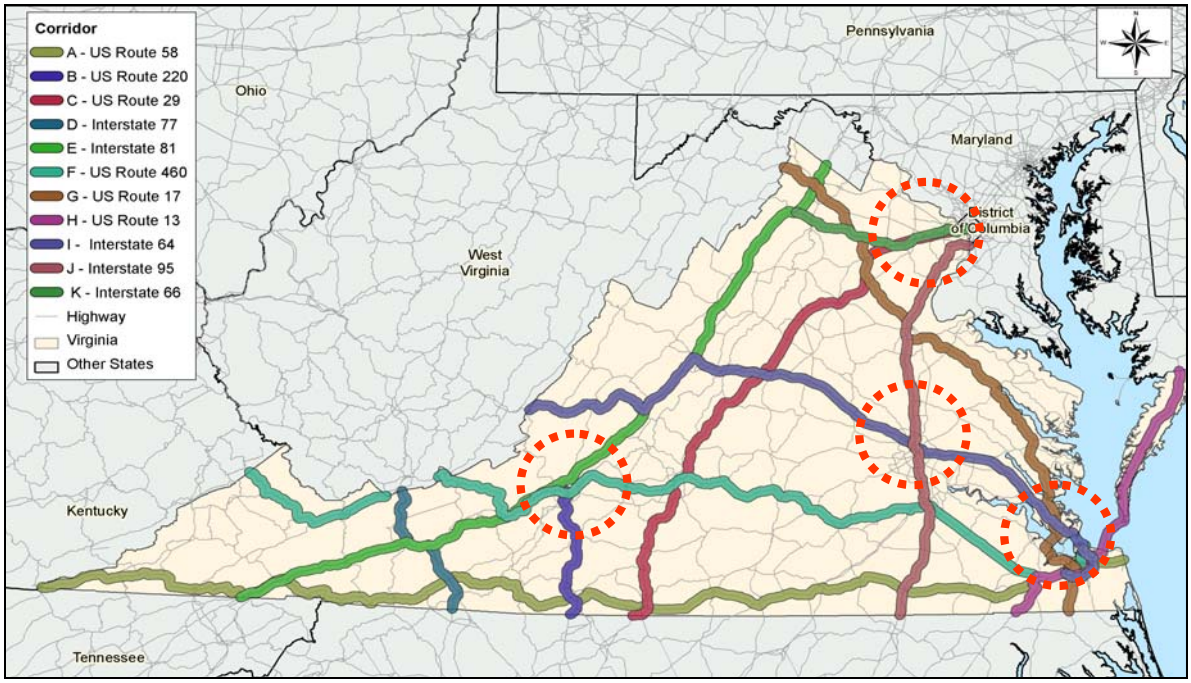
international services, as well as the potential for increased domestic cargo service from existing and additional airports, should continue to be explored.

Taking a Multimodal Approach

Virginia's public transportation agencies, communities, and private stakeholders already have done extensive work in identifying and advancing freight-supporting infrastructure projects. Phase II of the Statewide Multimodal Freight Study aims to evaluate these projects and identify additional opportunities. Freight advocates would like to see all freight-benefiting projects advanced as soon as practical, but it must be recognized that progress on many – if not most – will depend on the identification of new revenues, and the timetable for accomplishing this is far from certain. In the meantime, due to funding limitations, project opportunities will need to be carefully prioritized and tradeoffs evaluated, to obtain the greatest public benefit for the least public cost.

This requires a multimodal approach to transportation planning that considers all modes in the context of critical corridors and planning subregions, addresses the interrelated effects of improvements to one mode on the other modes, integrates freight and passenger mobility, and aims to maximize public benefit and return on public investment regardless of mode or location.

Figure ES.25 Critical Corridors and Subregions for Multimodal Freight Planning



Conclusions and Next Steps

Phase I of the Virginia Statewide Multimodal Freight Study was designed primarily to collect data, inventory conditions and needs, and draw general conclusions. These conclusions include the following:

- Maintaining and improving freight system performance – in terms of travel time, cost, reliability, capacity, safety, and security – will enhance Virginia's competitiveness and attractiveness as a business economic location, as a preferred gateway for global trade, and as one of the nation's most attractive places to live and work.

- Currently, Virginia's freight system is generally performing at a high level, but it faces increasing pressure to maintain performance and keep pace with growing demand.

- Virginia has significant freight needs, with significant costs, and very constrained funding for improvements. It is critical to make the most efficient use of Commonwealth resources, public-private partnership opportunities, and innovation. This requires a multimodal approach to freight transportation planning and programming, supported by the best available data and analytical tools, and informed by meaningful input from public and private interests.

- The next step is to develop freight policy and infrastructure recommendations, along with the transportation and economic analyses necessary to support them.

Phase II of the Virginia Statewide Multimodal Freight Study is envisioned to have five major components:

- Data and analytical tools development, addressing both freight transportation system modeling and economic cost-benefit analysis.

- Freight project planning for critical corridors and subregions, including freight planning analyses, including identification and analysis of recommended multimodal projects.

- Statewide policy analysis, addressing program-level impacts, regulation, funding, and other priority issues, with identification of recommended approaches.

- Expanded public and stakeholder outreach, to obtain input and feedback on potential strategies and recommendations.

- Institutional and organizational recommendations to help the Commonwealth best approach freight challenges in the coming years, through performance-based freight planning.

Finally, Phase II should address a series of difficult but important questions:

- Given Virginia's projected freight needs, and given the improvements that already are in the planning stages, is it enough? Or will there still be critical deficiencies?

- What are the economic and transportation infrastructure costs to Virginia of these deficiencies? Conversely, what are the economic benefits of addressing them?

- What additional improvements – whether infrastructure, policy, or institutional – will be needed to meet Virginia's emerging and future needs? How will critical corridors and regions be affected? What are the key scenarios and variables for growth, the environment, and other critical factors?

- How will needed improvements be funded? What are the fair and appropriate contributions of governments, and of the private sector?

- How should the Commonwealth approach freight planning on a consistent institutional basis, with its public and private sector partners, in Virginia and other states?

1.0 Introduction

1.1 Ten Reasons Why Freight Matters

Virginia was settled as a trading colony. Its economy was founded on agricultural production and trade, by land and by water. As Virginia grew, it produced a wider range of materials and products, and its growing population consumed a wider range of materials and products; and this activity, in turn, was supported and promoted by an expanding transportation system.

Today, freight movement remains an essential element of Commonwealth's economy and transportation system. Virginia hosts one of the nation's leading deep-water international seaports and several important river ports, two national "Class I" freight railroads and numerous local and regional railroads, four major cargo airports, and some of the nation's most heavily used truck corridors (particularly I-95 and I-81).

Yet freight movement remains, to many, an activity whose surface impacts are clearly visible, but whose deeper purposes and benefits may be seen as irrelevant, or perhaps not seen at all. Understanding why freight movement is a critical issue today for the Commonwealth of Virginia requires consideration of the following factors:

1. **Freight movement is essential to Virginia's overall economy.** Freight movement, and the underlying production and consumption activity it supports, accounts for over $350 billion (around 28 percent) of Virginia's Gross State Product annually. Freight-related industries employ more than one-third of Virginia's total workforce.

2. **Many Virginia industries are highly dependent on freight movement for their business operations.** "Freight intensive" industries – such as energy, food and agriculture, wood and paper, chemicals, and mining – require freight movement to receive and ship raw materials, intermediate products, and finished goods. For "goods movement" industries – trucking, railroads, air cargo facilities, ocean and river ports, and warehouse/distribution centers – freight movement is their livelihood. Finally, retailers of all kinds depend on freight movement to stock their warehouses and shelves. Freight utilizes all of Virginia's multimodal transportation system – its highways, railroads, deep water and river ports, and airports. This system is Virginia's bridge to regional, national, and international markets, and its gateway to the national and global economy.

3. **Efficient freight movement benefits Virginia's residents.** Virginians buy food, clothing, automobiles, electronic equipment, household goods, and other products every day. Some of these products arrive at their doorstep – usually by van or small truck. Some are picked up at retail outlets, after being delivered there by truck.

Virginians live in houses or apartments that were built from materials that came to the jobsite by truck. In each case, this is the last step in a "logistics chain" that often starts hundreds or even thousands of miles from the end user, and often involves aircraft, ships, and railroads as well as trucking.

4. **The benefits of freight movement are not delivered without costs.** Freight movement consumes capacity on highways, rail networks, airports, and seaports, contributing to congestion. Operations from trucks, trains, ships, and airplanes contribute to air emissions, noise, public safety, and other environmental effects. Freight activities may be, in some cases, incompatible with other existing or anticipated land uses.

5. **Much of Virginia's freight transportation system is operating at a high level of efficiency and performance, but there are critical physical and operational chokepoints throughout the system.** Some of these chokepoints represent modes, or places, or times, when the flow of freight is impeded. Some represent locations or actions where freight activities create undesirable impacts. Either way, these chokepoints create inefficiencies and effects which are paid for – directly or indirectly – by Virginia's businesses and residents.

6. **Virginia freight tonnage is projected to double over the next 30 years.** There are many factors that can influence how much growth will be realized and which modes will be most impacted. Regardless, more growth means more stress on Virginia's transportation system, and the likelihood of more freight chokepoints in the future.

7. **Addressing freight chokepoints requires public-sector actions to change private-sector behaviors.** Freight movement is, first and foremost, a series of private sector economic transactions. These transactions manifest themselves in three roughly parallel flows: the flow of physical materials or goods, the flow of information about those materials or goods, and the flow of money that makes the transaction possible. Physically, freight tends to flow by modes, and in corridors, and in time periods, that offer the "path of least resistance" – that is, the most desirable combinations of cost, speed, and reliability. Building (or not building) freight infrastructure improvements, and regulating (or not regulating) freight operations over this infrastructure, is how the public sector changes the economics of freight, and influences private sector choices about what freight to ship where, when, and how. This, in turn, affects how the benefits and impacts of freight movement are distributed, and the extent to which chokepoints are successfully addressed.

8. **With growing transportation system needs for both passengers and freight, and with rising project costs and limited funding, the Commonwealth needs to be especially careful to ensure that its freight investments are structured to deliver the maximum "return on investment."** Virginia has been investing in its freight infrastructure since the settlement of Jamestown, and it continues to do so today. The Commonwealth invests public dollars in highways and bridges, ports, airports, and railroads. Recognizing that freight investments benefit both the public and the private sectors, many of the opportunities recently or currently being explored by the Commonwealth involve significant private investment capital.

9. **Changes in the freight movement industry are forcing the public sector to embrace next-generation transportation planning strategies.** One important change is that supply chains are lengthening – more goods are moving internationally or domestically over longer distances. This means that each ton of freight is moving more miles, often as part of trips that involve multiple modes and moving through multiple states. Within the national freight system, Virginia is a crossroads state, and much of its freight is "pass through." Conversely, much of Virginia's freight passes through other states. This requires that effective freight planning be multijurisdictional in nature, considering opportunities and constraints throughout multistate corridors; it also requires multimodal planning, to address the appropriate roles and potential tradeoffs among investments in different transportation modes. Freight demands closer integration between transportation and economic development planning, and between transportation and land use planning. All of these approaches are supported by an increased emphasis on "performance based planning," which sets appropriate performance targets and measures progress towards them.

10. **"Freight happens."** Regardless of what, or whether, one thinks about freight movement, the simple fact is: freight happens, and it will continue to happen in Virginia as long as people live, work, and eat. The challenge from a public perspective is how to plan actively to guide and accommodate freight movement in a way that minimizes public burdens while maximizing public benefits.

1.2 Virginia's Freight Challenges and Opportunities

Through the year 2035, the forecast is for significant growth in the demand for freight movement into, out of, within, and through Virginia. Some of the Commonwealth's freight infrastructure is well-positioned to accommodate this growth. But much of its infrastructure will be challenged – from normal wear and tear; from growth in the amount, type, and location of freight movement; from increased passenger traffic over shared highways and rail corridors; and from environmental pressures associated with higher freight volumes and/or denser settlement patterns in and around major freight facilities and corridors. Almost 80 percent of Virginia's freight tonnage has an origin or a destination in another state – including 40 percent which is simply passing through Virginia on its way to and from other states – so growth and freight improvements in other states, or the lack thereof, could profoundly affect conditions in Virginia.

In meeting these challenges, as with all its transportation and public policy challenges, Virginia faces the critical problem of how to meet the greatest need, and derive the greatest public benefit, from constrained funding.

The opportunity before the Commonwealth is to make freight investments that generate significant public benefits and offer a positive return on public investment for the Commonwealth's economy, transportation system, and environment. Efficient freight

movement means lower costs for industries and businesses that depend on freight transportation, helping them (and Virginia's economy) grow and prosper, and making Virginia a more attractive place to do business. In turn, lower costs of transporting goods to market also benefits Virginia's consumers, in the form of lower prices. Taking a "systems approach" to freight movement – guiding it to the corridors, transportation modes, and travel time periods where the transportation system can provide the most capacity with the least cost and least environmental impact – can help offset the negative consequences of freight activities. Freight mobility improvements benefit passengers, and vice versa, because much of Virginia's transportation system is shared between them.

Over the past decade, Virginia has emerged as a national leader in addressing freight issues. Virginia has made, and continues to make, significant investments in its ability to move freight – by truck, rail, water, air, and "intermodally" among and between these modes. There are many studies, plans, and programs underway to improve Virginia's interstate and state highways, its ports and marine terminals, its freight rail corridors and terminals, and its airports. Freight has been addressed by each of Virginia's modal transportation agencies, through multimodal planning activities, and by several of Virginia's Metropolitan Planning Organizations. These efforts address not only public projects within Virginia, but also public projects involving partnerships with other states, as well as partnerships with the private sector stakeholders that benefit directly from freight system improvements.

1.3 The Virginia Statewide Multimodal Freight Study

To build on and supplement these efforts, to place them within a larger multimodal investment context, and to establish a guiding framework for near-term and long-range freight policy and investment strategies, the Commonwealth of Virginia has undertaken the Virginia Statewide Multimodal Freight Study. The Study is designed to:

- Compile available freight information – which exists in multiple places, from multiple sources – and fill in gaps, to tell the story of the Virginia's entire intermodal freight transportation system;

- Identify current needs and projected future needs for each mode, for the system as a whole, and for designated multimodal corridors and subregions of critical interest;

- Develop an understanding of the contributions that freight makes to Virginia's economy, clearly understand the benefits and costs of improving – or failing to improve – Virginia's freight transportation system, and create a "return on investment" framework for decision-making;

- Form substantial, implementable recommendations and solutions for Commonwealth planning and programming;

- Address the critical roles that other levels of government and the private sector can and must play; and

- Be grounded in a comprehensive outreach effort that reaches a full range of public and private stakeholders.

Phase I of the study, which is documented in this ***Report***, primarily addressed tasks related to outreach, data collection, baseline forecasting, system inventory/analysis, and freight improvement opportunities. The material in this ***Report*** is supplemented by: a) an ***Executive Summary***, enclosed and also available in stand-alone form; b) a separate ***Appendices*** document, which provides additional maps, data tables, and figures; and c) a separate ***Interview Summaries*** document, presenting results of stakeholder interviews.

Phase II of the study, now underway, will develop analysis tools, analyze corridor and regional freight needs and alternatives, and evaluate infrastructure and policy alternatives based on public benefits and return on investment to the Commonwealth.

2.0 Virginia Demographic, Economic, and Industry Profiles

2.1 Overview

Freight movement has been described by the U.S. Department of Transportation as the "economy in motion." This description highlights the key fact that freight movement is, first and foremost, an economic activity related to producing and consuming goods.

The physical movement of freight – by truck, rail, water, air, and pipeline – is a critical part of this economic activity. In turn, the physical movement of freight is supported by flows of information about the freight being moved, some of which moves physically with the freight and some of which moves through separate electronic channels.

The relationship between freight activity and the Virginia economy is strong and multi-faceted. Many industries rely heavily on the efficient movement of goods, both for the outbound shipments of their products to national and global markets, as well as for inbound shipments of intermediate goods required for production. The transportation sector – including ports, airports, railroads, trucking, warehouse and distribution activities – is itself an important and growing component of the Commonwealth's economy.

Around 50 percent of Virginia's output, 28 percent of its gross state product, and 34 percent of its employment, is from freight-related industries that depend heavily on the movement of raw materials, intermediate goods, and/or finished products. Virginia ranks among the faster growing states in the nation, whether measured by its rising population, overall income gains, or economic growth. The robust pace of economic growth puts pressure on the Commonwealth's transportation system as well as on all other aspects of its infrastructure.

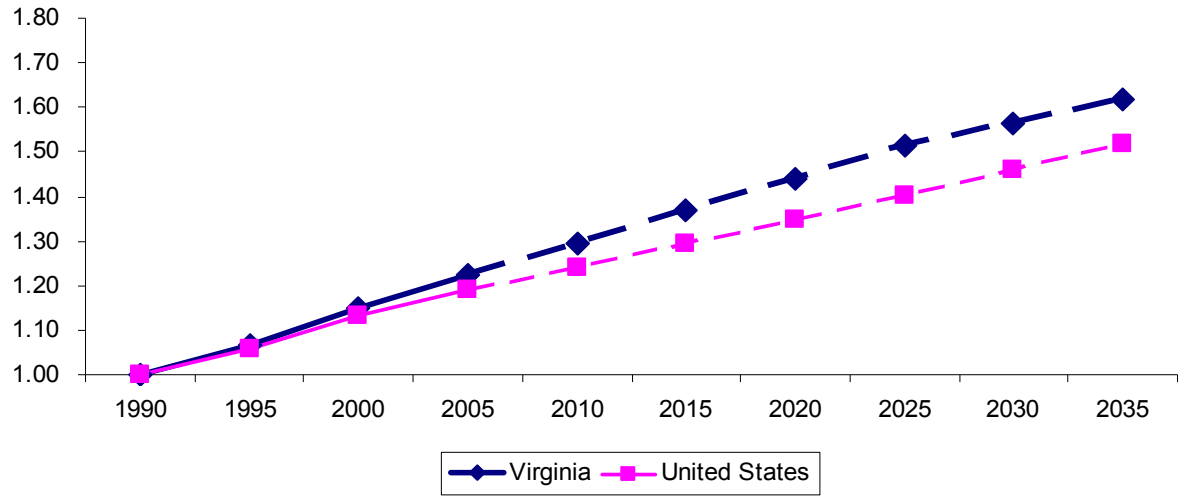
To understand freight movement in Virginia, it is therefore useful to start with the key economic drivers – Virginia's industries, which produce some goods and consume others, and Virginia's population, which staffs Virginia's industries and which consumes finished products. This chapter reviews recent and projected demographic and economic growth, changing trends and growth within major industry sectors, and the importance of Virginia's freight transportation intensive industries.

2.2 Current Conditions and Recent Trends

2.2.1 Population

As of 2006, Virginia was home to 7.6 million residents, making it the 12th most populous State in the country. Virginia is adding population at a faster pace (net) than all but six states. Virginia's expanding economy helps to draw people from throughout the United States and the world for jobs. Virginia has consistently added jobs at a rate either close to or faster than the U.S. average. The Virginia Employment Commission forecasts that Virginia population will increase an additional 30 percent by the year 2030.

Figure 2.1 Historic Population Growth Trends, United States and Virginia
1990 to 2035



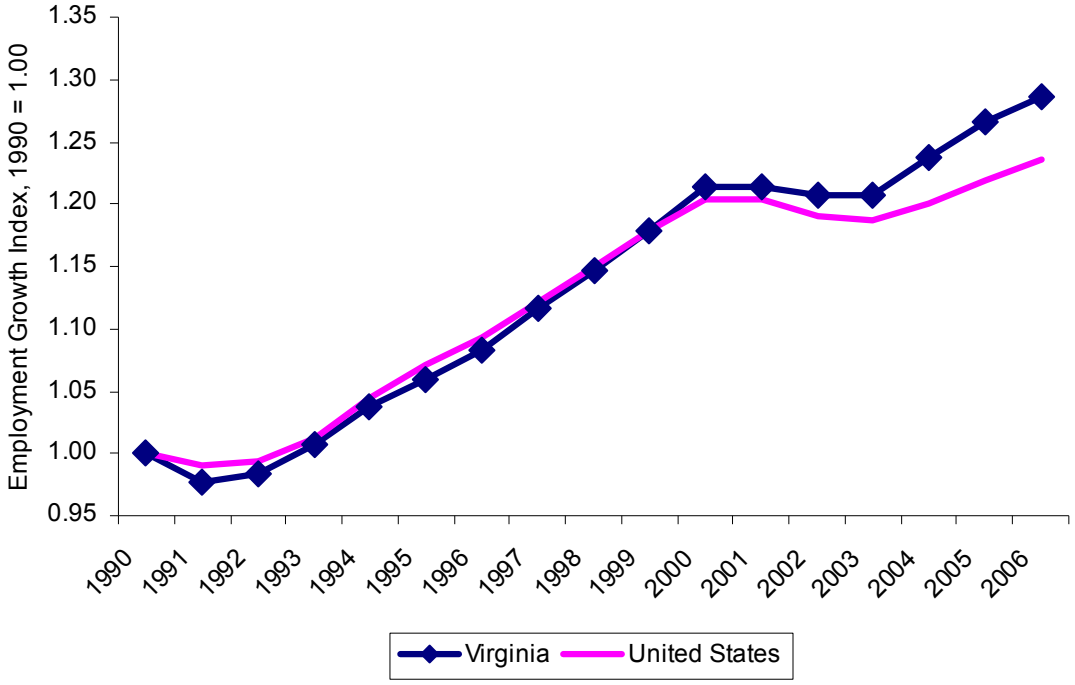
Source: U.S. Census Bureau.

2.2.2 Employment, Output, and Gross State Product

From a jobs perspective, the Virginia economy employed 3.7 million people in 2006, accounting for 2.8 percent of all U.S. jobs. Between 1990 and 2006, total employment in Virginia increased by 29 percent, compared to a U.S. growth rate of 24 percent, as it added 830,000 new jobs (net) as shown in Figure 2.2 following. Among all states, between 2000 and 2005, Virginia added the sixth-highest number of jobs.

Figure 2.2 Historic Employment Growth Trends – Virginia Compared to the United States

1990 to 2006

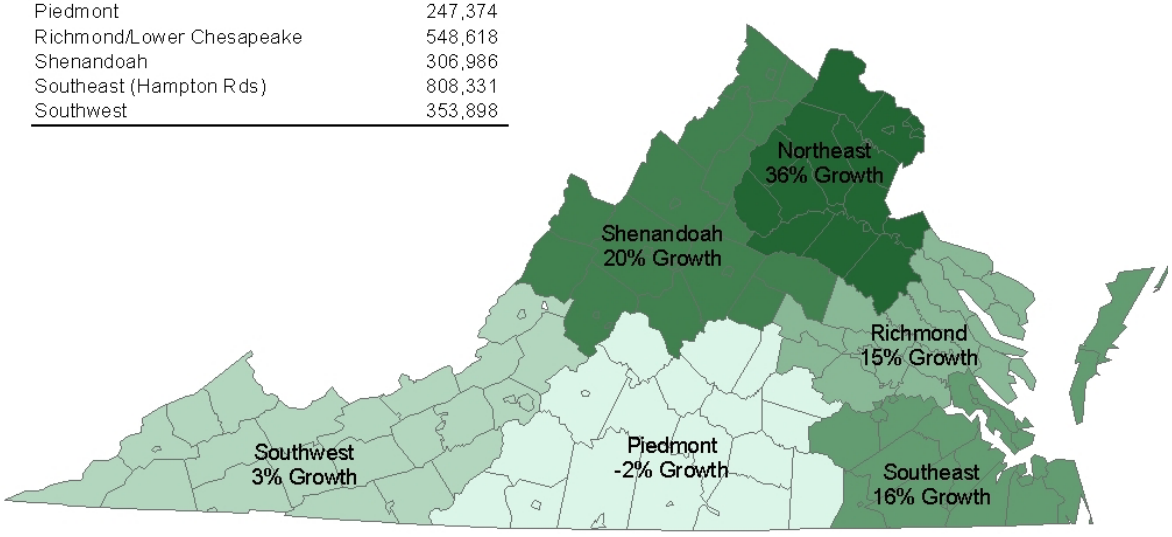


Source: Bureau of Labor Statistics.

Figure 2.3 Employment Growth by Region

1995 to 2005

Region	2005 Employment
Northeast	1,250,980
Piedmont	247,374
Richmond/Lower Chesapeake	548,618
Shenandoah	306,986
Southeast (Hampton Rds)	808,331
Southwest	353,898

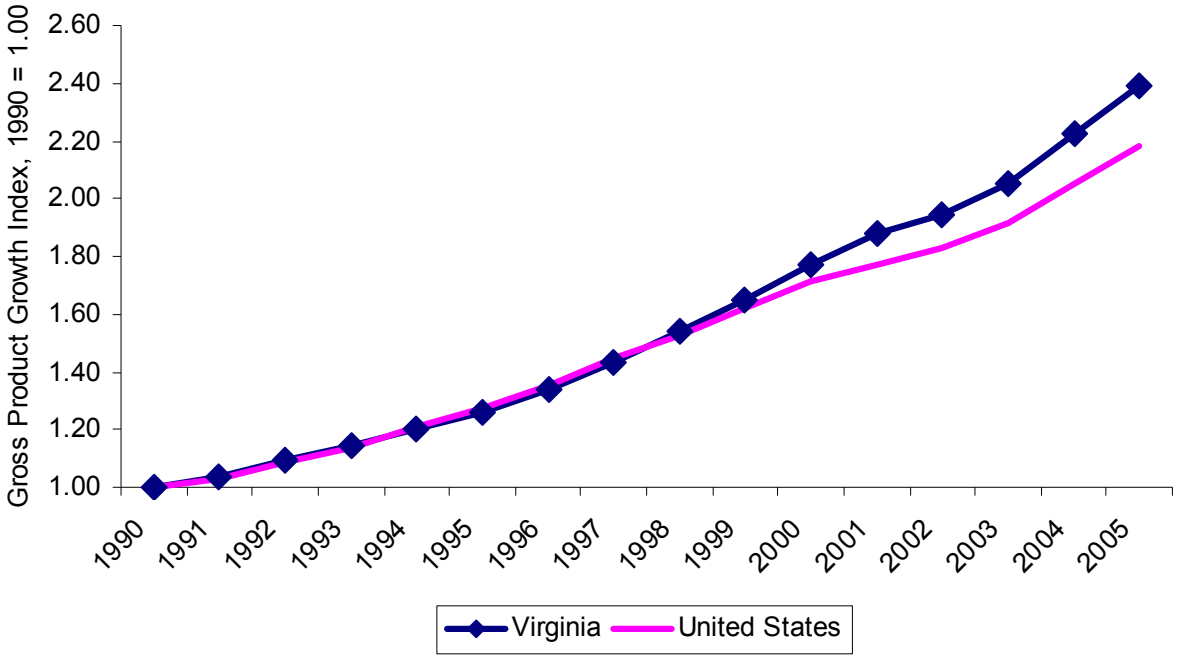


Source: Virginia Employment Commission, 2005.

Virginia's economic growth is occurring throughout most of the Commonwealth, although growth is not evenly distributed. Figure 2.4 shows employment growth in Virginia by region from 1995 to 2005. The strongest job growth took place in the north, with the Northeast region (metropolitan Washington) recording a 36 percent increase and the Shenandoah region just to the west growing by some 20 percent. Virginia's eastern regions also exhibited substantial jobs increases, with the Richmond area and the Southeast region posting increases of 15 and 16 percent, respectively, during the 10-year period. By comparison, the Southwest region grew by a slower three percent and the Piedmont region actually saw a small decrease in jobs (-2 percent) between 1995 and 2005.

In 2005, the total output of Virginia's economy was around $658 billion. (Output is a measure of the total value of goods and services produced in Virginia). For the same period, Virginia's gross state product (or GSP) was $352 billion. (GSP is a measure of the total value added to goods and services because of Virginia activity.) Virginia accounts for almost three percent of the entire U.S. economy. If Virginia were a country, its economy would be equivalent in size to Sweden's or Turkey's, ranking as the 21st largest in the world. As with job creation, Virginia has also been surpassing the United States in terms of growth in Gross State Product. In nominal terms, the Virginia GSP grew by 35 percent between 2000 and 2005, compared to a 27 percent increase in U.S. Gross Domestic Product.

Figure 2.4 Virginia's Gross State Product and U.S. Gross Domestic Product
1990 to 2005

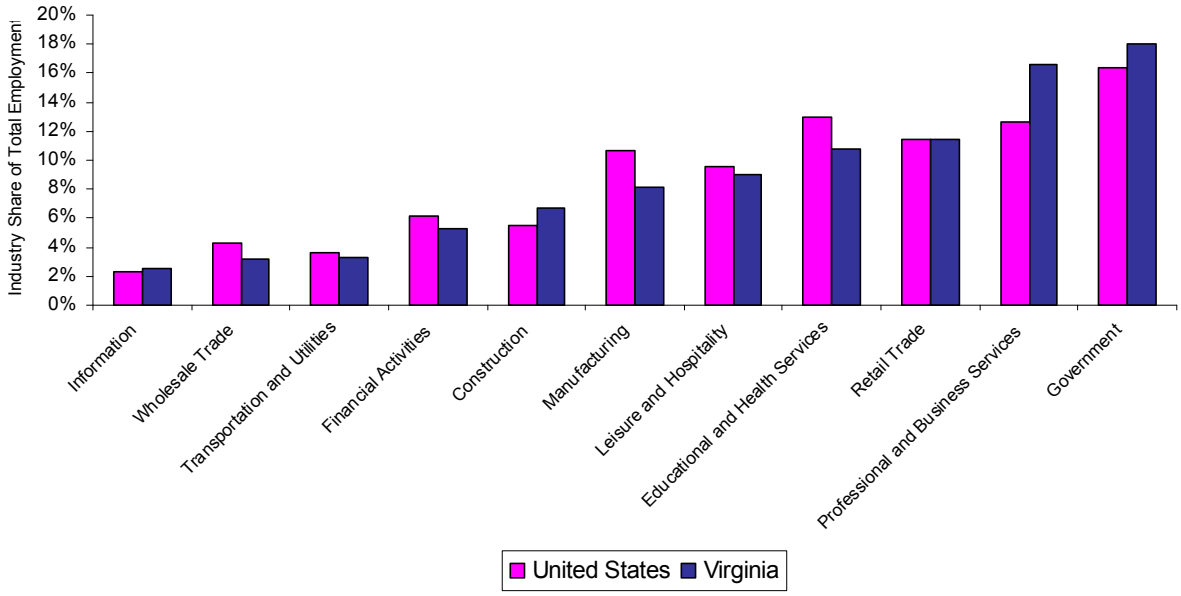


Source: Bureau of Economic Analysis.

2.2.3 Structure of the Economy

Virginia's economy is highly diversified, with employment spread across a variety of industry sectors. The leading sectors are: government; professional and business services; retail trade; education and health; leisure and hospitality; and manufacturing. Compared to the structure of the U.S. economy as a whole, Virginia's economy is: somewhat more concentrated in government, professional services, construction, and information; roughly equivalent in retail trade; and somewhat less concentrated in education and health, manufacturing, financial, transportation and utilities, and wholesale.

Figure 2.5 Economic Structure – Shares of Employment by Major Industry Sector, United States and Virginia
2005



Source: Bureau of Labor Statistics.

2.2.4 International Trade and Gateway Activity

Benefiting from its location on the center of the East Coast, Virginia also is a key U.S. gateway for international trade, exporting and importing goods destined for or originating from markets throughout the United States and the world. The Commonwealth's role as an international gateway, like population and business activity, generates very large volumes of freight activity, and Virginia relies on its rail, air, highway, and port infrastructure to compete with other gateway locations. Exports from Virginia to other countries (based on the "origin of movement" export data series) have been on a steady growth trend since the national economic recession at the start of this

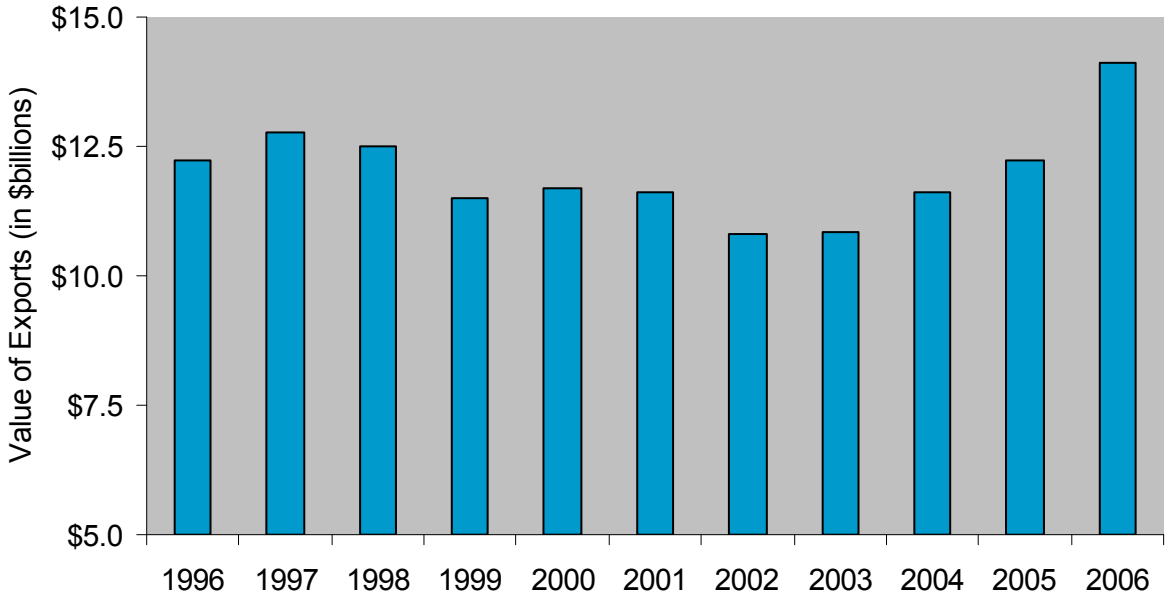
decade, topping $12 billion worth of goods in 2005 and surging to above $14 billion in 2006. Also, Virginia's central East Coast location makes it a through state for freight moving up and down the coast as well for freight moving to and from the south central states and the northeastern states.

As a gateway, Virginia is a node within a global international trade and transportation network, a network that has emerged in response to the forces of globalization that has been redefining how business is conducted and how goods are produced. Globalization is a trend towards cross-border production, services, and transportation that is expected to continue into the future.

A clear linkage between globalization and freight can be measured in terms of increases in international trade. In Virginia, this can be illustrated by analyzing the importance of exports to Commonwealth businesses as well as by the volumes of freight handled by port and airport gateways (goods that may or may not be originating from or destined to Virginia markets).

Exports from Virginia to other countries (based on the "origin of movement" export data series) have been on a steady growth trend since the national economic recession at the start of this decade, topping $12 billion worth of goods in 2005 and surging to above $14 billion in 2006 as shown in Figure 2.6.

Figure 2.6 Value of Virginia-Produced Exports
1996 to 2006



Source: WISERTrade, "Origin of Movement" series export data.

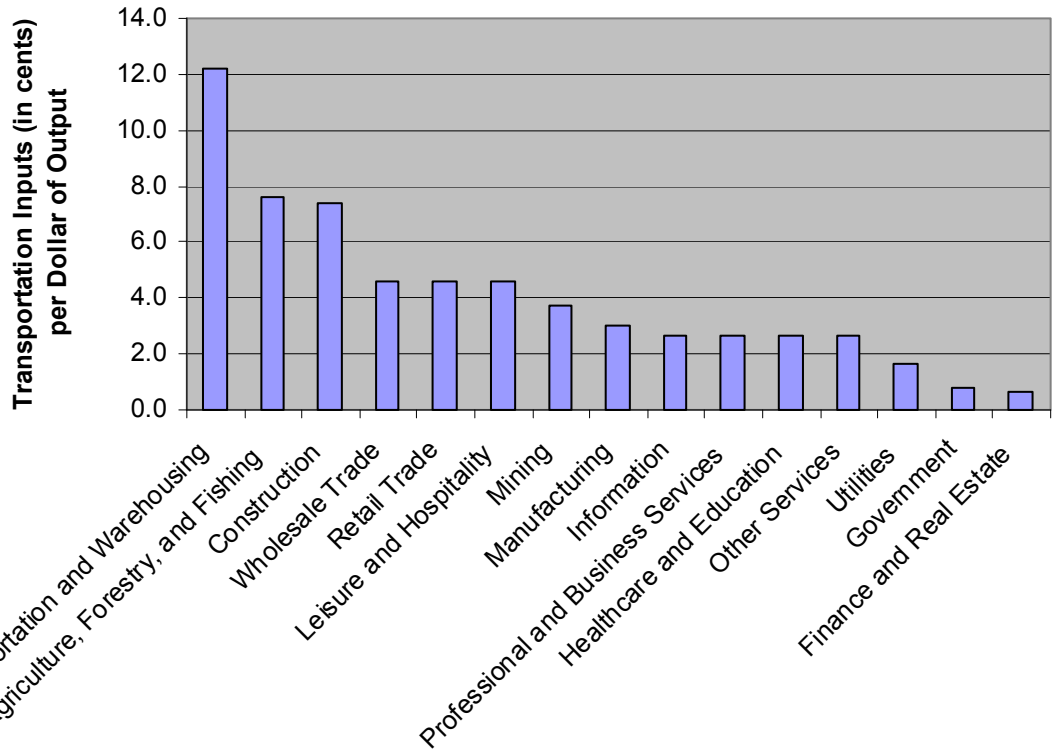
2.3 Freight Generating Industries

2.3.1 Demand for Transportation Services

Transportation represents a tangible cost of doing business and is a key input for major sectors of the Virginia economy. The efficiencies and connectivity provided by Virginia's multimodal freight network are instrumental to keeping business costs down and strengthening economic competitiveness.

Figure 2.7 below shows the relative use of freight and passenger transportation services by key industries, and illustrates the industry sectors that are most dependent on transportation services in order to function, based on the transportation costs (or inputs) that are required to generate goods and services (or outputs). In order, Virginia's most transportation dependent industries are: transportation and warehousing; agriculture, forestry, and fishing; construction; wholesale trade; retail trade; leisure and hospitality; mining; and manufacturing. Except for leisure and hospitality, all of these sectors are primarily dependent on freight transportation, rather than passenger transportation.

Figure 2.7 Transportation Reliance by Industry in Virginia
2004



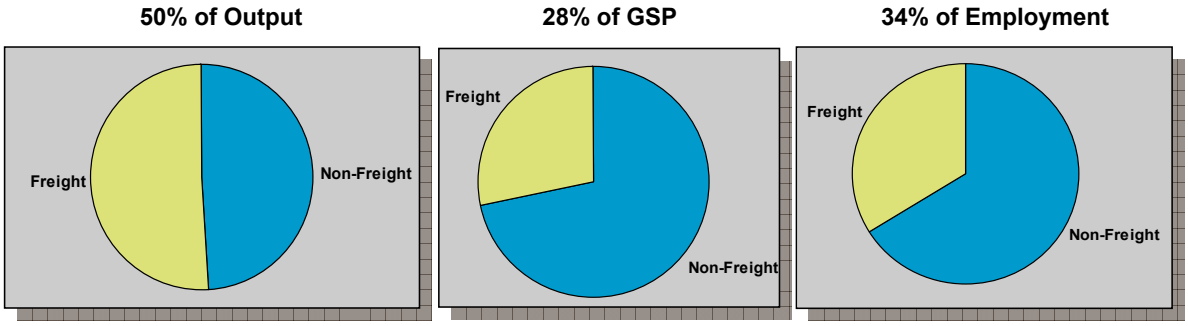
Sources: U.S. Department of Transportation, Bureau of Transportation Statistics Transportation Satellite Accounts, 1996 (for transportation inputs by industry); and U.S. Department of Commerce, Bureau of Economic Analysis (for measures of Virginia's economic output by industry, 2004).

2.3.2 Freight Intensive Industries

Many different Virginia industries and businesses rely heavily on the efficient movement of goods. Producing industries like agriculture depend on freight movement to move farm products from fields to processing plants to wholesalers to retail outlets, in Virginia and throughout the U.S. and the world. Other producing industries, like transportation equipment manufacturers, also depend on freight movement to bring them the intermediate products – rolled or fabricated steel, tires, engine parts, etc. – they need to assemble their finished products. Wholesale and warehouse/distribution industries serve as the bridge between producers and consumers, making sure that needed goods are transported where – and when – they are needed. Finally, consumers of all kinds – from shoppers at grocery stores to power plants – rely on freight movement to deliver the goods and materials to the final point of sale or point of use.

It is estimated that around 50 percent of Virginia's output, 28 percent of its gross state product, and 34 percent of its employment, is from freight-related industries that depend heavily on the movement of raw materials, intermediate goods, and/or finished products.

Figure 2.8 Freight-Related Industry Contributions to Virginia's Economy
2005



These freight-related businesses and industries generally fall into three "clusters":

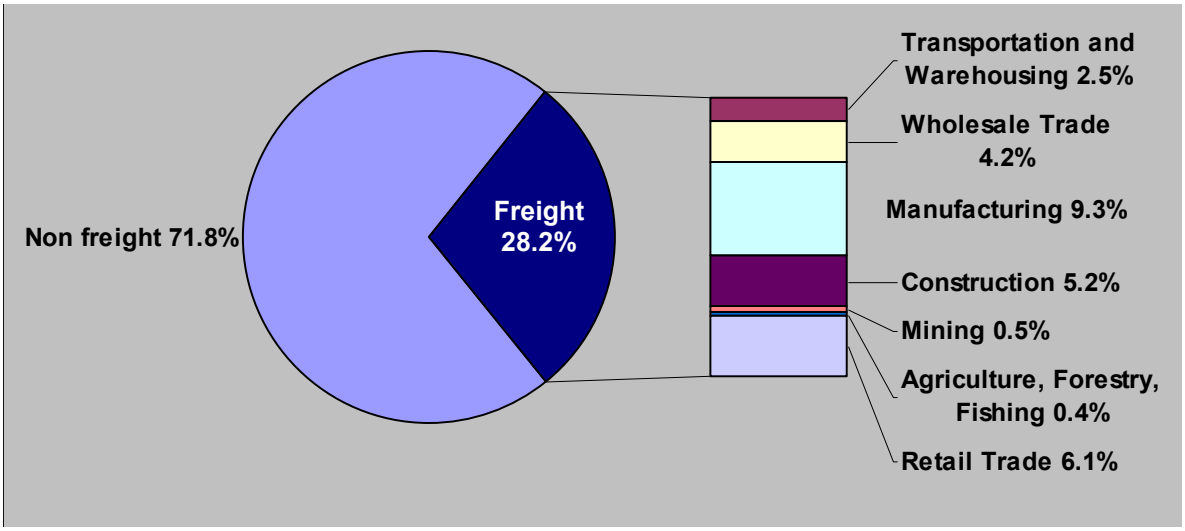
- The **goods movement cluster** includes industries and businesses that provide freight transportation services – such as truckers, railroads, marine and air cargo shipping companies, wholesalers, and warehouse/distribution facility operators – engaged in domestic and international transportation. Benefiting from its location at the center of the East Coast, Virginia is a key U.S. gateway for international trade, exporting and importing goods destined for or originating from markets throughout the United States and the world. Exports from Virginia to other countries (based on the "origin of movement" export data series) have been on a steady growth trend, topping $12 billion worth of goods in 2005 and surging to above $14 billion in 2006. Overall, the goods movement cluster represents around seven percent of Virginia's GSP.

- The **freight intensive industries cluster** includes industries where the transportation of raw materials, intermediate products, and finished goods accounts for a major share of their cost of doing business – such as agriculture, tobacco, food products, construction, wood and paper, machinery, transportation equipment, energy, chemical products and mineral extraction. The freight intensive industries cluster represents around 15 percent of Virginia's GSP.

- The **retail cluster** includes consumer outlets – supermarkets, merchandise retailers, auto dealers, etc. – that require freight transportation services to stock their inventory. The retail cluster represents around six percent of Virginia's GSP.

Other industries, while they may depend on freight movement to some extent, are not considered freight dependent. Nonfreight dependent industries include information, finance, personal and business services, education and health, leisure and hospitality, and government, and represent around 72 percent of Virginia's GSP.

Figure 2.9 Virginia's Freight- and Nonfreight-Related Industry Sectors by Share of Gross State Product
2005



2.3.3 The "Goods Movement Cluster"

To assess the goods movement industry cluster in Virginia, six industries with primary functions related to the transport and handling of goods were selected for further analysis. The Virginia goods movement industry encompasses industries representing a specific mode (truck transportation, water transportation, air transportation, and rail transportation) and those involved in the handling and processing of freight (wholesale

trade and warehousing and storage). The industries included in the goods movement cluster are significant contributors to Virginia's economy.

Between 1997 and 2004, the combined GSP of Virginia's goods movement industries increased by 34 percent from $14.9 billion to nearly $20.0 billion, as shown in Table 2.1 below. The largest industry in the goods movement cluster – wholesale trade – grew more than 36 percent. Trucking grew more than 42 percent, rail grew more than 20 percent, and air grew more than 11 percent. Water transportation, although the smallest contributor to GSP in dollar terms, grew at by far the highest rate, at 244 percent.

Table 2.1 Gross State Product – Goods Movement Cluster

In Millions of Dollars

Industry Code Description	1997	2004	1997-2004 Total Growth	1997-2004 Percentage Growth
Wholesale Trade	$10,450	$14,291	$3,841	36.8%
Truck Transportation	$1,548	$2,201	$653	42.2%
Air Transportation	$1,426	$1,585	$159	11.2%
Rail Transportation	$735	$885	$150	20.4%
Warehouse and Storage	$683	$732	$49	7.2%
Water Transportation	$76	$262	$186	244.7%
Total for Goods Movement Cluster	**$14,918**	**$19,956**	**$5,038**	**33.8%**
Total for Virginia, All Industries	**$211,921**	**$327,032**	**$115,111**	**54.3%**

Source: 2005 Bureau of Economic Analysis.

While these growth rates are impressive, they actually lag growth in the overall Virginia economy, which expanded by 54 percent during the period 1997 to 2004. This is a reflection of the overall strength of Virginia's economy, and the fact that nonfreight service sectors are growing even faster than freight sectors; it does not reflect any weakness in goods movement industries.

According the Bureau of Economic Analysis, the goods movement industries directly accounted for over 160,000 Virginia jobs in 2005 – nearly one out of every 20 jobs in the Commonwealth. Most, but by no means all, of this employment is concentrated in areas with high populations, major freight facilities such as seaports and airports, and/or centers of agricultural, construction, mining, and manufacturing activity, as shown in Table 2.2 following.

Table 2.2 Employment in the Goods Movement Cluster
2004

Jurisdiction	Goods Movement Industries
Fairfax	17,289
Loudoun	9,842
Henrico	9,132
Richmond City	8,511
Norfolk	8,011
Chesapeake	6,169
Virginia Beach	6,095
Arlington	6,010
Chesterfield	5,687
Roanoke	4,631
Hanover	4,002
Newport News	3,493
Augusta	3,191
Prince William	3,139
Alexandria	2,944
Rockingham	2,755
Stafford	2,730
Frederick	2,510
Roanoke City	2,479
Suffolk	2,462
All Other	53,782
Total	**164,864**

Source: Virginia Employment Commission, 2004.

2.3.4 The "Freight Intensive Industries Cluster"

There are a number of industries that are highly dependent on the efficient movement of goods to keep supply chains flowing, manage costs, and remain productive and competitive in national and global markets. These industries typically receive and/or ship large quantities of goods, and transportation costs are a large percentage of their costs of doing business. As shown in Table 2.3 following, these industries include: food, tobacco, and agriculture products; construction; machinery and equipment (electronic and nonelectronic); transportation equipment; energy products; and chemical products. Combined, these seven Virginia industry groupings account for 79 percent of the tonnage and 60 percent of the value of goods movement (across all modes) originating in Virginia.

Table 2.3 Outbound Shipments – Virginia Industries Most Reliant on Freight Movements

2004, In Thousands of Tons, In Millions of Dollars

Industry	Tons	Value	Percent of Tons	Percent of Value
Transportation Equipment	4,612	$72,154	4%	22%
Machinery	3,363	$60,573	3%	18%
Food, Tobacco, and Agriculture	11,987	$24,695	11%	7%
Chemicals	8,190	$22,268	7%	7%
Wood and Paper	17,105	$10,653	16%	3%
Construction*	26,722	$5,999	24%	2%
Energy	14,798	$2,444	13%	1%
Other	23,275	$130,758	21%	40%
Total	**110,052**	**$329,543**	**100%**	**100%**

Source: Global Insight TRANSEARCH; and Cambridge Systematics, Inc.

Note: "Construction" includes nonmetallic minerals; clay, concrete, glass, stone; and primary metals as the construction industry is heavily dependent on those goods.

Table 2.4 Gross State Product – Freight-Intensive Industries

In Millions of Dollars

Industry Code Description	1997	2004	1997-2004 Total Growth	1997-2004 Growth Rate
Construction	$9,240	$16,808	$7,568	81.9%
Food, Tobacco, and Agricultural Products	$8,266	$10,234	$1,968	23.8%
Machinery	$3,490	$3,954	$464	13.3%
Transportation Equipment	$2,423	$3,714	$1,291	53.3%
Wood and Paper Products	$2,329	$2,500	$171	7.3%
Chemical Products	$3,156	$2,283	($873)	-27.7%
Energy Products	$943	$1,639	$696	73.8%
Total for Freight Intensive Industry Cluster	**$29,847**	**$41,132**	**$11,285**	**37.8%**
Total for Virginia, All Industries	**$211,921**	**$327,032**	**$115,111**	**54.3%**

Source: 2005 Bureau of Economic Analysis.

All of the industries within this grouping are significant contributors to Virginia's economy. Between 1997 and 2004, the contribution of freight-intensive industries to the Virginia's gross state product increased by about 38 percent from $29.9 billion to $41.1 billion. The largest industry – construction – also experienced the most significant growth, with an 82 percent increase in GSP. The second largest industry – food, tobacco, and agricultural products – grew by almost 24 percent. Among other sectors, growth in energy products (coal, oil, natural gas, and petroleum) and transportation equipment was strongest, with moderate growth in machinery, wood, and paper, and declines in chemical products.

Employment in the freight-intensive and goods movement industry sectors is concentrated in the areas of Northern Virginia, Hampton Roads, Richmond, and the Interstate 81 corridor. Eleven counties have freight-intensive industry employment levels above 10,000, with Fairfax employing more people in this sector than any other county. This is primarily due to the large number of jobs overall in Fairfax, and not to Fairfax having a unique concentration of these types of jobs.

Table 2.5 Employment in the Freight-Intensive Industries Cluster
2004

Jurisdiction	Freight-Intensive Industries
Fairfax	37,849
Newport News	26,631
Richmond City	17,677
Virginia Beach	17,191
Loudoun	15,385
Chesterfield	14,719
Henrico	14,659
Prince William	13,211
Norfolk	13,032
Chesapeake	12,797
Rockingham	11,474
Hanover	9,009
Isle of Wight	6,145
Augusta	5,621
Roanoke City	5,397
Portsmouth	5,297
Albemarle	4,960
Frederick	4,911
Washington	4,624
Lynchburg	4,606
All Other	164,661
Total	**409,856**

Source: Virginia Employment Commission, 2004.

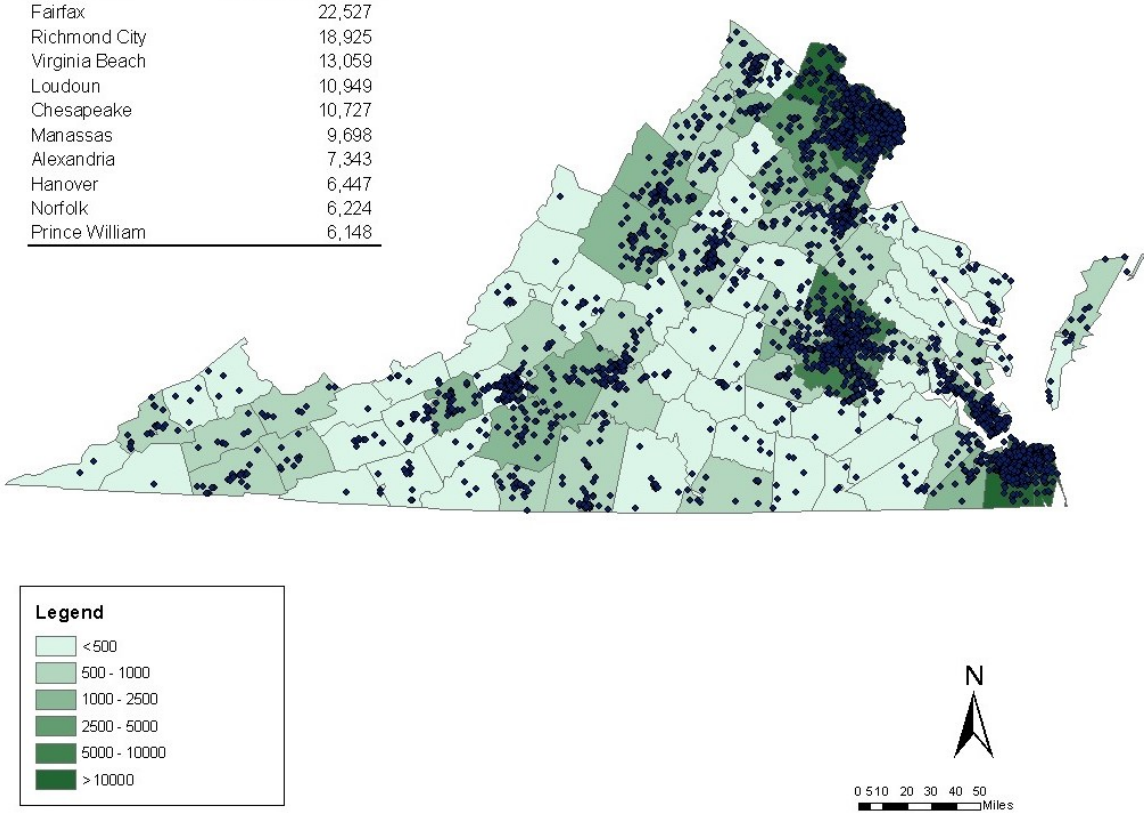
Construction

Construction is a major industry and one of the fastest growing sectors of the Virginia economy. The total value of construction contracts in Virginia reached some $18.5 billion in 2005, and the State has been outpacing overall U.S. growth in this sector. The construction industry is a primary end user of a range of supplies, including lumber, aggregate, and steel carried by rail, trucks, and ships. The timeliness of freight deliveries is crucial to the construction industry, making transportation reliability a primary concern. Congestion and delays add hours and costs to deliveries needed by construction contractors. Some construction inputs are perishable (e.g., ready-mix concrete only lasts two hours before thickening) and missed shipments can lead to work stoppages.

Figure 2.10 Construction Sector

Employment by County and Business Locations, 2004

County	Construction Sector Employment
Fairfax	22,527
Richmond City	18,925
Virginia Beach	13,059
Loudoun	10,949
Chesapeake	10,727
Manassas	9,698
Alexandria	7,343
Hanover	6,447
Norfolk	6,224
Prince William	6,148



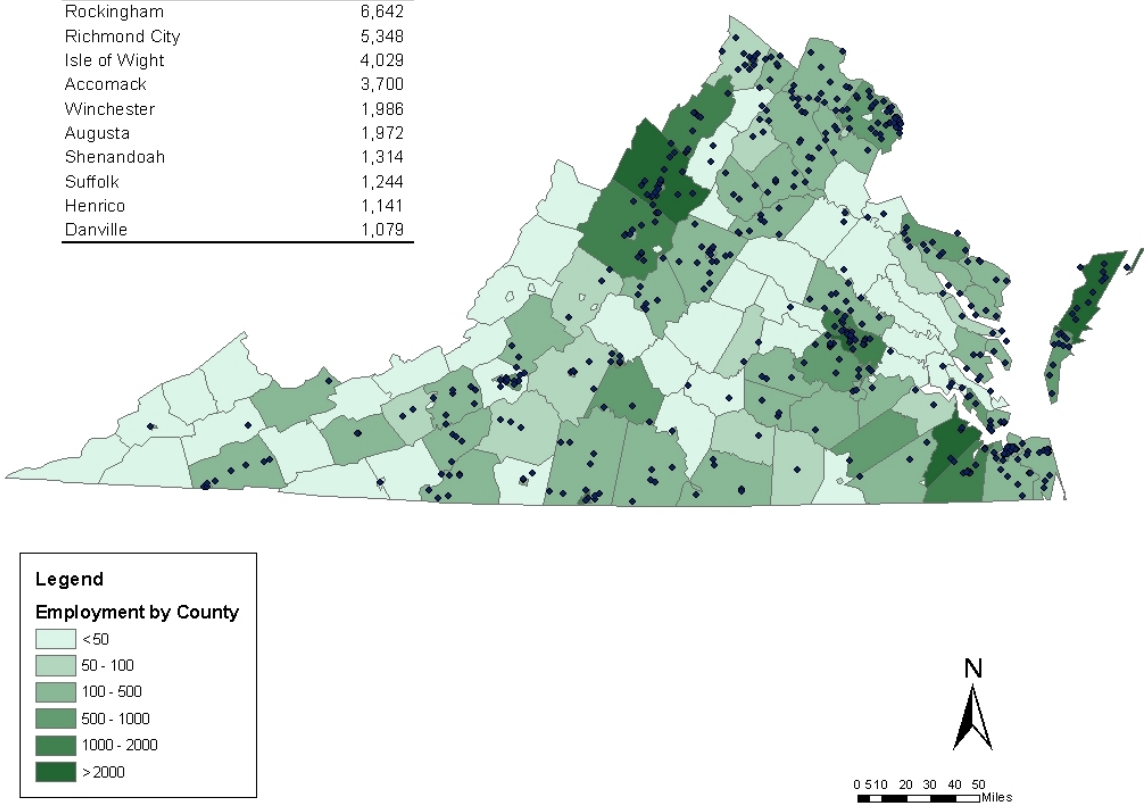
Source: Virginia Employment Commission.

Food, Tobacco, and Agricultural Products

The value of Virginia's agricultural production reached $2.7 billion in 2005. In addition to the crops grown and the livestock raised in the State, Virginia also has a substantial food, beverage, and tobacco processing industries, manufacturing goods with a shipment value of $23.8 billion in 2005. Virginia is the fourth largest tobacco grower in the United States and is the second ranking manufacturer of tobacco products. Virginia also is the nation's fifth largest producer of turkeys and ninth largest producer of broiler chickens. Food processors are located throughout the State, with a strong concentration in the Northwest. Rockingham County is the State's leading producer both in terms of agricultural receipts (the county accounted for about 20 percent of the state total in 2002) from farming and in food processing (based on 2004 employment figures).

Figure 2.11 Food, Tobacco, and Agriculture Sector
Employment by County and Business Locations, 2004

County	Food, Tobacco, & Ag. Sector Employment
Rockingham	6,642
Richmond City	5,348
Isle of Wight	4,029
Accomack	3,700
Winchester	1,986
Augusta	1,972
Shenandoah	1,314
Suffolk	1,244
Henrico	1,141
Danville	1,079



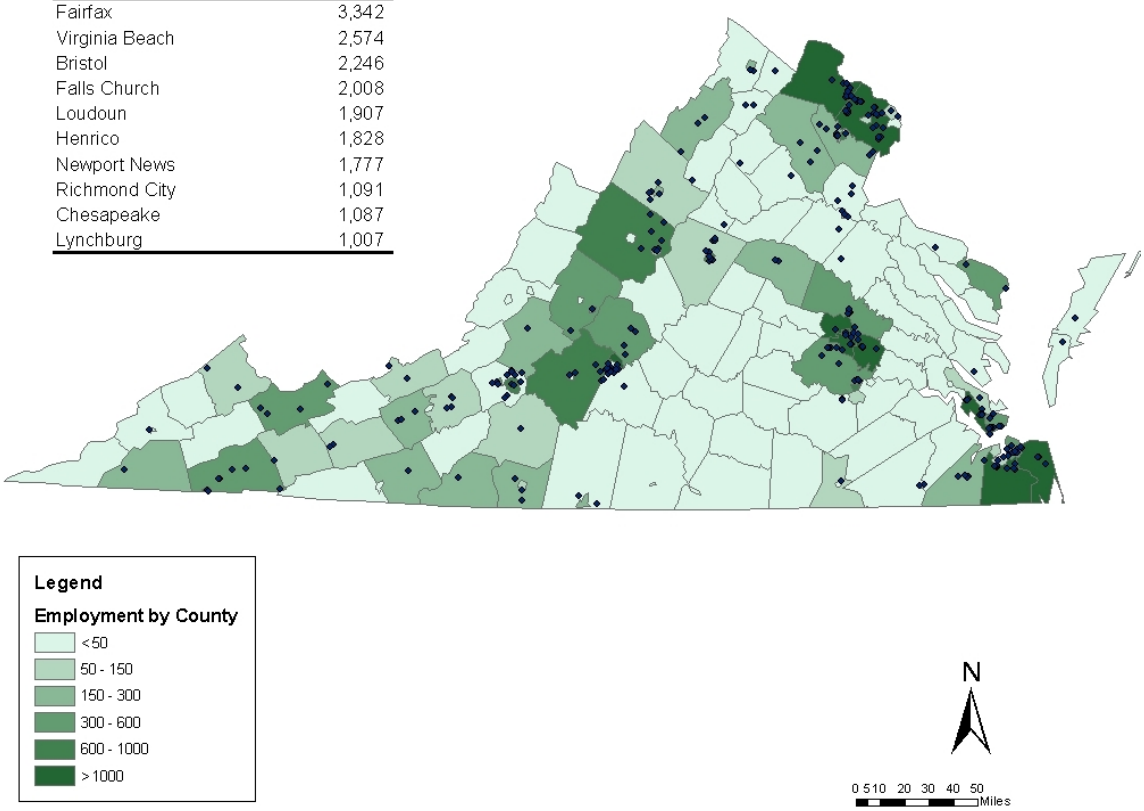
Source: Virginia Employment Commission.

Machinery

Manufacturers of machinery shipped products worth $4.1 billion from Virginia factories in 2005. Virginia is particularly strong in the manufacture of agricultural/construction machinery and heating/ventilation equipment. Machinery manufacturers are concentrated in the State's major metropolitan areas as well as along the I-81 Corridor.

Figure 2.12 Machinery Sector
Employment by County and Business Locations, 2004

County	Machinery Sector Employment
Fairfax	3,342
Virginia Beach	2,574
Bristol	2,246
Falls Church	2,008
Loudoun	1,907
Henrico	1,828
Newport News	1,777
Richmond City	1,091
Chesapeake	1,087
Lynchburg	1,007



Source: Virginia Employment Commission.

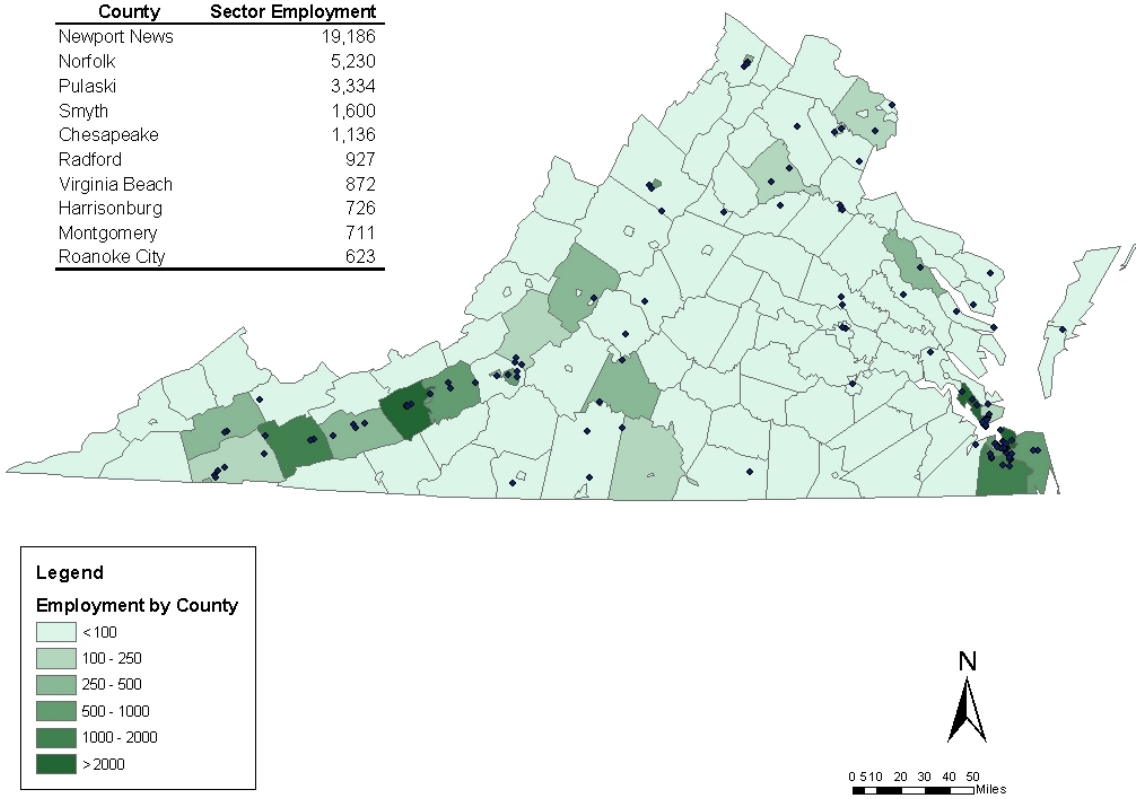
Transportation Equipment

Shipbuilding, motor vehicle parts, and heavy-duty truck manufacturing make Virginia a leader in transportation equipment. Jobs in this industry are concentrated along I-81 in the southwestern corner of the State where Volvo has a large heavy-duty truck factory (Pulaski County) and in the Hampton Roads area, the location of the largest shipbuilding facility (Northrop Grumman Newport News) in the United States.

Figure 2.13 Transportation Equipment Sector

Employment by County and Business Locations, 2004

County	Transportation Equipment Sector Employment
Newport News	19,186
Norfolk	5,230
Pulaski	3,334
Smyth	1,600
Chesapeake	1,136
Radford	927
Virginia Beach	872
Harrisonburg	726
Montgomery	711
Roanoke City	623



Source: Virginia Employment Commission, 2005.

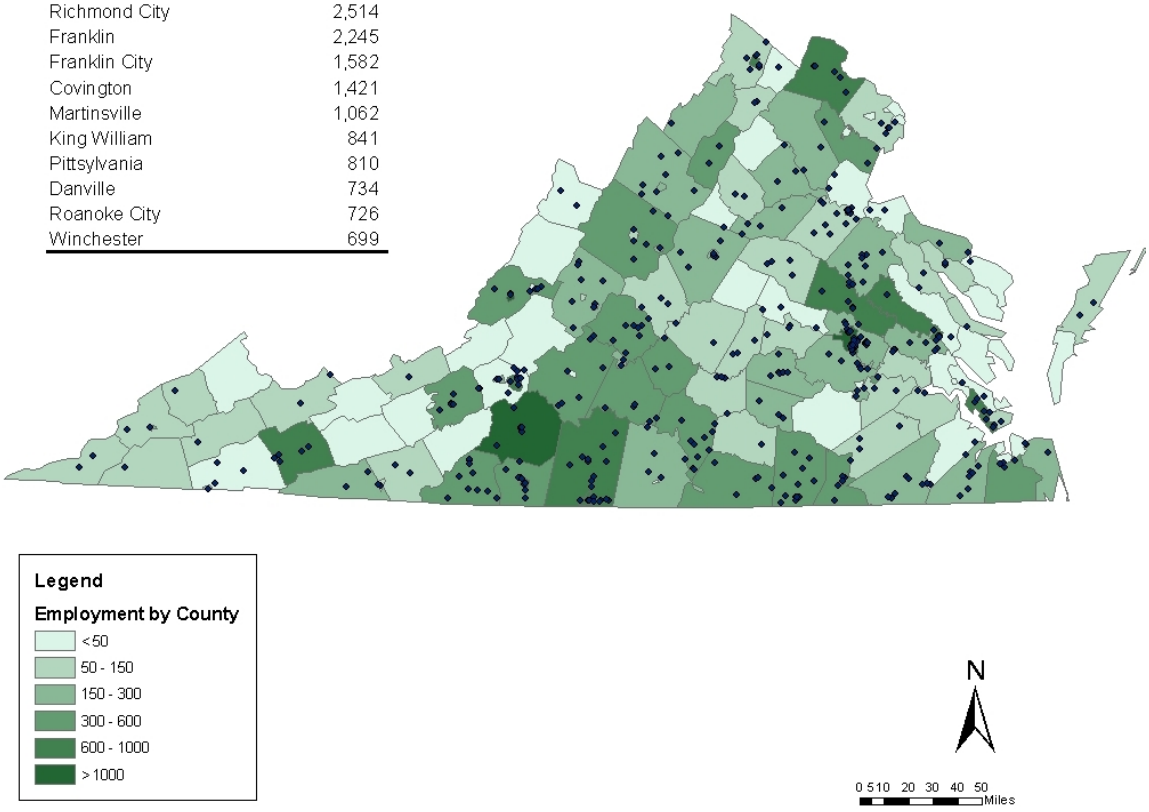
Wood and Paper Products

Large volumes of wood products (includes lumber), much of it bound for the construction industry, are carried on Virginia's highway and rail networks on an annual basis. Virginia's wood and paper industry is distributed statewide, with a particular concentration in the south central part of the State. In 2005, Virginia manufacturers shipped wood and paper products valued at $7.9 billion.

Figure 2.14 Wood and Paper Sector

Employment by County and Business Locations, 2004

County	Wood & Paper Sector Employment
Richmond City	2,514
Franklin	2,245
Franklin City	1,582
Covington	1,421
Martinsville	1,062
King William	841
Pittsylvania	810
Danville	734
Roanoke City	726
Winchester	699



Source: Virginia Employment Commission.

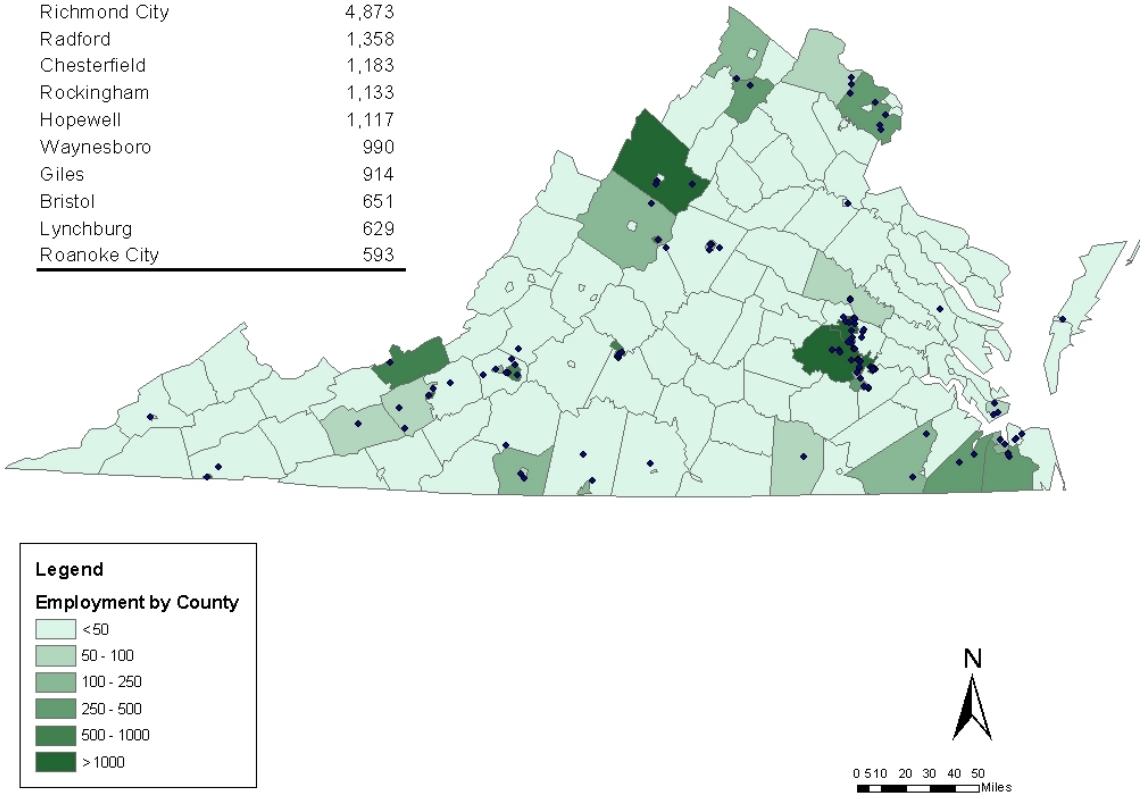
Chemical Products

Chemicals are a vital industrial input, used by industries throughout Virginia, including plastics products, agriculture, paper, electronics, and construction, among many others, both to produce finished goods (e.g., tires, pharmaceuticals, medical equipment) as well as in the manufacture of other intermediate products (e.g., semiconductors, rubber/plastic components) that will be used to produce other goods. On the production side, Virginia has a substantial chemicals industry, producing chemicals valued at $8.3 billion in 2005. These, in turn, are transported by rail and truck throughout Virginia and the nation, and by ship to overseas markets. Within Virginia, there are chemical industry concentrations in metropolitan Richmond, Rockingham County, and along I-81 in the southwestern part of the State.

Figure 2.15 Chemicals Sector

Employment by County and Business Locations, 2004

County	Chemicals Sector Employment
Richmond City	4,873
Radford	1,358
Chesterfield	1,183
Rockingham	1,133
Hopewell	1,117
Waynesboro	990
Giles	914
Bristol	651
Lynchburg	629
Roanoke City	593



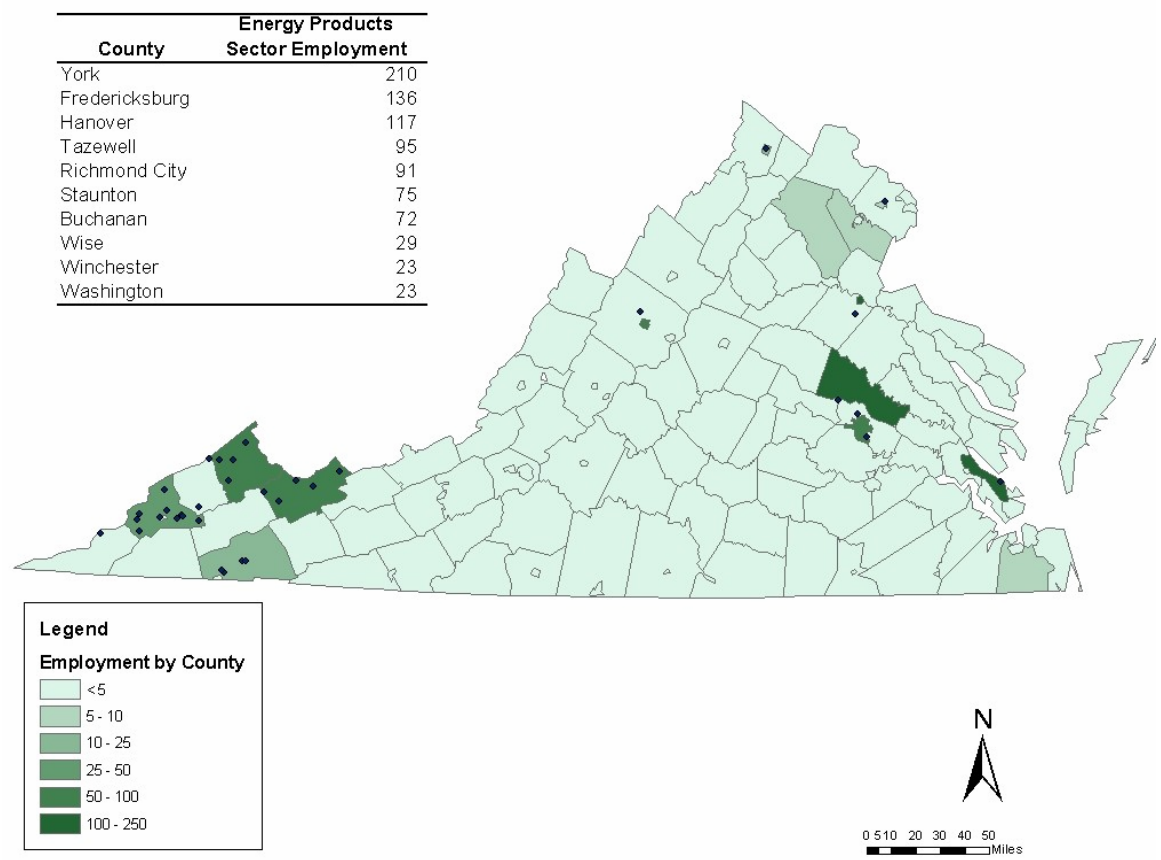
Source: Virginia Employment Commission.

Energy Products

Virginia has historically ranked as one of the larger producers of coal in the country, and coal is one of the leading commodities carried over the State's rail system. Coal mined in the southwestern part of the State is transported by rail to utilities throughout the State and region (e.g., Ohio River Valley) to generate electricity. Rail also brings Virginia coal to Hampton Roads and to the Port of Charleston (South Carolina) for export. In terms of oil and gas, Virginia is a small producer, pumping about 20,000 barrels of oil and 86 billion cubic feet of natural gas in 2004.

Figure 2.16 Energy Products Sector
Employment by County and Business Locations, 2004

County	Energy Products Sector Employment
York	210
Fredericksburg	136
Hanover	117
Tazewell	95
Richmond City	91
Staunton	75
Buchanan	72
Wise	29
Winchester	23
Washington	23



Source: Virginia Employment Commission.

2.3.5 The "Retail Cluster"

The third and final industry group comprising Virginia's set of freight-related industries is the retail cluster. Retailers are responsible for receiving goods and stocking shelves or making direct deliveries to consumers. Retail activity occurs throughout the State, roughly in proportion to population and income density, and represents around 6.1 percent of Virginia's Gross State Product.

2.4 Forecasts

2.4.1 Population

Virginia's population is forecast to increase by 29 percent through 2030, according to Virginia Employment Commission projections. Virginia is adding population at a faster pace (net) than all but six states. By 2030, Virginia is expected to have nearly 10 million people, an increase of nearly 2.2 million people over the 26-year period.

Table 2.6 Virginia's Population Growth Projection

2006	2030	Growth (Absolute)	Growth (Percentage)
7,642,884	9,825,019	2,182,135	29%

Source: U.S. Census Bureau, 2006; and Virginia Employment Commission, 2030.

Virginia population growth has a direct impact on transportation demand. More people take more trips, require more services, and need more goods to sustain themselves. Additionally, growth in other states and in international trade will put additional pressures on Virginia's highways, railroads, seaports, and airports. How Virginia grows economically and geographically will have long-term effects on freight demand and mode choice, both on a statewide as well as on a regional basis.

2.4.2 Employment, Output, and Gross State Product

This study prepared Virginia employment, output, and gross state product forecasts through the year 2035. These forecasts assumed "base case" macroeconomic conditions, as represented in the regional/national macroeconomic model maintained by Global Insight, Inc. (Alternative assumptions and sensitivities will be tested in Phase II of the Virginia Statewide Multimodal Freight Study.)

Table 2.7 Virginia's Macroeconomic Forecast 2005 to 2035

All Industry Sectors, In 2005 Dollars

	2005	2035	Growth (Absolute)	Growth (Percentage)
Employment (Thousands)	3,728	5,434	1,706	45.8%
Output (Millions)	$658,480	$1,953639	$1,295,139	196.7%
Gross State Product (Millions)	$351,901	$882,505	$530,604	150.8%

Source: Global Insight.

Virginia's expanding economy helps to draw people from throughout the United States and the world for jobs. Virginia has consistently added jobs at a rate either close to or faster than the U.S. average. Virginia weathered the 2001 to 2002 recession better than most other states and has seen its jobs growth rate return to a pace similar to those experienced in the 1990s. Virginia's growing economy and job numbers, like population, translate to higher demand for a full range of goods – all possessing transportation requirements. Virginia's role as a leader in U.S. job growth is not forecast to change in the future, and in fact, may strengthen. According to Global Insight, Virginia is forecast to add about 1.7 million jobs between 2005 and 2035, an increase of 46 percent.

While the expansion of jobs is a valid proxy of overall economic growth, the value of goods produced within Virginia and related increases in income levels are ultimately needed for economic expansion and to justify increased consumption. The Global Insight forecast projects the value of goods and services (i.e., gross state product) produced by the Virginia economy to rise from $352 billion in 2005 to $883 billion in 2035. The total output of the Virginia economy (a measure of economic activity that includes the value of intermediate inputs), is expected to increase even faster, due in part to rises in imported energy costs (a key intermediate input) that will likely grow at a faster rate than the value of goods and services produced (GSP) in the Commonwealth.

Additionally, total income levels in Virginia have grown quickly in recent decades and are forecast to continue increasing at a fast rate. Between 2005 and 2035, Virginia's total income is expected to increase by about $480 billion. These dollars, in combination with the expected rise in the Virginia's population, will contribute to much higher consumer demand (for products ranging from groceries and autos to the lumber and concrete required in the construction of homes) in coming years, increasing the need for efficient goods movement to satisfy this demand, as well as to sustain the economy.

Finally, it should be noted that increases in output and in GSP are forecast to outpace growth in employment, reflecting the assumption of increased productivity per employee.

2.4.3 Freight Intensive Industries

The Virginia economy is at the forefront of a national shift to services industries. While manufacturing, agriculture, and mining remain crucial elements of the Virginia economy and have played important historical roles, Virginia's rapid economic growth over the past decade has been fueled more by professional and business services (includes architecture, law, marketing, engineering, consulting, computer systems, and scientific research). Virginia is home to large numbers of Federal offices and serves as the headquarters of major Federal agencies.

This shift to service industries is forecast to continue. As a result, the forecast growth for freight intensive industries is somewhat slower than the forecast growth for the Virginia economy as a whole. But even so, the forecasts for freight intensive industries are strong – through the year 2035, freight industry employment will increase 20 percent, freight output will increase 100 percent, and freight GSP will increase 70 percent.

Table 2.8 Virginia's Industry Employment Forecast by Major Sector

Industry	2005	2035	Growth (Absolute)	Growth (Percentage)
Retail Trade	417,886	466,365	48,479	11.6%
Construction	244,675	419,335	174,660	71.4%
Manufacturing	296,461	284,562	(11,899)	-4.0%
Wholesale Trade	117,458	154,261	36,803	31.3%
Transportation and Utilities	121,697	139,940	18,243	15.0%
Natural Resources and Mining	70,830	55,987	(14,843)	-21.0%
Subtotal, Freight Intensive Industries	*1,269,007*	*1,520,450*	*251,443*	*19.8%*
Professional and Business Services	606,980	1,415,637	808,657	133.2%
Government	662,100	730,101	68,001	10.3%
Educational and Health Services	394,393	636,044	241,651	61.3%
Leisure and Hospitality	328,883	430,105	101,222	30.8%
Other Services	181,400	287,491	106,091	58.5%
Financial Activities	192,813	255,397	62,584	32.5%
Information	93,215	158,960	65,745	70.5%
Subtotal, Nonfreight Industries	*2,459,784*	*3,913,735*	*1,453,951*	*59.1%*
Total	**3,728,791**	**5,434,183**	**1,705,392**	**45.8%**

Source: Analysis of Global Insight, Inc. forecast.

For employment in freight intensive industries, the leading employer (retail) would see modest growth, while the second leading employer (construction) would see the strongest. Wholesale trade and transportation and utilities would see modest growth in

employment. Manufacturing and natural resources and mining would see declines in employment, although they would still see increase in output and GSP due to increased productivity. Also, when looking at apparent declines in the manufacturing sector, it is important to consider that services such as human resources, payroll, engineering, design, warehousing, distribution, marketing, and other activities formerly integrated within manufacturing operations are increasingly being outsourced – many of these jobs still exist, but are now captured in other sectors of the economy.

Among the different measures of economic activity, freight transportation demand is most closely related to output. Output from Virginia's freight intensive industries is forecast to double through the year 2035. One of the big stories is strong growth in wholesale and retail trade output. Another is strong growth in output from manufacturing and natural resources and mining, two "traditional" freight industries that are forecast to lose employees. But perhaps the biggest story is the dramatic growth in transportation and utilities, where output is expected to more than triple.

Table 2.9 Virginia's Industry Output Forecast by Major Sector

In Millions of Dollars

Industry	2005	2035	Growth (Absolute)	Growth (Percentage)
Wholesale Trade	73,059	175,043	101,984	139.6%
Retail Trade	96,459	167,080	70,621	73.2%
Manufacturing	94,812	151,494	56,682	59.8%
Transportation and Utilities	26,970	125,564	98,594	365.6%
Construction	36,237	42,182	5,945	16.4%
Natural Resources and Mining	5,309	8,459	3,150	59.3%
Subtotal, Freight Intensive Industries	332,846	669,822	336,976	101.2%
Professional and Business Services	93,512	533,050	439,538	470.0%
Financial Activities	77,406	204,387	126,981	164.0%
Educational and Health Services	34,093	186,877	152,784	448.1%
Information	36,919	139,705	102,786	278.4%
Government	51,430	113,080	61,650	119.9%
Other Services	14,614	63,056	48,442	331.5%
Leisure and Hospitality	17,660	43,664	26,004	147.2%
Subtotal, Nonfreight Industries	325,634	1,283,819	958,185	294.3%
Total	**658,480**	**1,953,639**	**1,295,159**	**196.7%**

Source: Analysis of Global Insight, Inc. forecast.

These structural shifts in the Virginia economy call for a different kind of freight transportation capacity than in the past. Historically, the need was mostly for service to the

mine, to the factory, to the farm. The additional future need is to accommodate statewide, national, and global transportation logistics chains that can involve and/or integrate all modes of transportation – truck, water, rail, air – and to do so in a manner that provides far greater speed, cost efficiency, reliability, safety, security, and visibility than ever before.

3.0 Virginia Freight Demand

3.1 Overview

Virginia's economy generates a complex pattern of interrelated freight movements. According to available data, Virginia's multimodal transportation system handled around 915 million tons of freight, worth more than $2.1 trillion. To understand these movements, it is important to consider:

- The "critical commodities" that are being moved in support of Virginia's economy – their volumes, values, directions, and transportation modes;
- The transportation modes that are being used to move these critical commodities, as well as other traffic including pass-through traffic;
- Major freight origins and destinations, and the Virginia regions that accommodate the highest levels of freight movement; and
- Future forecasts for Virginia freight movement and for national freight movement that could impact Virginia.

Many of these questions demand detailed statistical analysis. This Report presents key information in the form of summary tables and graphics, and the interested reader is referred to the Appendices for additional detail. Much of the analysis relies on a commercial data product known as TRANSEARCH, which provides estimates of domestic freight tonnage and units moving between different geographic areas (counties, business economic areas, states), by different transportation modes (truck, rail, water, air), distinguished by commodity type (according to standard commodity classifications) for 2004 with forecasts at intervals out to the year 2035. TRANSEARCH combines public datasets and proprietary information, but is limited to domestic trade. For international trade, supplemental information was obtained from the U.S. Army Corps of Engineers, the U.S. Census Bureau's USA Trade Online database, and other sources. Finally, other databases – including but not limited to the FHWA Freight Analysis Framework and the Surface Transportation Board Rail Waybill Sample – were reviewed to ensure consistency and completeness.

3.2 Virginia's Critical Commodities

To examine the direct link between economic activity and freight movement, it is useful to first consider commodities that are most critical to Virginia's economy – those that are moving into, out of, and within the Commonwealth. This excludes, for the moment, pass-through traffic.

3.2.1 Tonnage and Value

The two primary measures of freight activity are tonnage and value. Value is a good indicator of economic activity associated with freight, while tonnage is a good indicator of the demand that freight places on the transportation infrastructure.

Virginia's critical commodities account for nearly 540 million tons moved annually over Virginia's multimodal transportation system, with an equivalent value of more than $1 trillion. This includes both domestic trade (within Virginia or between Virginia and other states) as well as international trade (between Virginia and other countries).

Considering tonnage first, as shown in Table 3.1:

- For domestic trade, four major commodity groups are responsible for more than 50 percent of Virginia's critical commodity tonnage – nonmetallic minerals (rock, sand, soil, etc.), coal, "secondary traffic" (which is mixed freight typically moving to and from warehouse and distribution facilities), and clay/concrete/glass/stone. Other important commodity groups include petroleum, lumber/wood, food products, chemicals, pulp/paper, farm products, waste and scrap, primary metal products, and fabricated metal products.

- For international trade, noncontainerized waterborne commodities represent 67 percent of international tonnage. This includes all commodities that are not handled inside intermodal shipping containers; coal, moved in bulk form, is the leading noncontainerized commodity. Waterborne containerized trade represents nearly all of the remaining international tonnage. Air cargo, which specializes in high-value/low weight commodities, represents less than 1 percent of international tonnage.

Next, considering value, as shown in Table 3.2:

- Just two commodity groups – secondary traffic and transportation equipment – account for more than 50 percent of the value of domestically moved critical commodities. Other important commodity groups include chemicals, machinery, electrical equipment, food products, fabricated metal products, tobacco, rubber/plastics, apparel, petroleum, pulp/paper, mixed shipments, primary metal products, lumber and wood, instruments, textiles, and furniture.

- Internationally, waterborne container traffic represents 70 percent of commodity value, with air cargo and noncontainerized waterborne trade splitting the remainder.

It is important to note that the numbers in Tables 3.1 and 3.2 reflect "trip chaining." For example, if a one-ton machine worth $1 million starts in Winchester, is moved by truck to the Virginia Inland Port, then by rail to Virginia Port Authority marine terminals, then by water to China, it shows up as three tons and $3 million in the data. This is in the nature of all available freight data, and there is no good way to correct for it without introducing other distortions.

Even so, the data is extremely useful for descriptive purposes, so long as it is recognized that some "double counting" occurs for commodities that: a) are imported and exported, because the international legs and the domestic legs are counted separately; and/or b) are transferred among different transportation modes, because the truck and rail and water and air legs are counted separately.

Table 3.1 Virginia's Critical Commodities by Tonnage

In Short Tons, Virginia Inbound, Outbound, and Internal Moves, 2004

Rank	Commodity Class	Total	Cumulative Share
1	Nonmetallic Minerals	112,755,256	22%
2	Coal	71,023,359	36%
3	Secondary Traffic (Warehouse/Distribution)	62,524,254	49%
4	Clay, Concrete, Glass or Stone	39,302,561	57%
5	Petroleum or Coal Products	34,816,227	64%
6	Lumber or Wood Products	34,613,227	70%
7	Food or Kindred Products	33,542,452	77%
8	Chemicals or Allied Products	28,328,607	83%
9	Pulp, Paper or Allied Products	12,421,978	85%
10	Farm Products	12,001,316	87%
11	Transportation Equipment	11,400,040	90%
12	Waste or Scrap Materials (Excluding Truck)	9,936,836	92%
13	Primary Metal Products	8,917,944	93%
14	Fabricated Metal Products	5,988,776	95%
	All Other	26,931,976	100%
	Total Domestic	**504,504,809**	
1	International Water, Noncontainerized	22,627,103	67%
2	international water, containerized	11,094,450	100%
3	Air Cargo	102,590	100%
	Total International	**33,824,143**	
	Grand Total	**538,328,952**	

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

Table 3.2 Virginia's Critical Commodities by Value

In Millions of Dollars, Virginia Inbound, Outbound, and Internal Moves, 2004

Rank	Commodity Class	Total	Cumulative Share
1	Secondary Traffic (Warehouse/Distribution)	408,305	41%
2	Transportation Equipment	160,253	57%
3	Chemicals or Allied Products	55,941	62%
4	Machinery	54,427	68%
5	Electrical Equipment	54,283	73%
6	Food or Kindred Products	31,241	76%
7	Fabricated Metal Products	24,551	79%
8	Tobacco Products	21,135	81%
9	Rubber or Miscellaneous Plastics	18,964	83%
10	Apparel or Related Products	18,586	84%
11	Petroleum or Coal Products	16,205	86%
12	Pulp, Paper or Allied Products	15,907	88%
13	Miscellaneous Mixed Shipments (Rail and Air Containers)	14,844	89%
14	Primary Metal Products	14,830	91%
15	Lumber or Wood Products	13,037	92%
16	Instruments, Photo Equipment, Optical	13,015	93%
17	Textile Mill Products	10,709	94%
18	Furniture or Fixtures	9,765	95%
	All Other	48,393	100%
	Total Domestic	**1,004,391**	
1	International Water, Containerized	31,512	70%
2	International Air Cargo	7,006	86%
3	International Water, Noncontainerized	6,471	100%
	Total International	**44,989**	
	Grand Total	**1,049,380**	

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

3.2.2 Location of Trade in Critical Commodities

Figures 3.1 through 3.3 show the origin and destination patterns of freight flows for the top three commodities by weight. These commodities are:

- Nonmetallic minerals;
- Secondary traffic (freight flows related to warehousing and distribution); and
- Coal.

Nonmetallic mineral trade occurs statewide, with concentrations along the Interstate 81 corridor, throughout the central part of the State, and in Northern Virginia, Hampton Roads, and Richmond. Secondary traffic tonnage is highest in the Hampton Roads and Richmond areas and in Northern Virginia. Coal flows primarily from the western part of Virginia to the coal terminals in Hampton Roads.

Figures 3.4 through 3.6 show the origin and destination patterns of freight flows for the top three commodities by value. These commodities are:

- Secondary traffic (freight flows related to warehousing and distribution);
- Transportation equipment; and
- Electrical equipment.

Secondary traffic freight flows are concentrated along the Interstate 81 and Interstate 95 corridors and in Northern Virginia, Hampton Roads, and Richmond. Production and consumption centers for transportation equipment are centered in Northern Virginia, Hampton Roads, and Richmond. Electrical equipment freight flows are centered in Northern Virginia and Richmond with a lesser concentration in Hampton Roads.

Figure 3.1 Leading Regions, Nonmetallic Minerals Tonnage
Domestic Tonnage, Inbound and Outbound and Internal, 2004

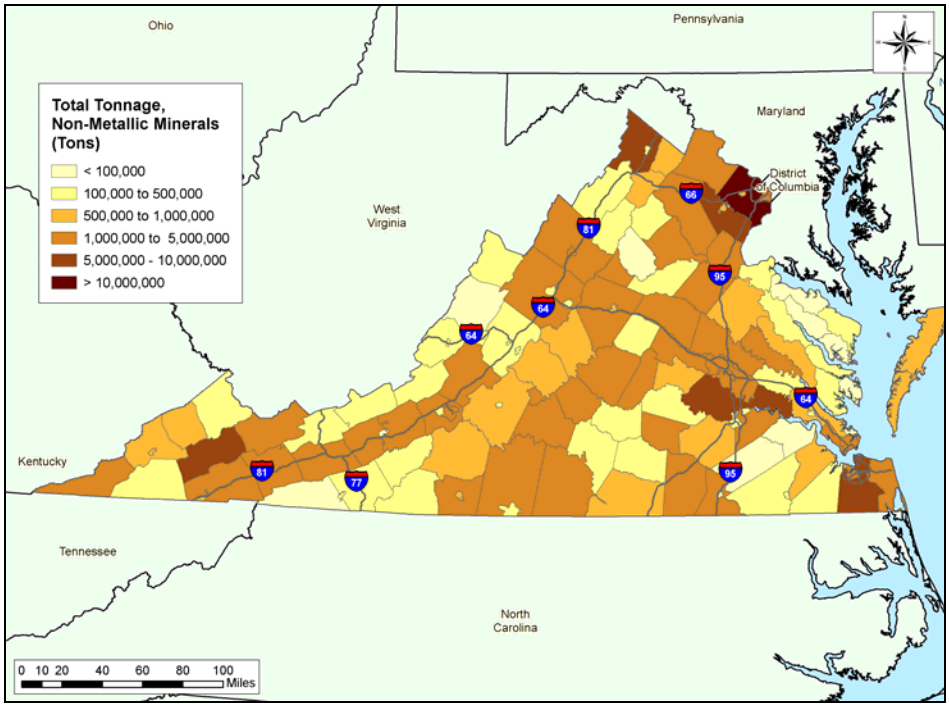


Figure 3.2 Leading Regions, Secondary Traffic Tonnage
Domestic Tonnage, Inbound and Outbound and Internal, 2004

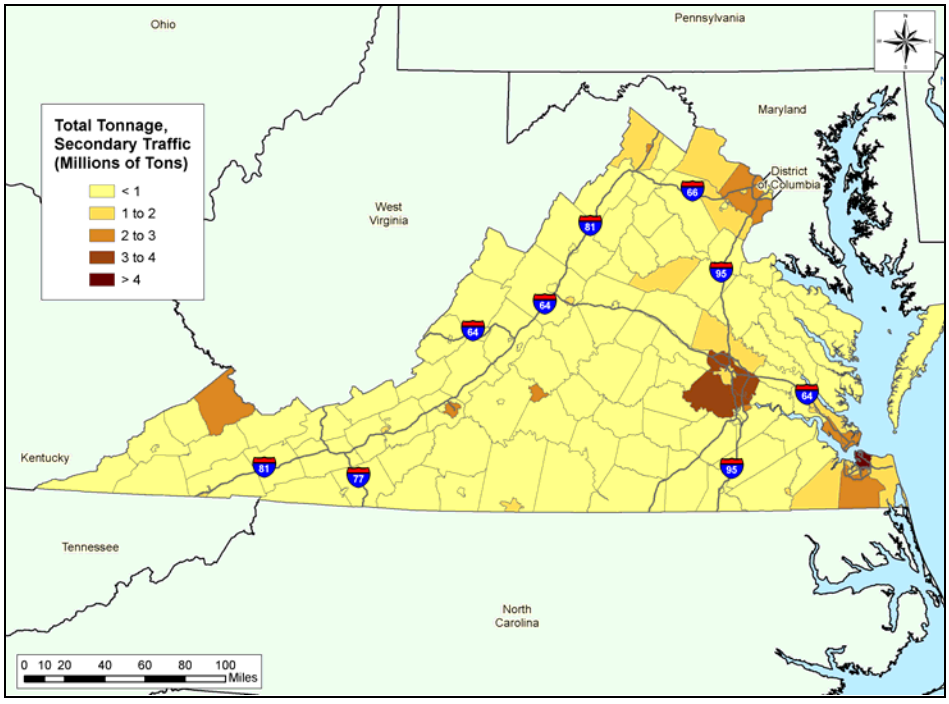


Figure 3.3 Leading Regions, Coal Tonnage
Domestic Tonnage, Inbound and Outbound and Internal, 2004

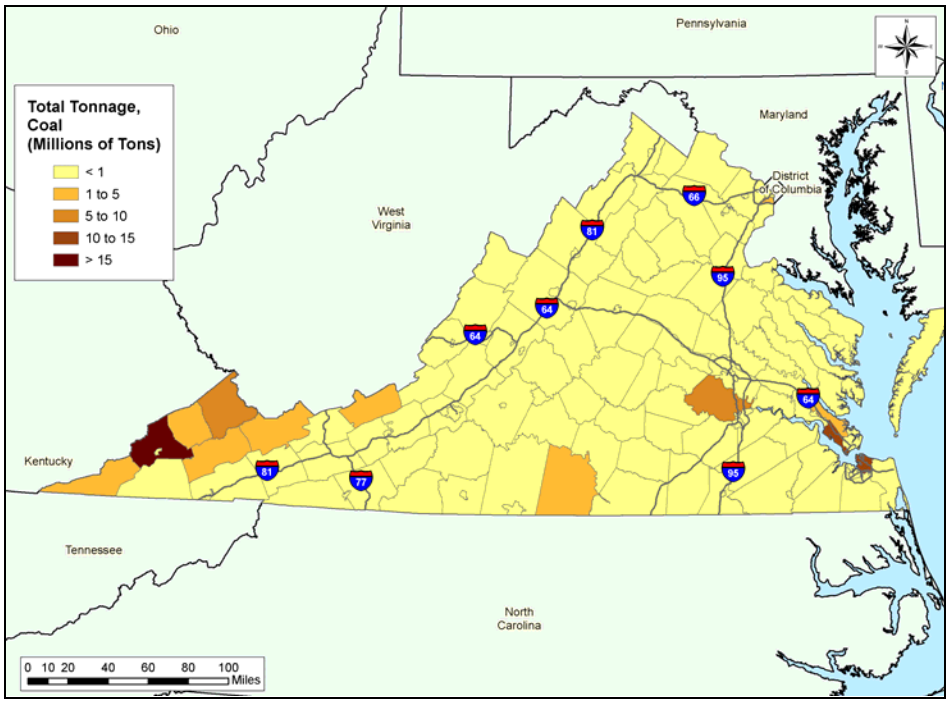


Figure 3.4 Leading Regions, Secondary Traffic Value
Domestic Value, Inbound and Outbound and Internal, 2004

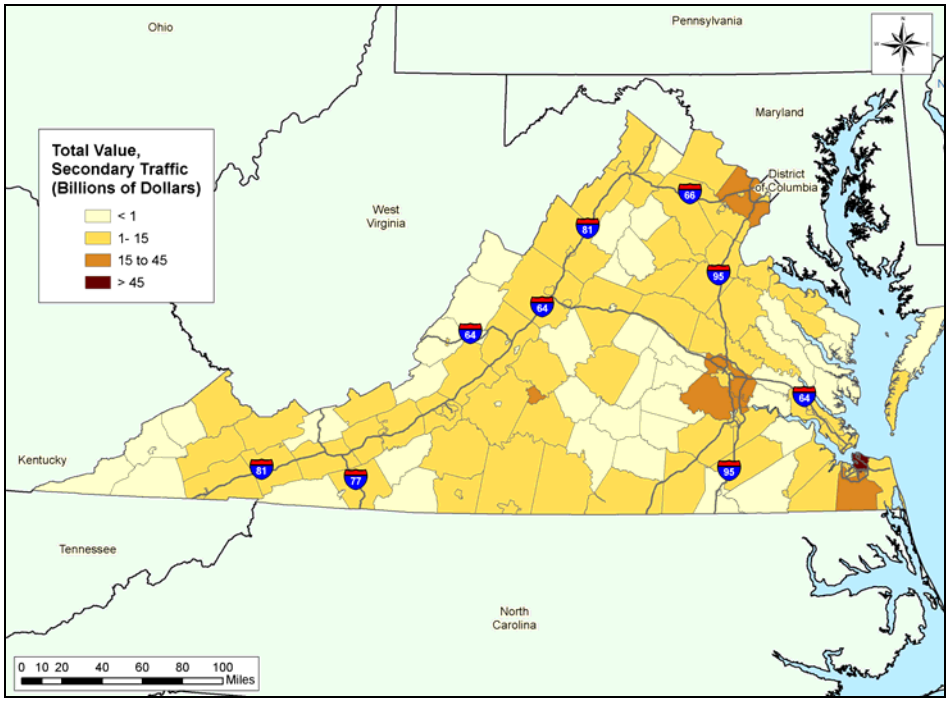


Figure 3.5 Leading Regions, Transportation Equipment Value
Domestic Value, Inbound and Outbound and Internal, 2004

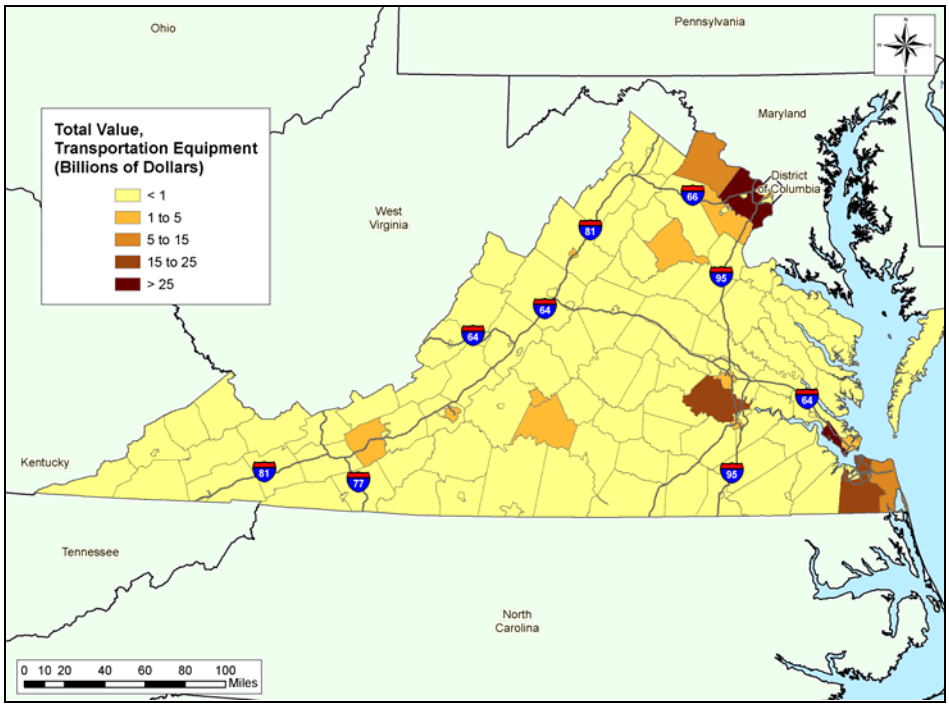
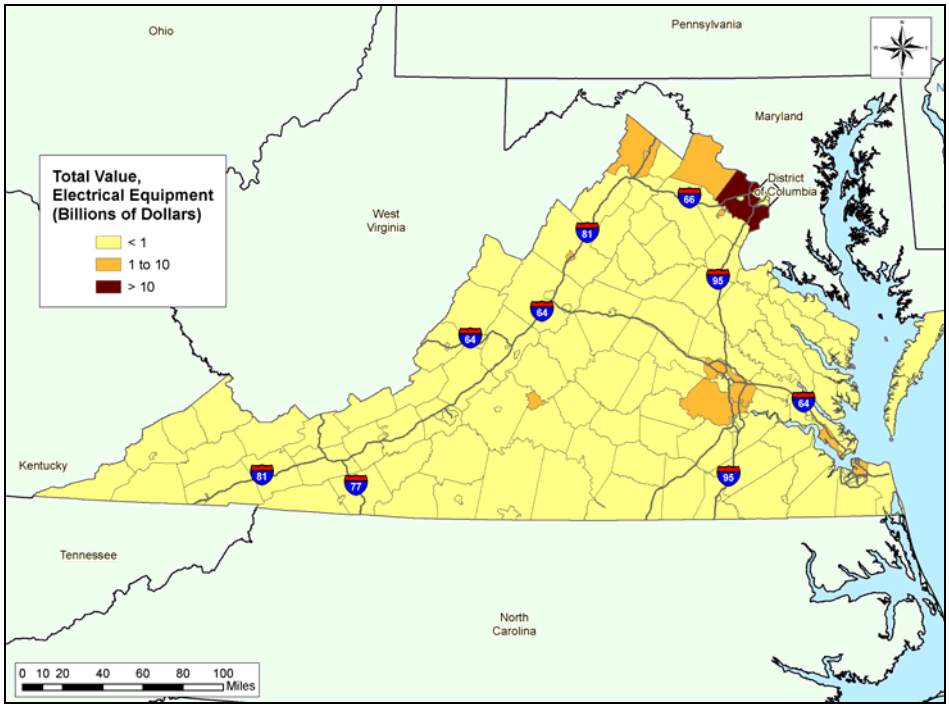


Figure 3.6 Leading Regions, Electrical Equipment Value
Domestic Value, Inbound and Outbound and Internal, 2004



3.2.3 Direction of Trade in Critical Commodities

Virginia's freight moves in different directions, depending on the commodity:

- Inbound freight is moved from other states, or other countries, to Virginia.
- Outbound freight is moved from Virginia to other states, or other countries.
- Internal freight is moved from one point in Virginia to another point in Virginia. In tallying statewide freight data, it counted only once in the data – rather than twice, at its point of origin and its point of destination. However, in tallying county-level freight date, it is counted at both its point of origin and point of destination.
- Pass-through freight is moving from a state other than Virginia to a state other than Virginia, via transportation infrastructure passing through the Commonwealth. As previously mentioned, pass-through freight does not contribute significantly to Virginia's economy and is not included in the tabulation of critical commodities.

Tables 3.3 and 3.4 below describe the directions of travel for Virginia's critical commodities, based on tonnage and on value. Moves that have a predominant directionality (50 percent or more of tonnage or value) are shaded.

As shown in Table 3.3 below, the directions of travel for Virginia's leading critical commodities on the basis of tonnage are:

- For domestic moves, around 35 percent of tonnage is inbound, 28 percent is outbound, and 38 percent is internal. Commodities that are primarily inbound include: petroleum and coal products; food products; waste and scrap; and primary metal products. Commodities that are primarily internal include: nonmetallic minerals, secondary traffic, and clay/concrete/glass/stone. Other groups do not show a clearly dominant direction. Coal and fabricated metal products are more inbound; transportation equipment and pulp and paper are more outbound; and farm products and lumber and wood are more internal.
- For international moves, around 60 percent of tonnage is outbound and 40 percent is inbound. Noncontainerized waterborne trade is primarily outbound (export), while containerized waterborne trade and air cargo is primarily inbound (import).

Table 3.3 Direction of Travel for Leading Commodities by Tonnage

Virginia Inbound, Outbound, and Internal Moves, 2004

Commodity Class	Percent Inbound	Percent Outbound	Percent Internal
Nonmetallic Minerals	14.8%	17.6%	67.5%
Coal	42.2%	36.4%	21.4%
Secondary Traffic (Warehouse/Distribution)	30.6%	17.8%	51.6%
Clay, Concrete, Glass or Stone	22.2%	22.4%	55.4%
Petroleum or Coal Products	65.4%	26.9%	7.7%
Lumber or Wood Products	25.3%	35.5%	39.2%
Food or Kindred Products	54.9%	25.9%	19.3%
Chemicals or Allied Products	53.9%	31.6%	14.5%
Pulp, Paper or Allied Products	32.4%	46.8%	20.8%
Farm Products	35.1%	22.8%	42.1%
Transportation Equipment	29.6%	44.3%	26.0%
Waste or Scrap Materials (Excluding Truck)	59.5%	30.9%	9.7%
Primary Metal Products	64.1%	21.4%	14.5%
Fabricated Metal Products	38.4%	39.2%	22.4%
Total Domestic	**34.6%**	**27.6%**	**37.8%**
International Water, Noncontainerized	27.7%	72.3%	0.0%
International Water, Containerized	63.2%	36.8%	0.0%
Air cargo	73.2%	26.8%	0.0%
Total International	**39.5%**	**60.5%**	**0.0%**
Grand Total	**34.9%**	**29.7%**	**35.5%**

Sources: TRANSEARCH 2004 and usa.tradeonline.gov.

As shown in Table 3.4 below, the directions of travel for Virginia's leading critical commodities on the basis of value are:

- For domestic moves, around 33 percent of value is inbound, 34 percent is outbound, and 33 percent is internal. Commodities that are primarily inbound include: food products; apparel; petroleum and coal products; mixed shipments by rail container and air; and primary metal products. Commodities that are primarily outbound include: machinery; electrical equipment; tobacco products; instruments; and furniture and fixtures. Secondary traffic is the only commodity that is primarily internal. Other groups do not show a clearly dominant direction.

Table 3.4 Direction of Travel for Leading Commodities by Value
Virginia Inbound, Outbound, and Internal Moves, 2004

Commodity Class	Percent Inbound	Percent Outbound	Percent Internal
Secondary Traffic (Warehouse/Distribution)	30.6%	17.9%	51.5%
Transportation Equipment	24.8%	46.0%	29.2%
Chemicals or Allied Products	40.0%	43.5%	16.6%
Machinery	24.3%	55.5%	20.2%
Electrical Equipment	38.8%	51.4%	9.7%
Food or Kindred Products	53.4%	28.6%	18.0%
Fabricated Metal Products	33.5%	43.1%	23.4%
Tobacco Products	8.7%	64.1%	27.2%
Rubber or Miscellaneous Plastics	26.3%	55.2%	18.5%
Apparel or Related Products	56.1%	21.2%	22.7%
Petroleum or Coal Products	77.3%	17.4%	5.3%
Pulp, Paper or Allied Products	36.7%	41.3%	22.0%
Miscellaneous Mixed Shipments (Rail and Air Containers)	51.2%	43.0%	5.8%
Primary Metal Products	62.5%	23.4%	14.1%
Lumber or Wood Products	36.6%	34.9%	28.5%
Instruments, Photo Equipment, Optical	29.6%	60.2%	10.2%
Textile Mill Products	33.1%	48.1%	18.8%
Furniture or Fixtures	22.3%	60.0%	17.7%
Total Domestic	**32.9%**	**33.8%**	**33.3%**
International Water, Containerized	69.0%	31.0%	0.0%
International Air Cargo	61.2%	38.8%	0.0%
International Water, Noncontainerized	45.9%	54.1%	0.0%
Total International	**64.4%**	**35.6%**	**0.0%**
Grand Total	**34.3%**	**33.9%**	**31.9%**

Sources: TRANSEARCH 2004 and usa.tradeonline.gov.

- For international moves, around 64 percent of value is inbound and 36 percent is outbound. Containerized waterborne trade and air cargo is primarily inbound (import), while noncontainerized waterborne trade is primarily outbound (export).

3.2.4 Transportation Modes Used by Critical Commodities

Freight in Virginia moves by four major modes – truck, rail, water, and air – in various combinations. (Pipelines are also important, but pipeline activity does not directly impact

Virginia's transportation system and is not addressed in this study). Thousands of different commodities are handled in Virginia, and within these four major modes, there is significant specialization to provide different equipment and services that are suitable for these different commodities.

From Table 3.5 below, for tonnage of critical commodities moving domestically, it can be seen that trucking accounts for 76 percent, rail for 20 percent, domestic water for 4 percent, and air for less than 1 percent. Rail has a dominant share of coal traffic and significant shares of traffic in all other leading commodity classes except secondary traffic. Domestic water has a meaningful share of petroleum traffic and a limited share of mineral and farm product traffic. Except for coal, each of the leading tonnage commodities depends heavily on trucking. For critical commodities moving internationally, water accounts for nearly all of tonnage.

Table 3.5 Virginia's Critical Commodities – Share of Tonnage by Mode

Inbound, Outbound, and Internal Moves, 2004

Commodity	Truck	Rail	Water	Air
Nonmetallic Minerals	89%	8%	3%	
Coal	7%	85%	8%	
Secondary Traffic (Warehouse/Distribution)	100%			
Clay, Concrete, Glass or Stone	92%	8%		
Petroleum or Coal Products	80%	8%	12%	
Lumber or Wood Products	95%	5%		
Food or Kindred Products	93%	7%		
Chemicals or Allied Products	86%	14%		
Pulp, Paper or Allied Products	80%	19%		
Farm Products	81%	17%	2%	
Transportation Equipment	87%	13%		
All Other	69%	19%	11%	1%
Total Domestic	**76%**	**20%**	**4%**	**< 1%**
International Water, Noncontainerized			67%	
International Water, Containerized			33%	
International Air Cargo				< 1%
Total International			**>99%**	**< 1%**

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

From Table 3.6 below, for value of critical commodities moving domestically, we see that trucking accounts for 95 percent, rail for 4 percent, and domestic water and air for less than 1 percent each. Rail has a dominant share of miscellaneous mixed shipments (a classification that refers to containerized shipments not using a truck) and a meaningful

share of transportation equipment, chemicals, food, petroleum, pulp/paper, and primary metal products. Domestic water has a meaningful share of petroleum. Except for miscellaneous mixed shipments, all commodities depend heavily on trucking. For value of critical commodities moving internationally, the importance of waterborne container trade (70 percent) and air cargo (16 percent) becomes clear.

Table 3.6 Virginia's Critical Commodities – Share of Value by Mode

Inbound, Outbound, and Internal Moves, 2004

Commodity	Truck	Rail	Water	Air
Secondary Traffic (Warehouse/Distribution)	100%			
Transportation Equipment	95%	5%		
Chemicals or Allied Products	92%	8%		
Machinery	96%	1%		3%
Electrical Equipment	98%	1%		1%
Food or Kindred Products	94%	6%		
Fabricated Metal Products	99%	1%		
Tobacco Products	100%			
Rubber or Miscellaneous Plastics	100%			
Apparel or Related Products	100%			
Petroleum or Coal Products	86%	6%	8%	
Pulp, Paper or Allied Products	87%	12%	1%	
Miscellaneous Mixed Shipments	0%	99%		1%
Primary Metal Products	92%	8%		
All Other	92%	5%		1%
Total Domestic	**95%**	**4%**	**< 1%**	**< 1%**
International Water, Containerized			70%	
International Air Cargo				16%
International Water, Noncontainerized			14%	
Total International	**0%**	**0%**	**84%**	**16%**

Source: TRANSEARCH database, 2004.

As mentioned earlier, it is important to note that these numbers reflect the effects of trip chaining and transfers of freight among and between different modes. Almost all air cargo moves have a corresponding landside move by truck. Most port traffic has one or more corresponding land moves by truck and/or rail. Many rail moves have a related truck trip at the origin or destination. Finally, even all-truck moves may be accomplished by more than one truck, with an intervening stop in a warehouse/distribution center. Each time the freight is handled by a given mode, it is logged as tonnage within the TRANSEARCH dataset, so the relative contribution of trucking tends to be significantly magnified compared to other modes.

3.3 Virginia's Freight Transportation Modes

3.3.1 Contributions to Moving Virginia's Critical Commodities

Trucking

Trucks are the "glue" that holds the freight system together. They are responsible for the most tonnage handled, the largest number of trips, and the largest number of ton-miles. They handle the broadest range of commodities, from raw materials to consumer goods to post-consumer products. In some cases they are responsible for the entire freight trip, via door-to-door service. In other cases they are part of intermodal trip chains, picking up and delivering to ports, railyards, airports, and warehouse/distribution centers. Every Virginia freight shipper or receiver that is not located on a navigable waterway or active rail line, or within walking distance of their nearest cargo airport, is dependent on trucking. Railroads, ports, and airports rely on trucking to reach customers throughout Virginia and the U.S.

By tonnage, the leading truck commodities are nonmetallic minerals and secondary traffic, followed by clay/concrete/glass/stone, lumber/wood, food products, petroleum products, and chemicals. By value, secondary traffic is by far the leading commodity, followed by transportation equipment and other important products.

Table 3.7 Virginia's Critical Commodities Handled by Truck
Domestic Inbound, Outbound, and Internal Moves, 2004

Leading Tonnage Commodities	Tons	Leading Value Commodities	In Million Dollars
Nonmetallic Minerals	99,947,446	Secondary Traffic	408,305
Secondary Traffic	62,524,254	Transportation Equipment	151,804
Clay, Concrete, Glass or Stone	36,171,451	Chemicals or Allied Products	51,480
Lumber or Wood Products	32,867,249	Machinery	52,290
Food or Kindred Products	31,112,374	Electrical Equipment	53,285
Petroleum or Coal Products	27,883,789	Food or Kindred Products	29,247
Chemicals or Allied Products	24,248,272	Fabricated Metal Products	24,318
Pulp, Paper or Allied Products	9,957,320	Tobacco Products	21,135
Transportation Equipment	9,922,172	Rubber or Miscellaneous Plastics	18,900
Farm Products	9,728,832	Apparel or Related Products	18,528

Source: TRANSEARCH 2004.

Figures 3.7 and 3.8 below show that the generation of truck tonnage tends to be most concentrated in Northern Virginia, Hampton Roads, Richmond, and some of the counties along the I-81 Corridor.

Figure 3.7 Leading Regions, Critical Commodity Tonnage by Truck
Domestic Tonnage, Inbound and Outbound and Internal, 2004

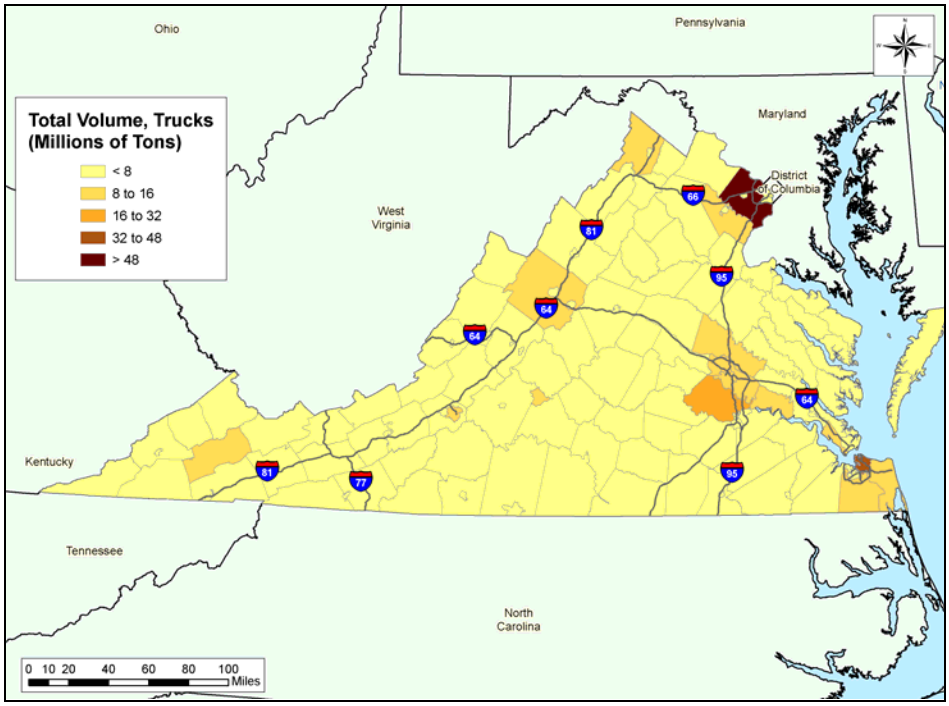
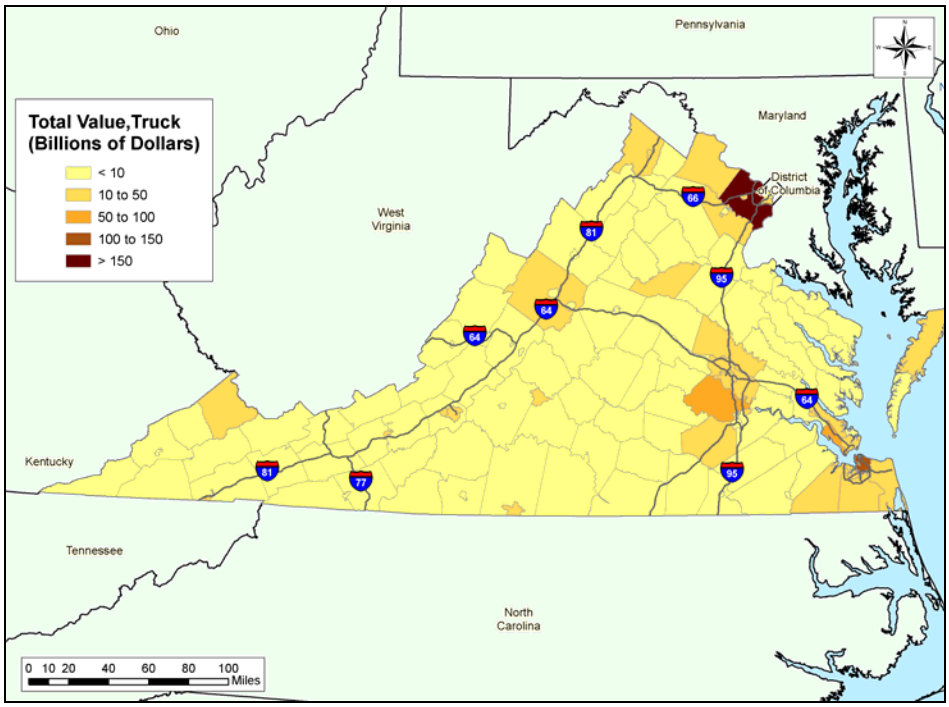


Figure 3.8 Leading Regions, Critical Commodity Value by Truck
Domestic Value, Inbound and Outbound and Internal, 2004



Rail

If trucks are the "glue" of Virginia's freight transportation system, the railroads are its "heavy lifters." Rail specializes in long-haul transportation of high-value containerized goods (known as intermodal service); short- and long-haul transportation of bulk goods, such as coal in dedicated train sets (known as unit train service); and short- and long-haul transportation of mixed car types (flatcars, tanker cars, bulk cars, etc., known as carload service). The availability of rail service reduces dependence on trucking, particularly for heavy commodities that have major impacts on Virginia's pavement. Virginia's railroads are critical in transporting containers and bulk materials to and from Virginia's ports.

By tonnage, the leading rail commodity is coal, by a large margin, followed by nonmetallic minerals, waste and scrap, and other freight. By value, the leading rail commodity is miscellaneous mixed shipments, which is container-load and trailer-load traffic moving on rail; transportation equipment, chemicals, food, and other materials are also important.

Table 3.8 Virginia's Critical Commodities Handled by Rail

Domestic Inbound, Outbound, and Internal Moves, 2004

Leading Tonnage Commodities	Tons	Leading Value Commodities	In Million Dollars
Coal	60,163,310	Miscellaneous Mixed Shipments	14,753
Nonmetallic Minerals	9,017,950	Transportation Equipment	7,906
Waste or Scrap Materials	4,246,557	Chemicals or Allied Products	4,386
Miscellaneous Mixed Shipments	4,143,586	Food or Kindred Products	1,960
Chemicals or Allied Products	4,035,169	Pulp, Paper or Allied Products	1,953
Clay, Concrete, Glass or Stone	3,119,845	Waste or Scrap Materials	1,853
Petroleum or Coal Products	2,735,239	Primary Metal Products	1,182
Pulp, Paper or Allied Products	2,409,933	Coal	1,179
Food or Kindred Products	2,397,023	Petroleum or Coal Products	925
Farm Products	2,079,675	Clay, Concrete, Glass or Stone	612

Source: TRANSEARCH 2004.

Rail tonnage and value associated with different Virginia regions are shown in Figures 3.9 and 3.10 below. Coal origin and destination regions are dominant in Figure 3.9, while mixed shipments and transportation equipment origin and destination regions are dominant in Figure 3.10. Both figures illustrate how much of the Commonwealth's rail service is focused on Hampton Roads, where it is integrated with the Virginia Port Authority marine terminals. Both figures also illustrate the lack of rail freight service for Fairfax and Loudoun Counties, which are essentially truck dependent.

Figure 3.9 Leading Regions, Critical Commodity Tonnage by Rail
Domestic Tonnage, Inbound and Outbound and Internal, 2004

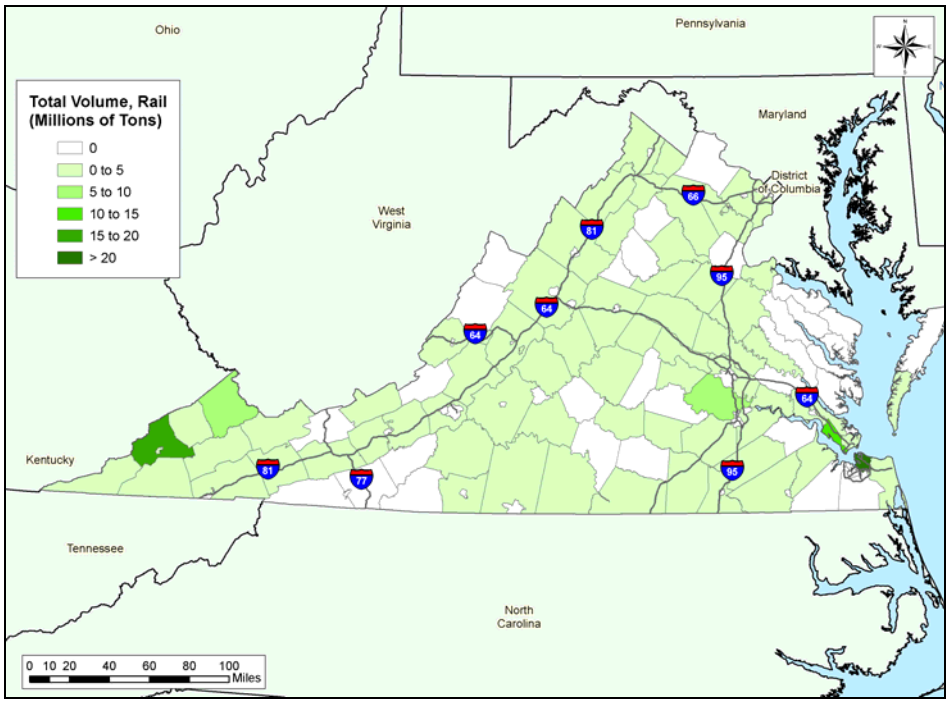
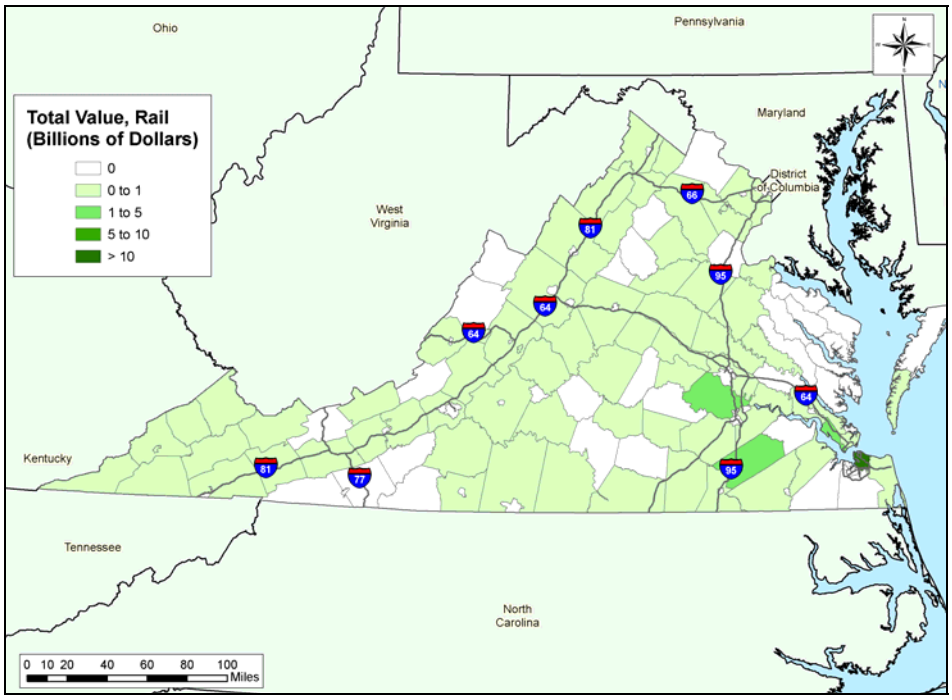


Figure 3.10 Leading Regions, Critical Commodity Value by Rail
Domestic Value, Inbound and Outbound and Internal, 2004



Water

Virginia is one of the nation's leading states for marine transportation of both domestic and imported goods, and hosts both public and private marine facilities. Marine transportation, perhaps more than any other freight activity, depends on an interconnected system of functional components – navigable waterways; productive marine terminals; efficient distribution to inland and other coastal markets via truck, rail and barge; and extensive warehouse/distribution center capacity to serve the needs of major shippers, who bring large quantities of imported goods to these facilities and then subsequently distribute them throughout Virginia and other states.

By tonnage, the leading class is international noncontainer traffic, primarily coal. Leading domestic commodities by tonnage are waste and scrap, coal, and petroleum products. By value, the leading class is international container traffic, primarily high-value machinery, products, and equipment. Waterborne trade, by its nature, is concentrated along Virginia's coastline and navigable waterways (see Figures 3.11 and 3.12).

Table 3.9 Virginia's Critical Commodities Handled by Water

Inbound, Outbound, and Internal Moves, 2004

Leading Tonnage Commodities	Tons	Leading Value Commodities	In Million Dollars
Domestic			
Waste or Scrap Materials	5,661,992	Petroleum or Coal Products	1,327
Coal	5,625,709	Waste or Scrap Materials	712
Petroleum or Coal Products	4,196,920	Fresh Fish or Marine Products	212
Nonmetallic Minerals	3,789,859	Coal	151
Farm Products	190,511	Nonmetallic Minerals	129
International			
All Noncontainerized	22,627,103	All Containerized	31,512
All Containerized	11,094,450	All Noncontainerized	6,471
International			
Coal and Mineral Fuels	18,817,095	Machinery	7,366
Wood and Articles of Wood	1,526,415	Transportation Equipment	2,581
Nonmetallic Minerals	1,298,237	Pharmaceutical Products	2,434
Machinery	1,100,949	Electrical Equipment	2,043
Paper and Paperboard	699,297	Plastics	1,621
Plastics	675,881	Tobacco	1,597
Wood Pulp and Waste Paper	628,941	Furniture	1,404
Transportation Equipment	593,756	Chemicals	1,234
Furniture	558,053	Coal and Mineral Fuels	925
Beverages	553,526	Toys, Games, Sports Equip	874

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

Figure 3.11 Leading Regions, Critical Commodity Tonnage by Water
Domestic Tonnage, Inbound and Outbound and Internal, 2004

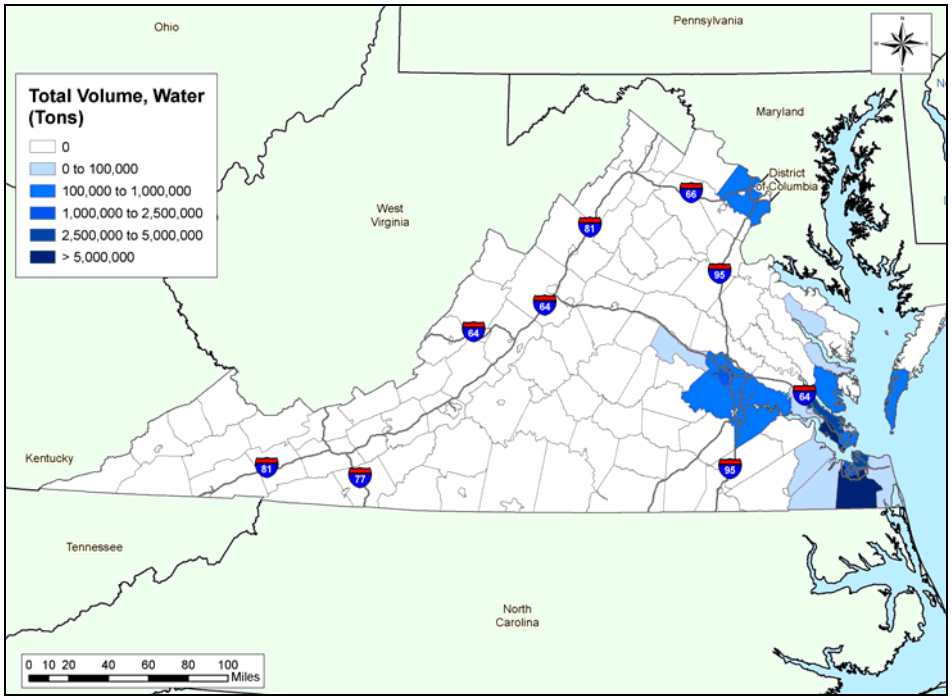
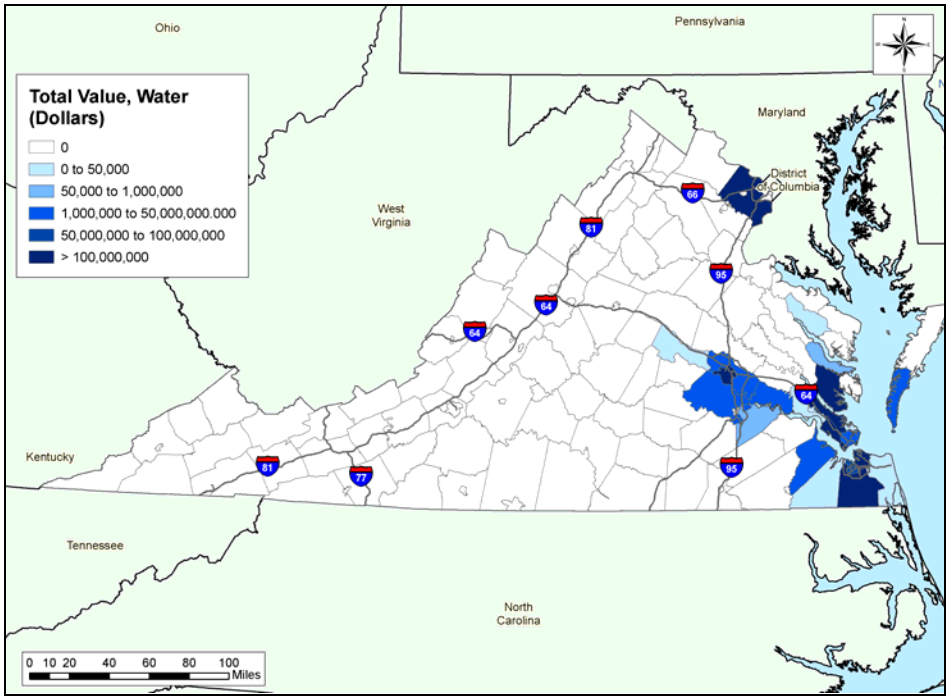


Figure 3.12 Leading Regions, Critical Commodity Value by Water
Domestic Value, Inbound and Outbound and Internal, 2004



Air

Professional service businesses, industries, and consumers are increasingly reliant on the fast, reliable, just-in-time service that air cargo provides, and that "integrated carriers" such as UPS and FedEx have perfected. By providing fast, reliable transportation for high-value, time-sensitive goods – mail and express packages, perishable agricultural and biotech products, specialized machinery and consumer goods, etc. – air cargo services become a key driver for economic growth, and can be instrumental in attracting and supporting manufacturing, shipping, and distribution companies.

For domestic traffic, the leading commodity by tonnage is mail or contract traffic, followed by machinery, transportation equipment, mixed shipments, and chemicals; the value leader is machinery, followed by electrical equipment. For international traffic, the tonnage leaders are machinery and electrical equipment; the value leaders are pharmaceutical products, electrical equipment, and machinery. Air cargo activity is tends to be clustered at a limited number of air cargo airports, with the greatest concentrations at Dulles, Norfolk, Richmond, and Roanoke (see Figures 3.13 and 3.14).

Table 3.10 Virginia's Critical Commodities Handled by Air

Inbound, Outbound, and Internal Moves, 2004

Leading Tonnage Commodities	Tons	Leading Value Commodities	In Million Dollars
Domestic			
Mail or Contract Traffic	267,105	Machinery	1,572
Machinery	52,932	Electrical Equipment	690
Transportation Equipment	31,688	Mail or Contract Traffic	543
Miscellaneous Mixed Shipments	25,534	Transportation Equipment	542
Chemicals or Allied Products	20,925	Miscellaneous Manufacturing Products	226
International			
Machinery	25,957	Pharmaceutical Products	1,642
Electrical Equipment	10,045	Electrical Equipment	1,343
Optical/Photo/Medical Equip	5,021	Machinery	1,169
Vehicles	4,509	Optical/Photo/Medical Equip	653
Plastics	4,007	Aircraft/Spacecraft And Parts	474

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

Figure 3.13 Leading Regions, Critical Commodity Tonnage by Air
Domestic Tonnage, Inbound and Outbound and Internal, 2004

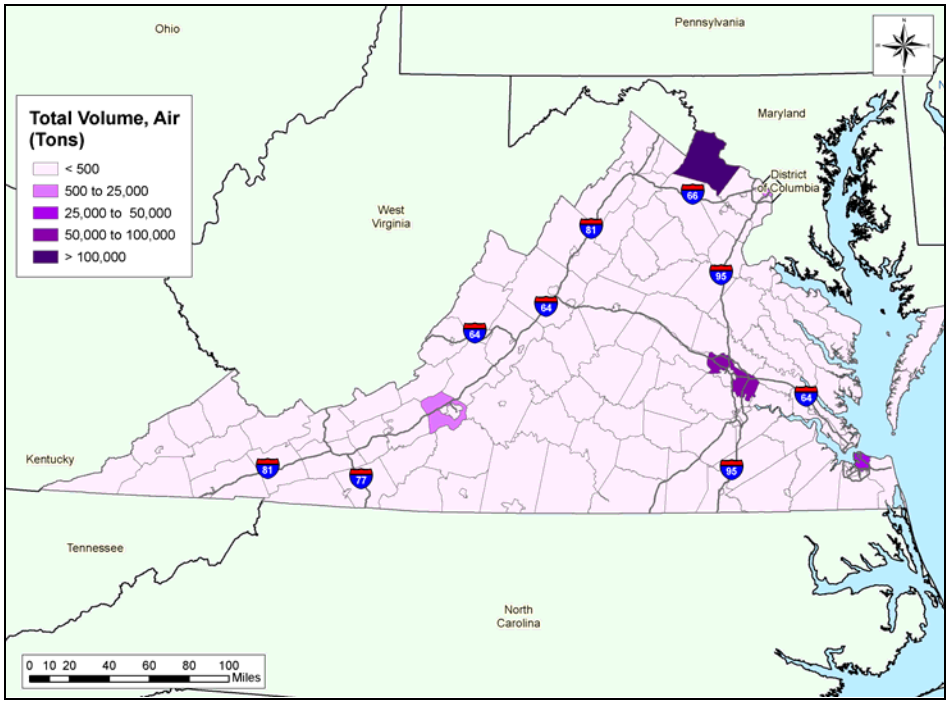
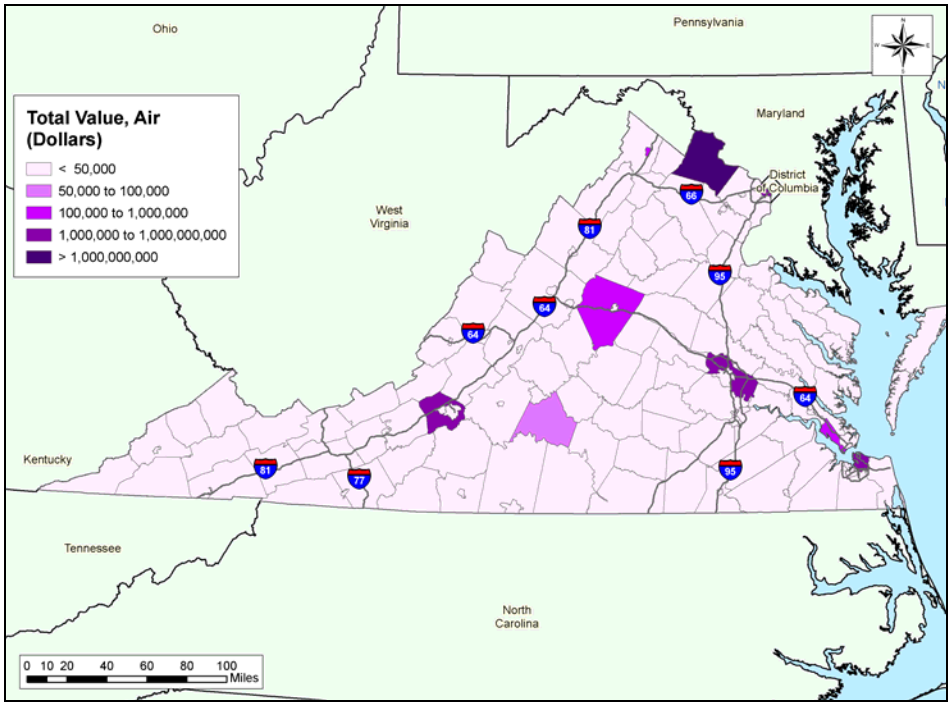


Figure 3.14 Leading Regions, Critical Commodity Value by Air
Domestic Value, Inbound and Outbound and Internal, 2004



3.3.2 Total Tonnage and Value

Virginia's freight transportation modes – truck, rail, water, and air – carry more than just Virginia's critical commodities. They also carry traffic that is passing through Virginia on its way from and to other states.

According to available data, in 2004, Virginia's multimodal transportation system handled around 915 million tons of freight worth more than $2.1 trillion, including inbound, outbound, internal, and pass-through traffic. This is the equivalent of more than 45 million loaded trucks (at 20 tons per truck); if you could line these trucks up end to end, the queue (at 70 feet per truck) would be nearly 600,000 miles long, which is more than the distance to the moon and back. In other words: this is a lot of tonnage and value.

Total tonnage and value handled by Virginia's multimodal freight transportation system is summarized in Figure 3.15 and Tables 3.11 and 3.12 below.

On the basis of tonnage:

- Trucking handled around 74.2 percent of tonnage, followed by rail at 19.9 percent, international water at 3.7 percent, domestic water at 2.1 percent, and air at less than 0.1 percent.

- Around 21 percent of tonnage was inbound, 17 percent was outbound, 21 percent was internal, and 41 percent was pass through. Of the pass-through tonnage, around 78 percent was by truck and 22 percent was by rail.

On the basis of value:

- Trucking handled around 94.1 percent of value, followed by rail at 3.5 percent, international water at 1.8 percent, air at 0.5 percent, and domestic water at 0.1 percent.

- Around 17 percent of value was inbound, 16 percent was outbound, 16 percent was internal, and 51 percent was pass through. Of the pass-through value, 97 percent were by truck and 3 percent were by rail.

Figure 3.15 Total Virginia Freight Tonnage and Value by Mode and Direction

All Traffic, 2004

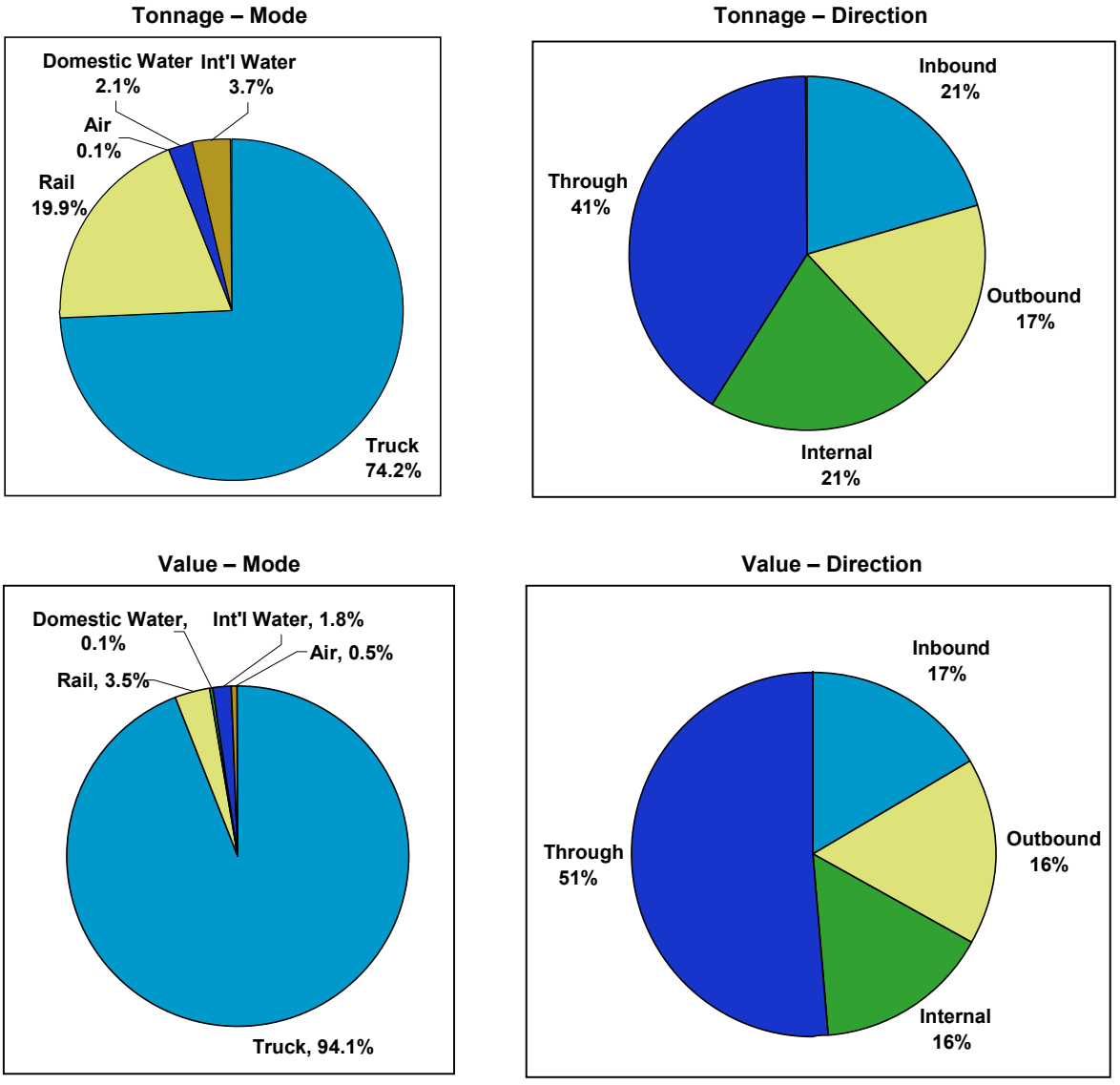


Table 3.11 Virginia's Freight Transportation Modes – Tonnage
All Traffic, Short Tons, 2004

Mode	Inbound	Outbound	Internal	Through	Total
Truck	122,558,887	98,413,261	164,223,717	293,653,650	**678,849,515**
Rail	47,118,374	30,549,739	21,526,944	83,254,468	**182,449,525**
Water – Domestic	4,501,020	10,016,623	5,126,686	N/A	**19,644,329**
Water – International Containerized	7,012,509	4,081,941	N/A	N/A	**11,094,450**
Water – International Noncontainerized	6,262,286	16,364,817	N/A	N/A	**22,627,103**
Air – Domestic	258,946	203,135	7,477	N/A	**469,558**
Air – International	75.140	27,450	N/A	N/A	**102,590**
Total	**187,787,162**	**159,656,966**	**190,884,824**	**376,908,118**	**915,237,070**

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

Table 3.12 Virginia's Freight Transportation Modes – Value
All Traffic, In Millions of Dollars, 2004

Mode	Inbound	Outbound	Internal	Pass-Through	Total
Truck	302,173	321,841	334,357	1,069,228	**2,027,600**
Rail	23,257	14,324	1,567	36,629	**75,778**
Water - Domestic	1,135	1,088	584	N/A	**2,807**
Water – International Containerized	21,746	9,766	N/A	N/A	**31,512**
Water – International Noncontainerized	2,973	3,498	N/A	N/A	**6,471**
Air – Domestic	2,267	1,670	127	N/A	**4,064**
Air – International	4,290	2,717	N/A	N/A	**7,006**
Total	**357,841**	**354,904**	**336,636**	**1,105,857**	**2,155,238**

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

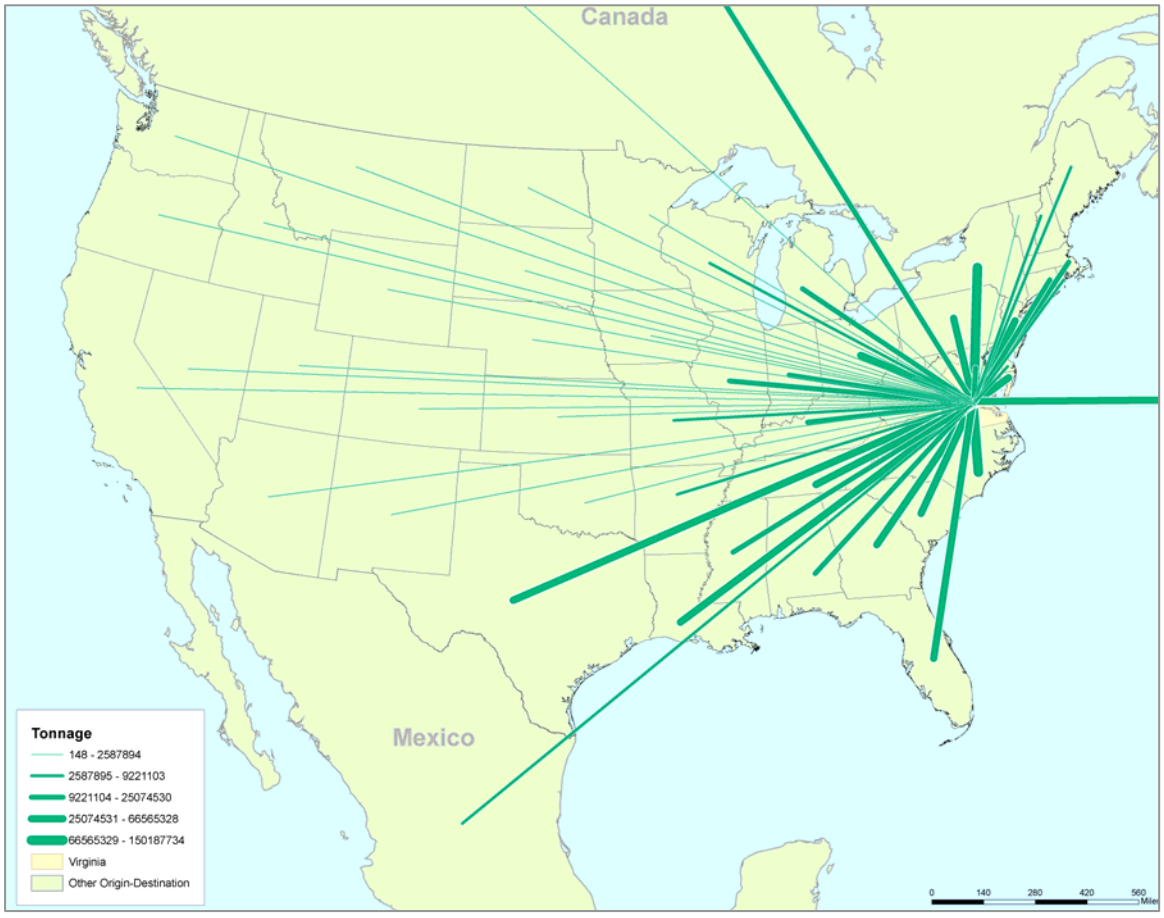
3.4 Virginia's Freight Origins and Destinations

3.4.1 Total Out-of-State Traffic

Looking at the origins and destinations of Virginia's out-of-state freight tonnage – which includes inbound, outbound, and pass-through traffic, and excludes internal traffic – the leading states are North Carolina, New York, Pennsylvania, Maryland, Georgia, South

Carolina, New Jersey, Florida, Louisiana, Ohio, Texas, and Tennessee. Together, freight moving to and from these states represents around 67 percent of Virginia's out-of-state freight tonnage.

Figure 3.16 Virginia's Out-of-State Traffic
2004, Short Tons



Source: TRANSEARCH 2004 and www.usatradeonline.gov.

Table 3.13 Virginia's Trade with Other States and Countries
Short Tons

Rank	State	Trade Tonnage	Percentage	Cumulative Percentage
1	NC	150,187,734	14%	14%
2	NY	99,184,573	9%	23%
3	PA	66,565,328	6%	29%
4	MD	62,970,457	6%	34%
5	GA	54,902,672	5%	39%
6	SC	52,103,271	5%	44%
7	NJ	51,339,147	5%	49%
8	FL	51,236,393	5%	53%
9	LA	46,464,417	4%	58%
10	OH	45,098,484	4%	62%
11	TX	41,921,611	4%	66%
12	TN	37,043,873	3%	69%
13	MA	20,814,348	2%	71%
14	IL	18,848,599	2%	73%
15	AL	16,685,894	2%	74%
16	DC	14,178,986	1%	75%
17	MS	14,062,827	1%	77%
	Overseas	33,824,143	3%	80%
	Canada	25,074,530	2%	82%
	Mexico	5,508,054	1%	82%
	All Other	193,245,024	18%	100%
Total*		**1,101,264,360**		

Sources: TRANSEARCH 2004 and www.usatradeonline.gov.

* The total here represents the sum of a) inbound VA tonnage; b) outbound VA tonnage; and c) twice the amount of pass-through tonnage, which first moves into VA, then out of VA.

For overseas trade, about one-half of Virginia's public and private terminal trade tonnage is with Europe and the Mediterranean; nearly 20 percent are with the east coast of Central and South America; about 10 percent are with the Far East; and around 20 percent are with all other parts of the world. By value and by container trade, the Far East represents a substantially larger share of overseas trade.

3.4.2 Inbound and Outbound Tonnage

For trade in Virginia's critical commodities – that is, inbound and outbound tonnage, excluding pass-through traffic – the leading partner regions are listed in Tables 3.14 and 3.15 below.

Table 3.14 Top Trading Partner Regions by Tonnage
Short Tons, Domestic Inbound and Outbound, 2004

Rank	Partner Region (Business Economic Area)	Tons	Percent	Cumulative Percent
1	Charleston, West Virginia	22,097,895	7%	7%
2	New York, New York	21,925,960	7%	14%
3	Lexington, Kentucky	16,984,275	6%	20%
4	Philadelphia, Pennsylvania	11,214,064	4%	24%
5	Charlotte, North Carolina	11,111,532	4%	28%
6	Chicago, Illinois	10,688,579	4%	32%
7	Atlanta, Georgia	9,371,455	3%	35%
8	Greensboro, North Carolina	9,282,023	3%	38%
9	Raleigh, North Carolina	9,022,208	3%	41%
10	Cleveland, Ohio	7,100,507	2%	43%

Source: TRANSEARCH 2004.

Table 3.15 Top Trading Partner Regions by Value
Domestic Inbound and Outbound, 2004

Rank	Partner Region (Business Economic Area)	Dollars	Percent	Cumulative Percent
1	New York, New York	$62,020,817,162	9%	9%
2	Philadelphia, Pennsylvania	$29,286,570,501	4%	13%
3	Charlotte, North Carolina	$26,855,737,307	4%	17%
4	Cleveland, Ohio	$24,066,269,782	4%	21%
5	Chicago, Illinois	$22,801,313,391	3%	24%
6	Raleigh, North Carolina	$16,408,441,036	2%	26%
7	Columbus, Ohio	$16,164,877,358	2%	28%
8	Greensboro, North Carolina	$15,578,834,291	2%	30%
9	Detroit, Michigan	$15,383,003,311	2%	32%
10	Baltimore City, Maryland	$15,185,093,033	2%	34%

Source: TRANSEARCH 2004.

3.4.3 Pass-Through Truck Tonnage

Virginia's geography places it at the center of the Mid-Atlantic corridor, and positions it at a major "crossroads" for goods moving between the west/southeast/south and the northeastern U.S. As previously noted, around 41 percent of Virginia's freight tonnage is pass-through tonnage; and of that amount, 78 percent of pass-through tonnage is moving by truck.

TRANSEARCH estimates of pass-through traffic were developed by modeling national freight flows over a national highway network, then extracting the flows that the model routed through Virginia. The modeling process was fairly simplified, and relied on "all or nothing" assignments. For example, if there were three good routes between a region in Texas and a region in New York, the model assigned all tonnage to the best route and none to the other two. If the best route happened to pass through Virginia, it registered as Virginia through tonnage; if not, then not. Clearly, more detailed data collection and modeling would be required to validate and/or modify these estimates. Still, for present purposes, the TRANSEARCH estimates are useful in painting a general picture.

From Table 3.16, we see that 20 origin-destination pairs account for almost 50 percent of Virginia's pass-through truck tonnage. Seven of the top 10 pairs, and all of the top five, involve the State of New York.

As presented in Table 3.17, the states that receive the most truck tonnage passing through Virginia are: New York (33 percent), Pennsylvania (11 percent), North Carolina (10 percent), Massachusetts (7 percent), and Maryland (6 percent). Table 3.18 presents the states that send the most truck tonnage passing through Virginia are: North Carolina (17 percent), Louisiana (12 percent), Texas (9 percent), Florida (9 percent), Georgia (8 percent), and New York (8 percent).

The Commonwealth has participated in several previous studies asking whether some of this pass-through truck traffic could be diverted to rail routes roughly paralleling the I-81 and/or I-95 corridors. Past studies have suggested opportunities, but have not conclusively settled the issue of how much public benefit would be derived by diverting truck traffic to rail, and at what cost to public and private sector stakeholders. Other studies of this opportunity are currently being conducted by the Commonwealth, by other states, and by the railroads.

Table 3.16 Top Origin-Destination Pairs for Through Truck Tonnage

Rank	Origin	Destination	Tons (Short)	Percent	Cumulative Percent
1	LA	NY	19,893,304	7%	7%
2	NC	NY	16,100,828	5%	12%
3	TX	NY	13,409,353	5%	17%
4	FL	NY	12,381,984	4%	21%
5	GA	NY	11,100,490	4%	25%
6	LA	PA	6,860,605	2%	27%
7	TN	NY	6,762,832	2%	29%
8	NC	OH	6,349,167	2%	32%
9	NY	NC	5,507,375	2%	33%
10	TX	PA	5,181,240	2%	35%
11	NC	PA	5,163,790	2%	37%
12	NY	FL	4,662,243	2%	39%
13	OH	NC	4,651,256	2%	40%
14	SC	NY	4,630,196	2%	42%
15	AL	NY	4,406,981	2%	43%
16	PA	NC	3,998,918	1%	45%
17	MS	NY	3,787,442	1%	46%
18	NC	MD	3,519,353	1%	47%
19	GA	PA	3,413,949	1%	48%
20	TX	MA	3,357,767	1%	49%

Source: TRANSEARCH 2004.

Table 3.17 Top Destination States for Through Truck Tonnage

State	Tons (Short)	Percent	Cumulative Percent
NY	96,001,816	33%	33%
PA	31,422,252	11%	43%
NC	28,009,654	10%	53%
MA	20,787,108	7%	60%
MD	18,378,908	6%	66%
FL	13,523,465	5%	71%
OH	11,110,500	4%	75%
GA	8,517,961	3%	78%
TX	8,386,024	3%	80%
TN	6,009,578	2%	82%
DC	5,717,125	2%	84%
SC	5,111,723	2%	86%
WV	4,649,394	2%	88%
ME	4,617,997	2%	89%

Source: TRANSEARCH 2004.

Table 3.18 Top Origin States for Through Truck Tonnage

State	Tons (Short)	Percent	Cumulative Percent
NC	49,929,525	17%	17%
LA	35,495,393	12%	29%
TX	25,462,002	9%	38%
FL	25,028,153	9%	46%
GA	24,261,869	8%	55%
NY	22,709,454	8%	62%
PA	15,726,524	5%	68%
TN	15,572,316	5%	73%
SC	12,673,593	4%	77%
OH	9,467,263	3%	80%
AL	8,488,875	3%	83%
MS	8,256,210	3%	86%
WV	5,885,467	2%	88%
MD	5,814,155	2%	90%

Source: TRANSEARCH 2004.

3.5 Freight Transportation Forecasts

3.5.1 Virginia Freight Forecasts

Virginia's TRANSEARCH data includes a set of forecasts for growth in freight tonnage and value, by mode, by commodity, and by origin-destination pair. These forecasts are linked to the Global Insight economic forecasts discussed in Section 2.0 of this report. Like the economic forecasts, these freight transportation forecasts represent a "base case" scenario. More detailed forecasting in support of project planning and investment programming would consider a range of "what if" conditions, possibly including significant changes in economic activity, fuel prices, climate, and logistics.

By the year 2035, the output of Virginia's freight-related industries is forecast to double. Freight tonnage is forecast to grow at a comparable rate through the year 2035, growing from 915 million tons to almost 2 billion tons. This includes all types of tonnage – inbound, outbound, internal, and pass-through.

Table 3.19 Freight Output and Tonnage Forecasts

	2004	2005	2035	Percent
Freight-related industry output (in million dollars)		332,846	669,822	101%
Tonnage	915,237,070		1,952,399,596	113%

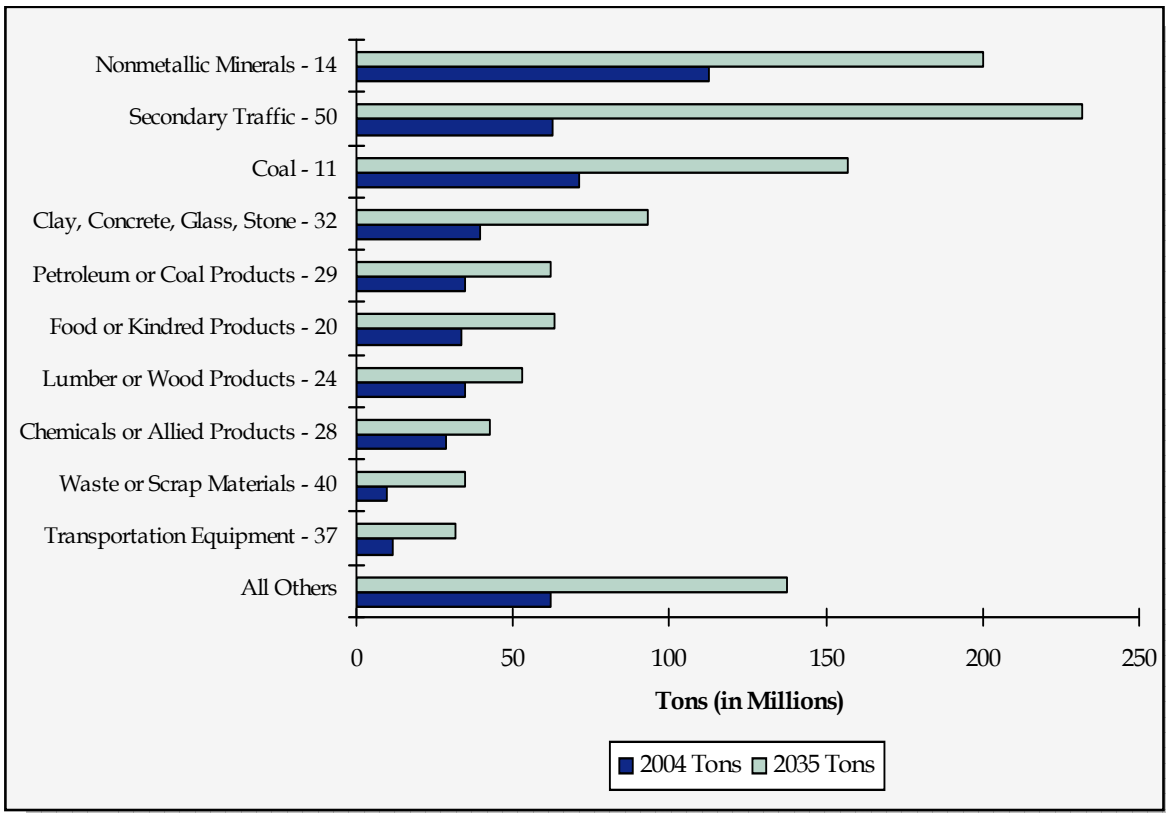
Sources: Global Insight Inc.; TRANSEARCH 2004; and Cambridge Systematics, Inc.

Virginia's Critical Commodities

Growth in output will drive growth in tonnage, and changes in Virginia's economy will drive faster growth in some types of commodities and slower growth in others.

Looking at Virginia's critical commodities, in 2004, the leading commodities by weight were nonmetallic minerals, coal, secondary traffic, and clay/concrete/glass/stone. By 2035, secondary traffic is expected to nearly triple, becoming the Commonwealth's leading commodity by tonnage.

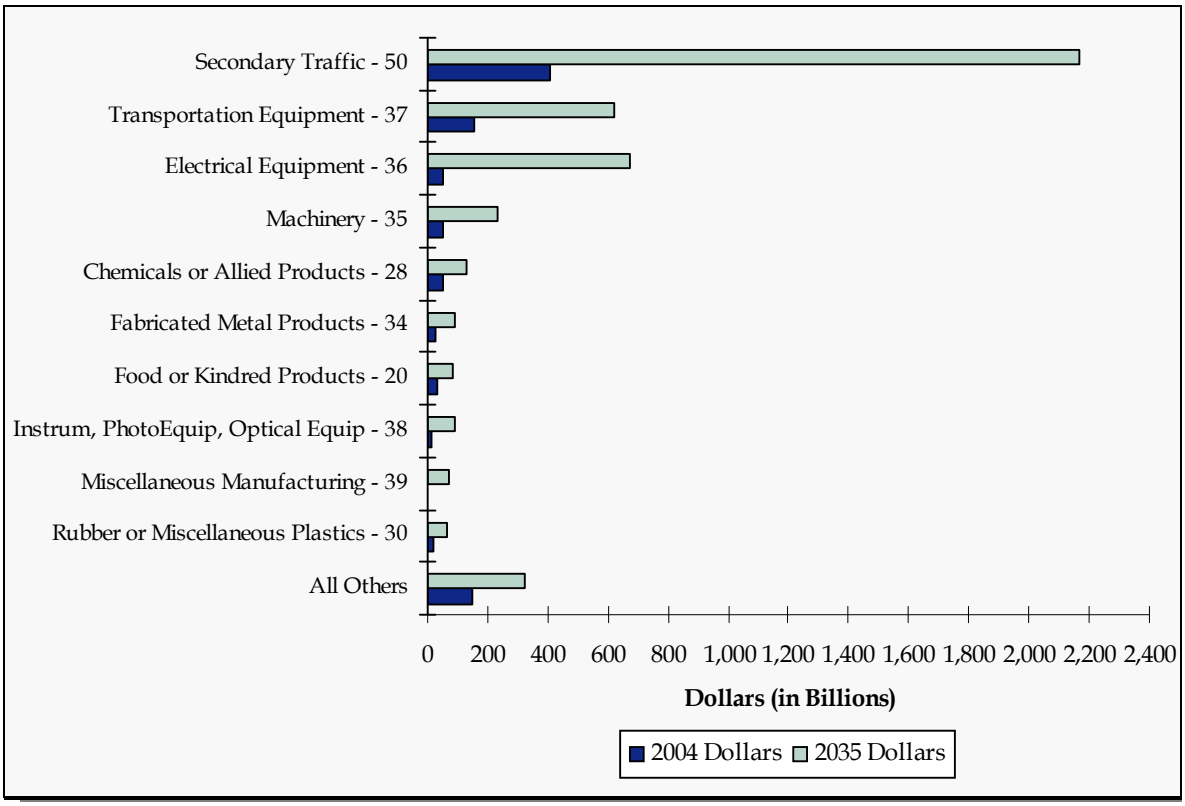
Figure 3.17 Forecasted Growth in Virginia's Domestic Commodity Tonnage
By "Two-Digit" Level Commodity Classes



Source: TRANSEARCH 2004.

By value, secondary traffic is already the leading commodity, and is forecast to become even more dominant. Strong growth is also forecast for transportation equipment and electrical equipment, as well as machinery and other commodity classes.

Figure 3.18 Forecasted Growth in Virginia's Domestic Commodity Value
By "Two-Digit" Level Commodity Classes



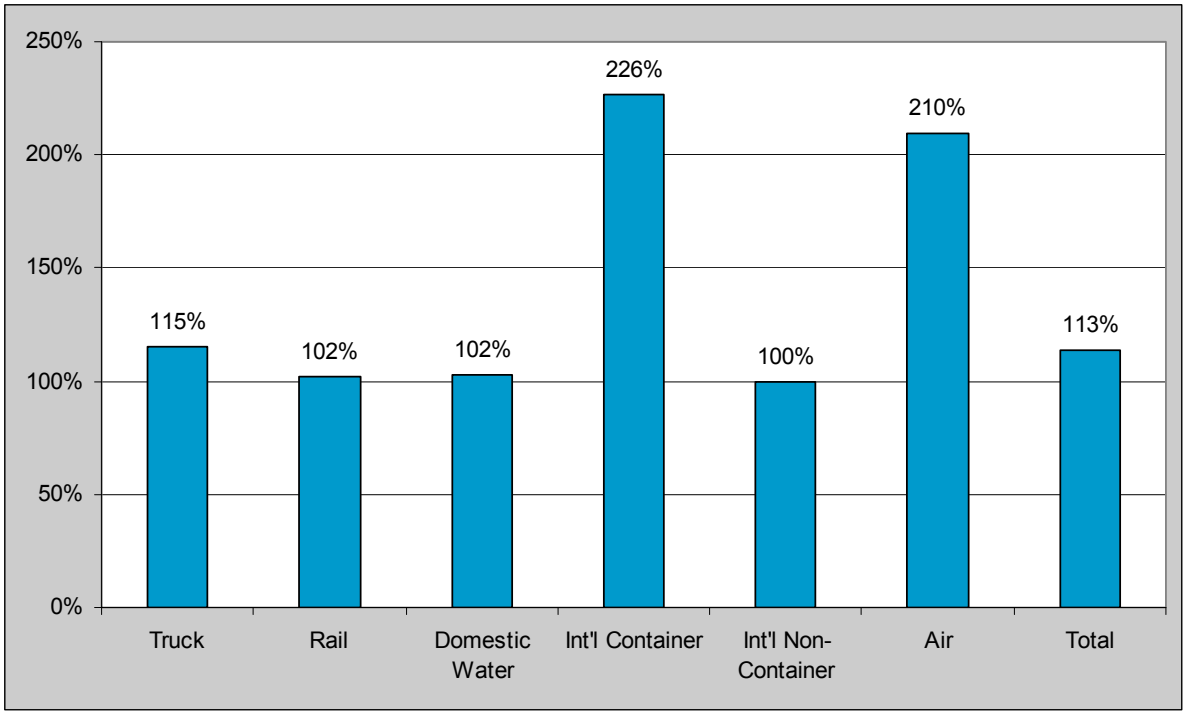
Source: TRANSEARCH 2004.

Modes

Different transportation modes will experience different growth rates. Modes that specialize in the fastest growing commodities will grow fastest.

The fastest growth is for international container and air cargo trades, with each anticipated to increase more than 200 percent by 2035. Trucking, rail, domestic water, and noncontainerized international water, which handle the great majority of total tonnage, are anticipated to increase at rates between 100 percent and 115 percent.

Figure 3.19 Forecasted Growth in Virginia's Freight Tonnage
2004 to 2035



Source: TRANSEARCH 2004; and Cambridge Systematics, Inc.

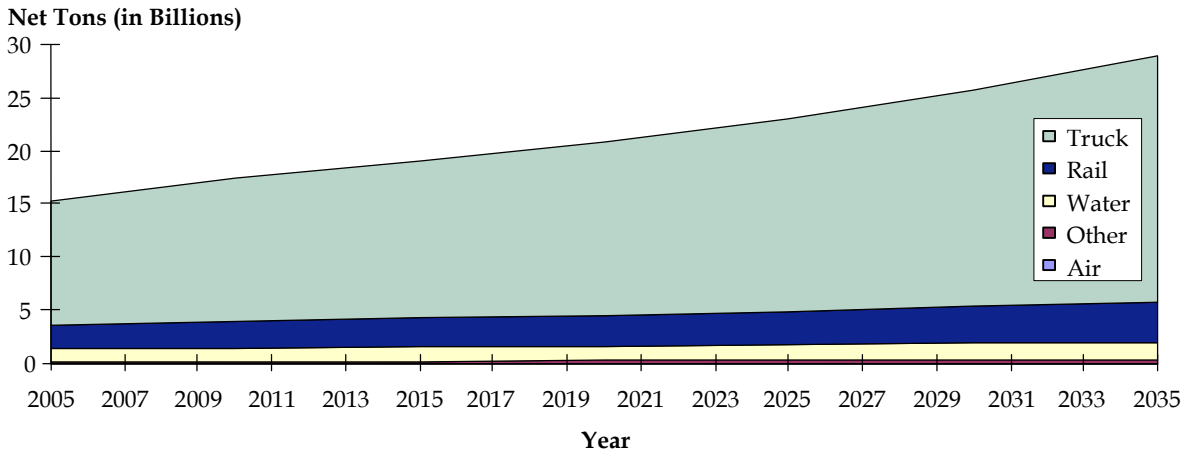
3.5.2 National Freight Forecasts

National freight forecasts are important, because growth in pass-through freight traffic is dictated by growth rates in other states. Generally, the national forecasts are similar to the Virginia forecasts.

As shown in Figure 3.20 below, national domestic freight tonnage is expected to nearly double by 2035, based on Global Insight Inc. analyses for the AASHTO's Freight Bottom Line project and the FHWA's recent Freight Analysis Framework-2 (FAF2) release.

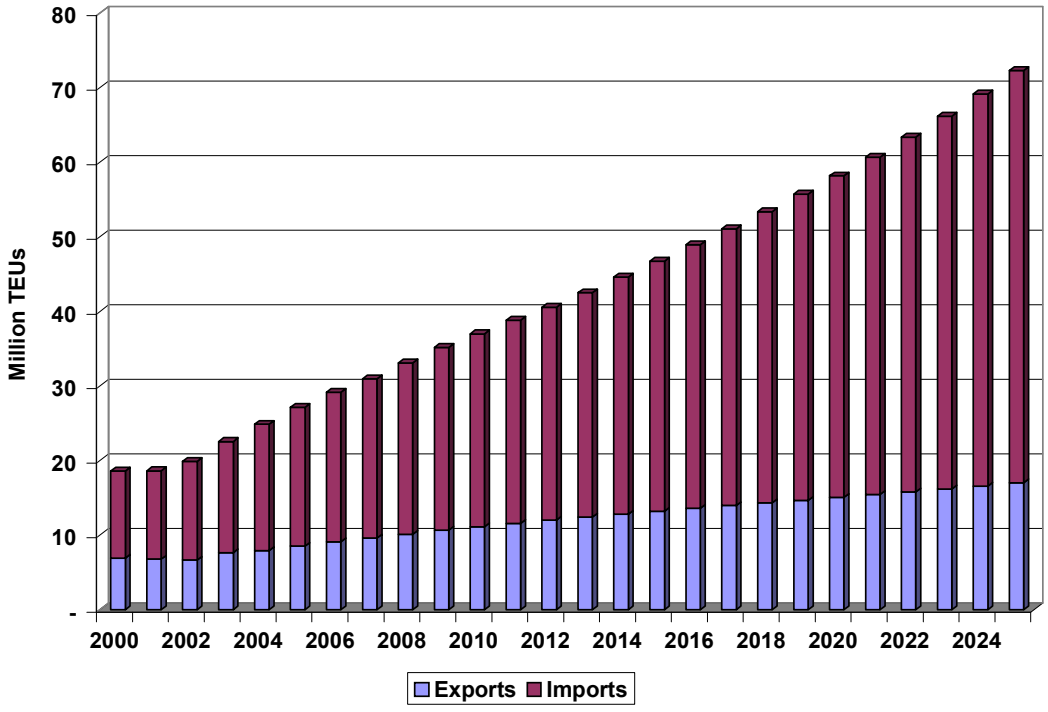
For the U.S. as a whole, international container traffic is expected to triple by 2025, as shown in Figure 3.21.

Figure 3.20 Growth in National Domestic Freight Tonnage by Mode
2005 to 2035



Source: Global Insight, Inc., TRANSEARCH 2004.

Figure 3.21 Growth in International Container Trade
In Loaded 20-Foot Equivalent Units



Source: Global Insight, Inc. for the AASHTO.

4.0 Virginia's Multimodal Freight Transportation System

4.1 Intermodal and Multimodal Systems

This section describes the various elements of the Virginia statewide multimodal freight system – its roadways, railroads, ports, intermodal connectors, warehouse/distribution facilities, and cargo airports. It provides an inventory of the current freight infrastructure network, described by its key components, an overview of how the system is performing – who is using it, and how their needs are being addressed.

The terms "multimodal" and "intermodal" can mean different things to different stakeholders. Generally, we use "multimodal" to refer to a **transportation system** that encompasses both the unique and the shared functionality of its component modes (air, water, truck, rail) and of its facilities for exchanging traffic among and between modes (warehouse/distribution centers, rail terminals, seaports, airports). The term "intermodal" was originally invented to describe a logistics process and service where a shipping container is handled by more than one mode, interchangeably. Today, the term "intermodal" is often used more broadly, to describe any freight **transportation service** involving multiple freight modes, as well as any **facility** used to accommodate the transfer. Regardless of how they are used, the terms intend to describe a system and a process that involves and attempts to maximize the relative contributions of all its disparate components, across different modes, owners, and operators.

4.2 Trucking and Virginia's Roads

4.2.1 Truck Types

Virginia's highway network is publicly owned, and the majority of truck freight activity occurs over Virginia's interstate and state highway systems. However, the equipment operating over that network – trucks and trailers – is privately owned. There are many different kinds of trucks, which are specialized to certain kinds of cargo. Trucks can be small delivery vans, medium-size "single-unit" vehicles, or large combination tractor-trailer vehicles. Their cargo can be carried on a flatbed trailer, in a dry bulk hopper, in a liquid bulk tank, on a specialized "auto rack," in a "dry van" (basically a simple enclosed box), or in an intermodal shipping container designed for direct transfer between truck,

ship, and train using specialized overhead lift equipment. There may be a refrigerator unit for keeping the cargo at a suitably cool temperature.

Figure 4.1 Combination Trucks Carrying Intermodal Shipping Containers
Boxes with Specially Designed Corners (Can Be Lifted from Above)

Figure 4.2 Combination and Single-Unit Trucks With "Dry Van" Bodies
Similar to Containers, But Connected to Trailers

Figure 4.3 Cars on an "Auto Rack" and Boats on a Flatbed Truck

Figure 4.4 Dry Bulk and Liquid Bulk Trucks

Figure 4.5 Cement and Dump Trucks

Figure 4.6 Delivery Vans
Specializing in "Last Mile" Commercial and Residential Service

4.2.2 Highway Inventory

Virginia's state-maintained highway system is divided into categories for funding and hierarchical operations purposes. As of 2005, this system consisted of 68,466 total miles, distributed as follows:

- **Interstate.** 1,118 miles of four- to 10-lane highways that connect states and major cities.
- **Primary.** 8,111 miles of two- to eight-lane roads that connect cities and towns with each other and with interstates.
- **Secondary.** 48,305 miles of local connector or county roads. (Arlington and Henrico Counties maintain their own county roads.)
- **Urban.** 10,561 miles of urban streets, maintained by cities and towns with the help of state funds. (Virginia's cities are independent of counties.)
- **Toll.** 39 miles of toll roads.
- **Frontage.** 333 miles of frontage roads.

Figure 4.7 below illustrates the locations of Virginia's major highways. Table 4.1 below describes the major truck routes and the intermodal facilities they provide connections to.

Figure 4.7 Interstate and Primary Highway Systems in Virginia

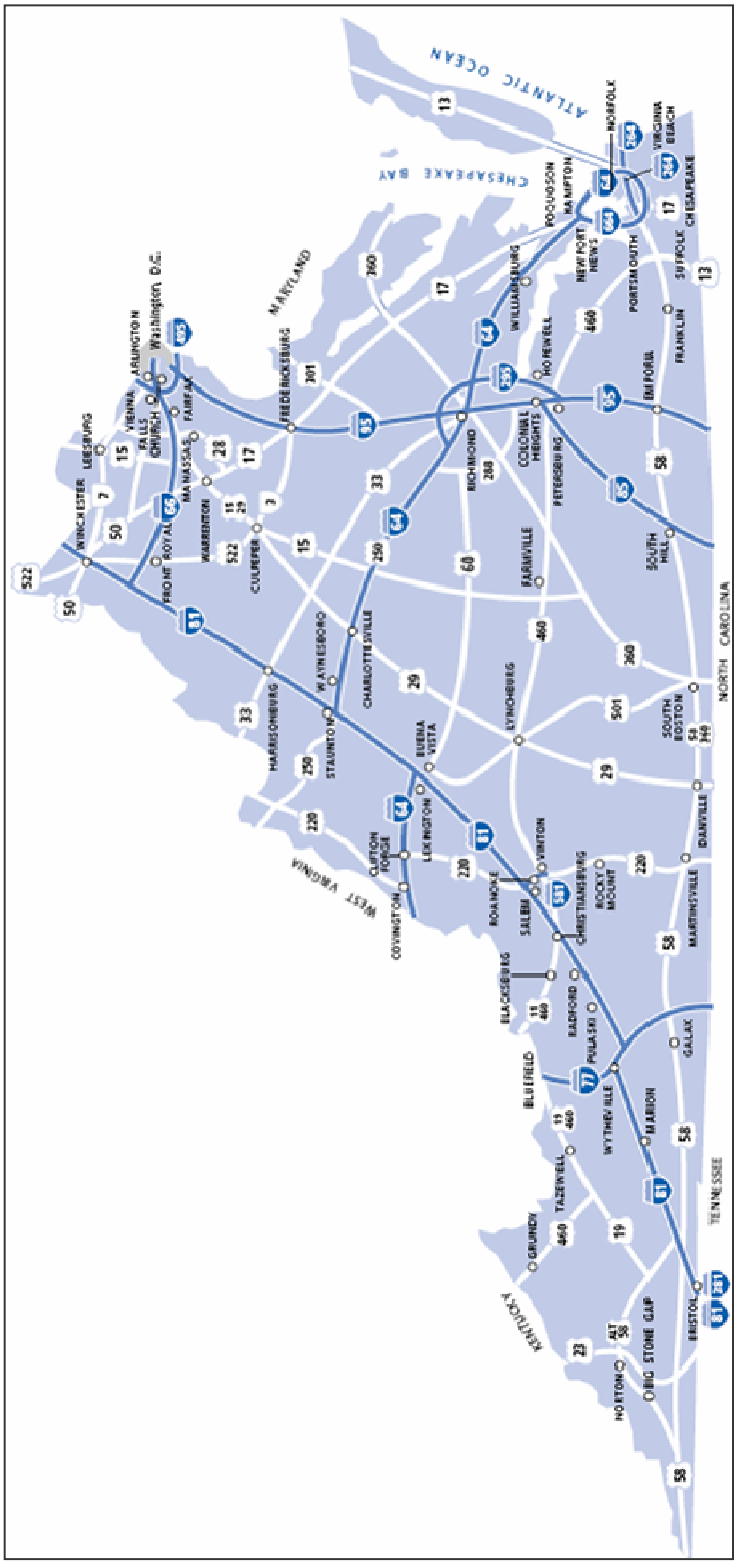


Table 4.1 Key Freight Highway Network and Intermodal Connections

Physical Description	Significant Intermodal Connections		
	Roadway	Airport	Seaport
I-64 enters Virginia from West Virginia near Covington. After joining I-81, I-64 continues east, serving Charlottesville, Richmond, and Norfolk. I-64 provides access all the way west to St. Louis, Missouri.	Route I-81 Route I-95	Richmond Intl, Norfolk Intl, Staunton, Charlottesville	Richmond Newport News
I-66 travels from Middletown, Virginia, where it links to I-81, to Washington, D.C. The eastern portion of the highway is heavy with Dulles Airport traffic and commuters from the growing Northern Virginia suburbs to the District. With the heavy volumes, HOV lanes have been instituted on the highway, and within the Capital Beltway, all lanes in the peak direction operate as HOV in rush hour. The Orange Line of WMATA travels in the median of I-66 through Arlington and Fairfax Counties.	Route I-81 Route I-495	Dulles International Airport Reagan National Airport	Front Royal Inland Port
I-77 crosses Virginia for about 68 miles in the western portion of the State from the North Carolina border to the West Virginia border. It serves the towns of Hillsville, Wytheville, and Bluefield. I-77 operates as a rural interstate, with mostly pass-through traffic and little development around it; I-77 overlaps I-81 for about eight miles near Wytheville.	Route I-81	None	None
Paralleling Virginia's western border, I-81, which extends from Tennessee to New York, has developed as a major interstate trucking route as drivers have chosen it as an alternative to the congestion along I-95. Simultaneously recognized as one of the top scenic interstates and as a popular truck route, VDOT and FHWA began an I-81 Corridor Improvement Study resulting in a ROD, which currently has moved into the Tier 2 phase.	Route I-66 Route I-76 Route I-64 Route I-77	Staunton Airport Roanoke Airport	Front Royal Inland Port
I-85 travels from the North Carolina border north to Petersburg where it meets with I-95. I-85 provides access all the way south to Montgomery, Alabama.	Route I-95	None	None
From Maine to Florida, I-95/395/495 is the spine of the East Coast highway network, passing through 15 states as the longest north-south Interstate in the country. In Virginia, I-95 travels for about 179 miles from Washington, D.C. straight south past Richmond to the North Carolina border; the Interstate is not tolled in Virginia. I-395 and I-495 represent a radial to downtown Washington, D.C. and the Capitol Beltway, respectively, and congestion on either may directly impact I-95.	Routes I-495 and I-66 Route I-64 Route I-85	Dulles International Airport Richmond International airport	Port of Richmond

Table 4.1 Key Freight Highway Network and Intermodal Connections (continued)

Physical Description	Significant Intermodal Connections		
	Roadway	Airport	Seaport
I-264 runs from the juncture of I-64 and I-664 east through Norfolk to the Virginia Beach on the coast.	Route I-64 Route I-564 Route I-464	Norfolk International Airport	Port of Norfolk
I-295 is the eastern bypass of both I-64 and I-95 around Richmond and Petersburg. In addition to linking many Richmond suburbs, I-295 provides a route for travelers from Washington, D.C. to southeastern Virginia.	Route I-64 Route I-95	Richmond International Airport	Port of Richmond
I-564 is a less than three-mile spur in Norfolk off of I-64 to the U.S. Naval Base used mostly by destination travelers.	Route I-64	N/A	N/A
I-664 forms part of the Hampton Roads Beltway and connects I-64 in Newport News to the juncture of I-264 and I-64 to the west of Norfolk.	Route I-64 Route I-264	N/A	N/A
U.S. 1	Route I-64 Route 460 Route 58	N/A	N/A
U.S. 13	Route 17 Route I-64	Norfolk Airport	Port of Norfolk
U.S. 17	Route I-664 Route 164 Route I-64 Route I-95 Route I-81		
U.S. 29	Route I-64 Route 460	Lynchburg Airport Charlottesville Airport	
U.S. 52	Route I-81 Route I-77 Route 58		
U.S. 58	Route I-77 Route I-85 Route I-95 Route I-81		Port of Norfolk
SR-100	Route I-81 Route 100		
SR-168	Route I-64 Route I-564 Route I-264	Norfolk International Airport	Port of Norfolk
U.S. 220	Route I-64 Route I-81 Route 11	Roanoke Airport	

Table 4.1 Key Freight Highway Network and Intermodal Connections (continued)

Physical Description	Significant Intermodal Connections		
	Roadway	Airport	Seaport
Route U.S. 250 runs parallel to Route 64 running between Staunton and Richmond	Route I-64 Route I-81 Route 11	Lynchburg Airport	
U.S. 301	Route I-95 Route I-295 Route 17	Richmond International Airport	Port of Richmond
U.S. 460	Route I-64 Route I-85 Route I-95 Route I-81	Lynchburg Airport Roanoke Airport Norfolk International Airport	Port of Richmond

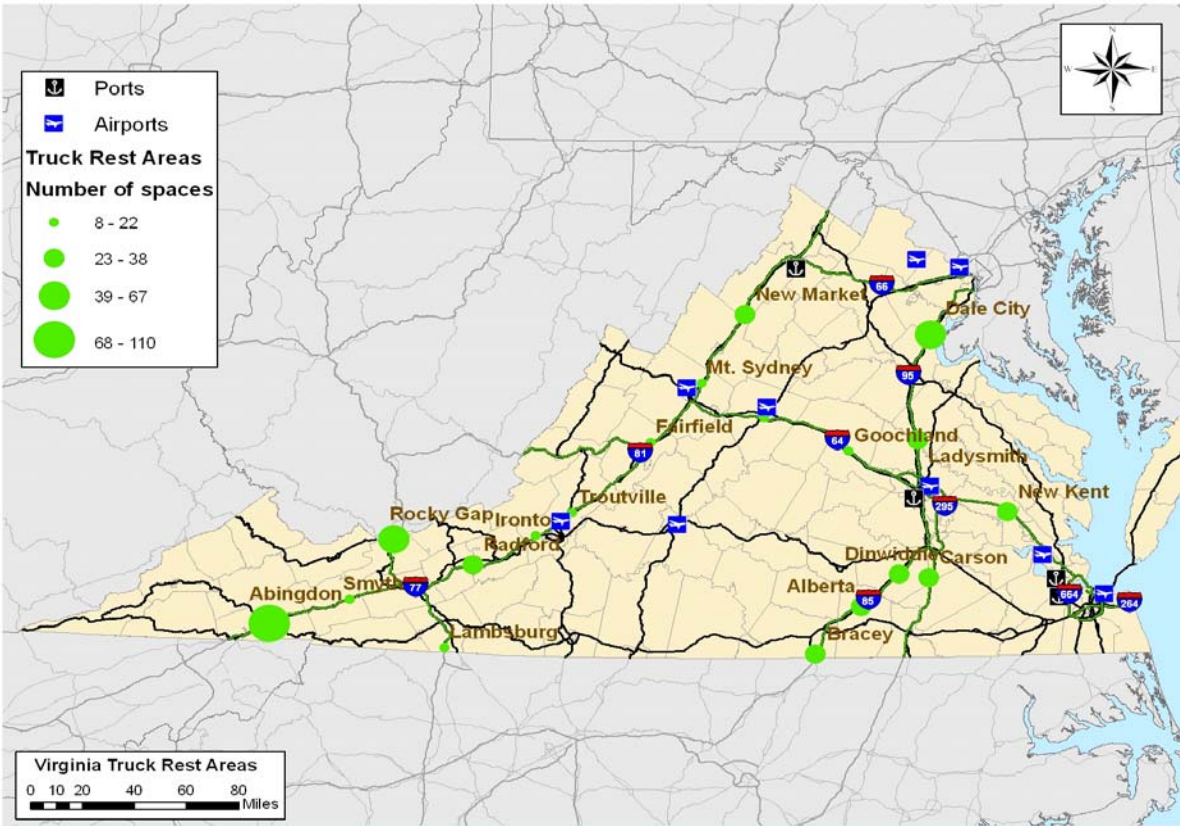
Truck service facilities, or truck stops, represent an important element of the long-haul element of freight. Drivers' route and stop choices may be significantly influenced by "hours-of-service" rules constraining the number and timing of driving hours. While full-service facilities (usually private and requiring highway exit) can bring local economic benefit relative to roadside limited-service truck stops (usually public or concessioned), the latter play a role in improving safety and mitigating local impacts at general purpose highway exits by substantially confining combination trucks to limited access highways. For example, roadside truck stops can reduce the impact of local air pollutant "hot spot" emissions by localizing pollutants away from populated and commercial areas and through "truck stop electrification" services, such as IdleAire, which reduce idling.

Table 4.2 Private Truck Parking Spaces in Virginia

Interstate	Rest Area Name	Number of Truck Spaces	Is This a Truck Only Rest Area?	Scheduled Improvements
Total Truck Parking Spaces Available		**624**		
Total Truck Parking Spaces Available on I-95		**122**		
I-95	Carson (North)	38	No	
I-95	Ladysmith (Both)	24	No	
I-95	Dale City (North)	60	Yes	
Total Truck Parking Spaces Available on I-84		**64**		
I-64	Charlottesville (West)	13	No	Undergoing renovation
I-64	Goochland (Both)	18	No	
I-64	New Kent (East)	33	No	
Total Truck Parking Spaces Available on I-81		**246**		
I-81	Abingdon (North)	110	Yes	
I-81	Smyth (South)	8	No	Undergoing renovation
I-81	Radford (Both)	28	No	
I-81	Ironto (North)	22	No	
I-81	Troutville (South)	10	No	Undergoing renovation
I-81	Fairfield (South)	20	No	Undergoing renovation
I-81	Mt. Sydney (North)	13	No	
I-81	New Market (Both)	35	No	Undergoing renovation
Total Truck Parking Spaces Available on I-86		**85**		
I-85	Bracey (North)	25	No	
I-85	Alberta (Both)	26	No	
I-85	Dinwiddie (Both)	34	No	
Total Truck Parking Spaces Available on I-77		**86**		
I-77	Lambsburg (Both)	19	No	
I-77	Rocky Gap (Both)	67	No	
Total Truck Parking Spaces Available on I-66		**21**		
I-66	Manassas (Both)	21	No	Undergoing renovation

Figure 4.8 illustrates public roadside truck-only and mixed truck/auto rest areas. The size of the dot is proportional to the number of truck parking spaces available. It should be noted that this map does not include numerous private truck stops off exits, which are a very important element of the truck stop network.

Figure 4.8 Truck Rest Area Locations in Virginia



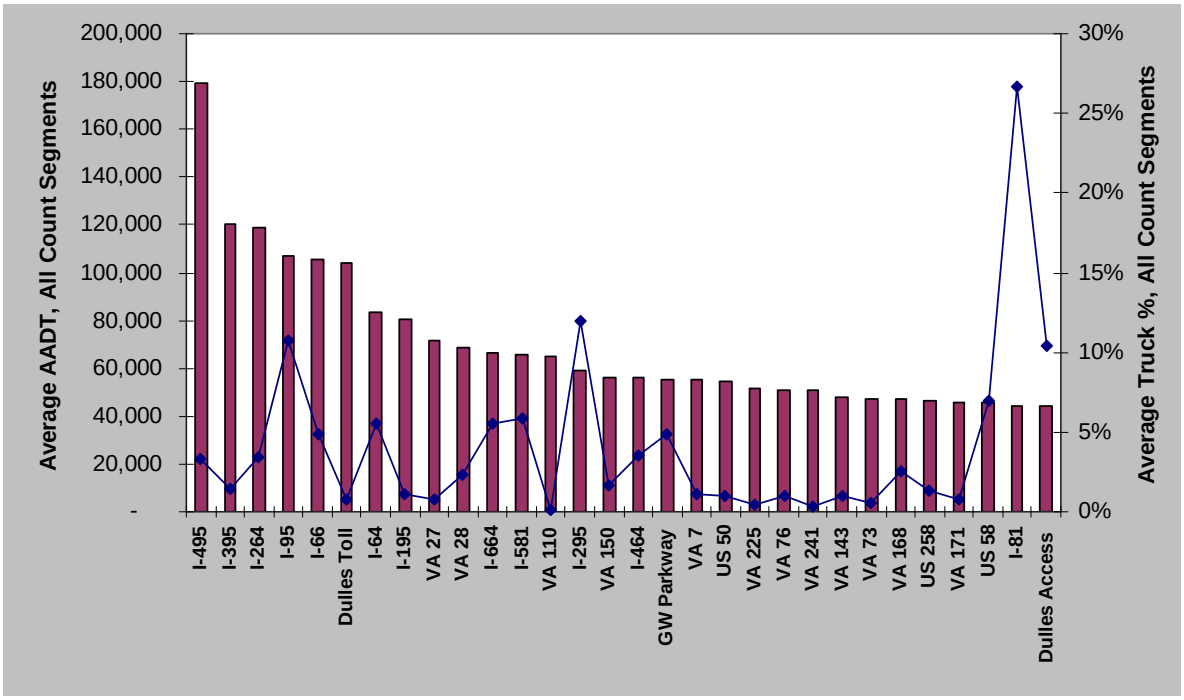
4.2.3 Truck System Utilization

Virginia Traffic Counts

Virginia maintains a statewide vehicle count program on its major highways, including collection and/or estimation of truck counts and percentages.

Figure 4.9 shows the average Virginia AADT (all vehicle types) for all segments of a given route as columns, and the corresponding average truck percentages as points. Segment counts taken in a single direction on divided highways have been adjusted to represent bidirectional activity, for easier comparison with nondivided highway counts. All averages are weighted based on the length of the segment associated with the data.

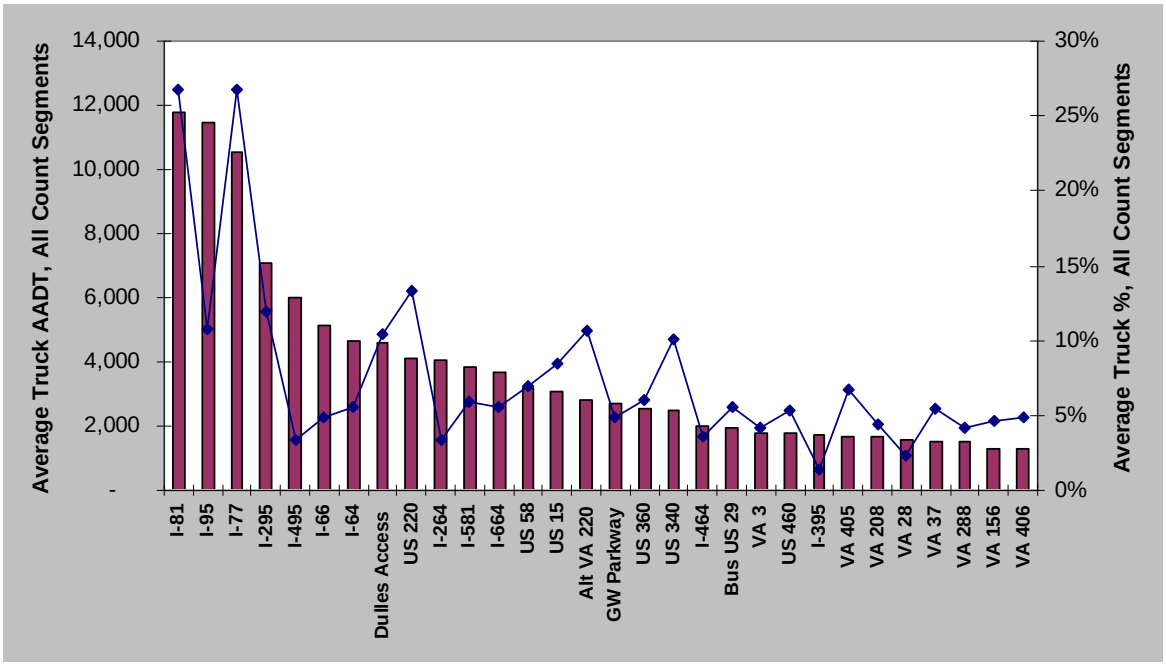
Figure 4.9 Average Total AADT and Truck Percentages, All Count Segments
Virginia's Top 30 AADT Routes, 2005



The top 10 routes on the basis of average AADT are: I-495 (the Capital Beltway); I-395; I-264; I-95; I-66; the Dulles Toll Road (VA 267); I-64; I-195; VA-27; and VA-28. Of these, only I-95 has a truck percentage exceeding 10 percent. Among other top 30 AADT routes, the highest average truck percentages are found on I-81 (27 percent), I-295 (12 percent), and the Dulles Airport Access Road (10 percent). Trucks actually represent a relatively low percentage of AADT on most of Virginia's most heavily used highways.

Figure 4.10 shows Virginia truck AADT for all segments of a given route as columns, and the corresponding average truck percentages as points. The highest average truck AADT is found on I-81, followed closely by I-95 and I-77, all with averages exceeding 10,000 trucks per day. Segments averaging over 4,000 trucks per day include I-295, I-495, I-66, I-64, the Dulles Airport Access Road, U.S. 220, and I-264. As previously noted, the truck percentage for I-81 (27 percent) is relatively high compared to other routes, as is the truck percentage for I-77; this reflects a combination of high truck volumes and lower "background" automobile traffic. Average truck volumes on I-95 are almost as high as for I-81, but the truck percentage is lower because the background traffic is so much higher, given that I-95 traverses much more densely populated areas than I-81. And despite their relatively low truck percentages, we see that "commuter routes" such as I-495 and I-66 are also critical truck routes.

Figure 4.10 Average Truck AADT and Truck Percentages, All Count Segments
Virginia's Top 30 AADT Routes, 2005



Many of these highways extend for long distances through Virginia, or traverse areas with very different land uses. Therefore, it is useful to look at each highway on a segment-by-segment basis as shown in Figure 4.11, understanding that highways may have areas of high truck counts and areas of low truck counts. This analysis indicates that the highest truck counts on any Virginia highway segment are actually found on I-95, with a maximum of around 25,000 trucks per day in Northern Virginia (both directions counted). The next highest are on I-81, with maximum segment volumes exceeding 17,000 trucks per day. After I-95 and I-81 there are 13 highways with maximum segment volumes greater than 5,000 trucks per day: I-295, I-66, I-85, I-77, the Capital Beltway portion of I-95, U.S. 220, I-264, I-64, I-495, U.S. 17, U.S. 58, U.S. 460, and U.S. 13. Finally, there are five additional highways with maximum segment volumes close to 5,000 trucks per day: U.S. 360, the Dulles Access Road, U.S. 29, I-581, and U.S. 15. It is interesting to note that the minimum segment volumes are close to the maximums for some routes – I-85, I-77, the Capital Beltway, Dulles Access Road, and I-581 – which tells us they are significant truck routes over their entire extent. However, for other roads, such as I-95, I-295, I-64, and I-264, truck volumes on the segments least used by trucks are about one-fourth the volumes on the segments most used by trucks, which tells us the utilization of these roads for freight movement is different in different parts of Virginia. This is seen most dramatically on I-66, where the western segments are heavily used by trucks, but the eastern segments have almost no trucks due to truck restrictions.

Figure 4.11 Lowest and Highest Daily Truck Counts on Different Segments of Virginia's Highways
2005

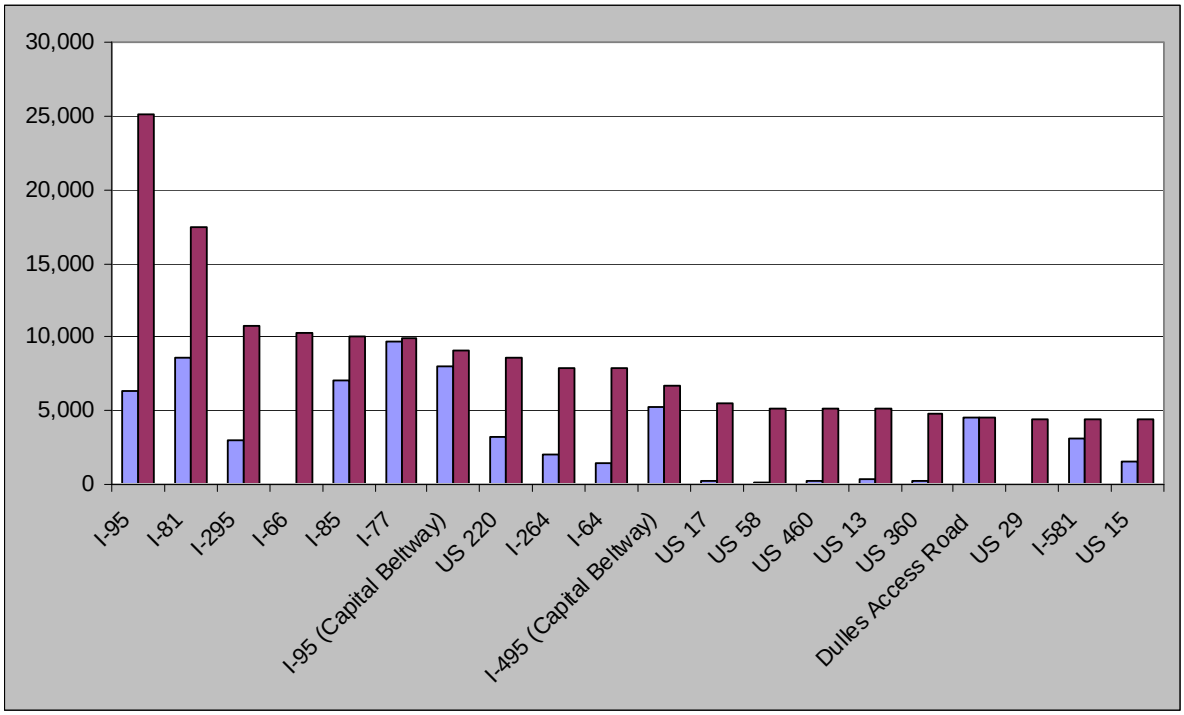


Table 4.3 looks at individual highway segments and locations, using unadjusted count data. As might be expected, the highest AADT segments are in the metropolitan Northern Virginia area and the Hampton Roads area. Somewhat surprisingly, only two of these segments – I-95 NB and SB in Fairfax County – also rank among the leading truck AADT segments.

If we instead look at the top highway segments by truck AADT, as shown in Table 4.4 below, we see a completely different picture. Truck percentages on these segments range from nine percent to 32 percent, and the list is dominated by I-95 and I-81. Many of the top truck segments are located outside of Northern Virginia and Hampton Roads. Only two of the top 15 truck AADT segments are among the top 15 total AADT segments.

Table 4.3 Top 15 Virginia Highway Segments by Total AADT
2005

Segment	Location	2005 AADT	2005 AADT Rank	Truck Percent (3+ Axle)	AADT Trucks	AADT Truck Rank
I-95 SB	Fairfax County	133,000	1	10%	12,919	2
I-95 NB	Fairfax County	112,000	2	9%	9,863	9
I-495 NB	Fairfax County	106,000	3	3%	3,474	526
I-495 NB	Fairfax County	104,000	4	3%	3,394	537
U.S. 50	Fairfax County	103,000	5	1%	1,416	940
I-264 WB	City of Virginia Beach	102,000	6	4%	3,987	482
I-264 WB	City of Norfolk	102,000	7	4%	3,987	481
VA 28	Loudoun County	100,000	8	2%	2,244	722
VA 28	Fairfax County	100,000	9	2%	2,244	721
I-495 SB	Fairfax County	100,000	10	3%	3,354	538
I-495 SB	Fairfax County	100,000	11	3%	3,481	524
I-264 EB	City of Virginia Beach	99,000	12	1%	1,017	1,063
VA 28	Loudoun County	99,000	13	2%	2,222	723
I-264 WB	City of Virginia Beach	98,000	14	1%	1,041	1,062
I-495 SB	Fairfax County	98,000	15	3%	3,287	545

Table 4.4 Top 15 Highway Segments by Truck AADT
2005

Segment	Location	2005 AADT	2005 AADT Rank	Truck Percent (3+ Axle)	AADT Trucks	AADT Truck Rank
I-95 SB, U.S. 17	Stafford County	78,000	79	17%	13,375	1
I-95 SB	Fairfax County	133,000	1	10%	12,919	2
I-95 NB, U.S. 17	City of Fredericksburg	82,000	62	14%	11,726	3
I-95 NB, U.S. 17	Stafford County	82,000	61	14%	11,726	4
I-95 NB, U.S. 17	City of Fredericksburg	82,000	60	14%	11,726	5
I-95 NB, U.S. 17	Stafford County	82,000	59	14%	11,726	6
I-95 SB, U.S. 17	Spotsylvania County	61,000	238	17%	10,460	7
I-95 SB, U.S. 17	City of Fredericksburg	61,000	237	17%	10,460	8
I-95 NB	Fairfax County	112,000	2	9%	9,863	9
I-81 NB	City of Salem	33,000	956	29%	9,406	10
I-81 NB	Roanoke County	33,000	955	29%	9,406	11
I-81 NB, I-64 EB	Augusta County	28,000	1,214	32%	9,083	12
I-81 NB, I-64 EB	Augusta County	28,000	1,213	32%	9,083	13
I-95 SB	Fairfax County	90,000	35	10%	8,742	14
I-95 NB	Henrico County	64,000	213	14%	8,712	15

The true impact of truck activity on a highway depends on the volume of trucks, the mix of truck and auto traffic, the number of lanes available in which to operate, the terrain and geometry of the route, and other factors. Per unit, a truck utilizes more of a highway's capacity than a car, simply because the truck is larger and slower to change speeds. A measure called "adjusted AADT" counts each truck as the equivalent of several automobiles. Dividing the adjusted AADT by the number of travel lanes yields the measure "adjusted AADT per lane," which provides a good indicator of the overall intensity of utilization of a roadway segment.

As shown in Table 4.5 below, the leading highway segments on the basis of adjusted AADT per lane are all located in Northern Virginia and Hampton Roads, where significant truck activity coincides with high levels of auto traffic. The top 20 segments are on I-95, I-264, I-64, and I-495. Another way of looking at this data is shown in Table 4.6, in which routes are ranked by number of top 500 segments based on adjusted AADT per lane. Two-thirds of the top 500 segments are associated with just three routes – I-81, I-64, and I-95. I-81 leads this ranking with almost twice as many top 500 segment miles as I-95.

Table 4.5 Top 20 Highway Segments by Adjusted AADT per Lane[a]
2005

Segment	Location	2005 AADT	Truck Percent (3+ Axle)	AADT Trucks	AADT Truck Rank	AADT Adjusted per Lane
I-95 SB	Fairfax County	133,000	10%	12,919	2	58,328
I-95 NB	Fairfax County	112,000	9%	9,863	9	48,018
I-95 SB, U.S. 17	Stafford County	78,000	17%	13,375	1	40,490
I-64 EB	City of Norfolk	74,000	3%	2,036	760	40,308
I-66 EB	Prince William County	62,000	9%	5,633	243	40,154
I-95 NB, U.S. 17	Stafford County	82,000	14%	11,726	6	40,037
I-95 NB, U.S. 17	City of Fredericksburg	82,000	14%	11,726	5	40,037
I-95 NB, U.S. 17	Stafford County	82,000	14%	11,726	4	40,037
I-95 NB, U.S. 17	City of Fredericksburg	82,000	14%	11,726	3	40,037
I-95 SB	Fairfax County	90,000	10%	8,742	14	39,470
I-64 EB	City of Norfolk	72,000	3%	1,981	779	39,219
I-95 NB	Fairfax County	91,000	9%	8,013	33	39,014
I-95 NB	Prince William County	91,000	9%	8,013	32	39,014
I-95 NB	Fairfax County	90,000	9%	7,925	35	38,586
I-95 NB	Fairfax County	90,000	9%	7,925	34	38,586
I-495 NB	Fairfax County	104,000	3%	3,394	537	38,344
I-264 WB	City of Virginia Beach	102,000	4%	3,987	482	38,319
I-264 WB	City of Norfolk	102,000	4%	3,987	481	38,319
I-95 NB	Fairfax County	88,000	9%	7,749	39	37,728

[a]Assumes one truck equals 4.25 cars

Table 4.6 Locations of Top 500 Segments for Adjusted AADT per Lane
2005

Route	Number of "Top 500" Segments	Miles of "Top 500" Segments	Share of Route Miles That Are "Top 500" Segments
I-81	154	397.2	30%
I-64	124	258.8	20%
I-95	108	206.6	16%
All Other			34%

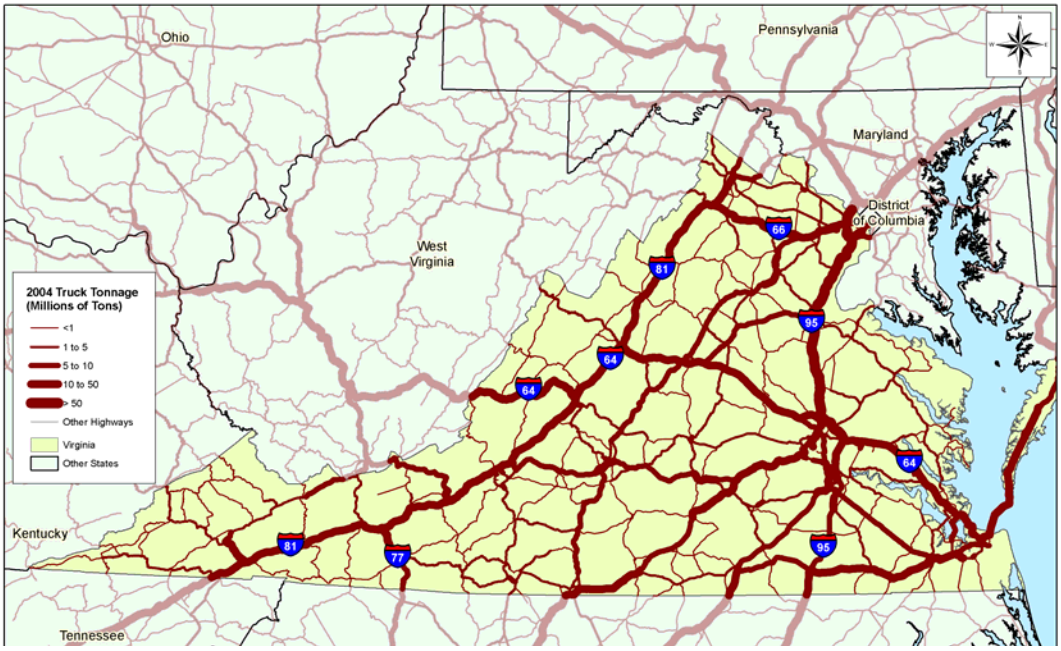
Truck Flows and Network Utilization

Besides truck AADT data, truck volumes over the Virginia and national highway systems can be estimated from the Virginia TRANSEARCH dataset. The limitation of TRANSEARCH-based volume maps is that they reflect modeled network assignments, rather than actual counts. However, where reasonably consistent with counts, the TRANSEARCH flows can provide important insights into the origin-destination patterns and commodities using any given element of the highway network.

From Figure 4.12, we see that truck tonnage with a Virginia trip purpose (inbound, outbound, and internal traffic) is heaviest along I-95 and the Washington Beltway; next heaviest along I-64, I-66, I-81, I-77, I-85, and U.S. 13; and next heaviest along U.S. 29, U.S. 460, U.S. 360, and other state routes. The highest densities of truck activity are at Virginia's major population hubs: Northern Virginia, Richmond, and Hampton Roads, with concentration also visible at Roanoke, Lynchburg, and Charlottesville.

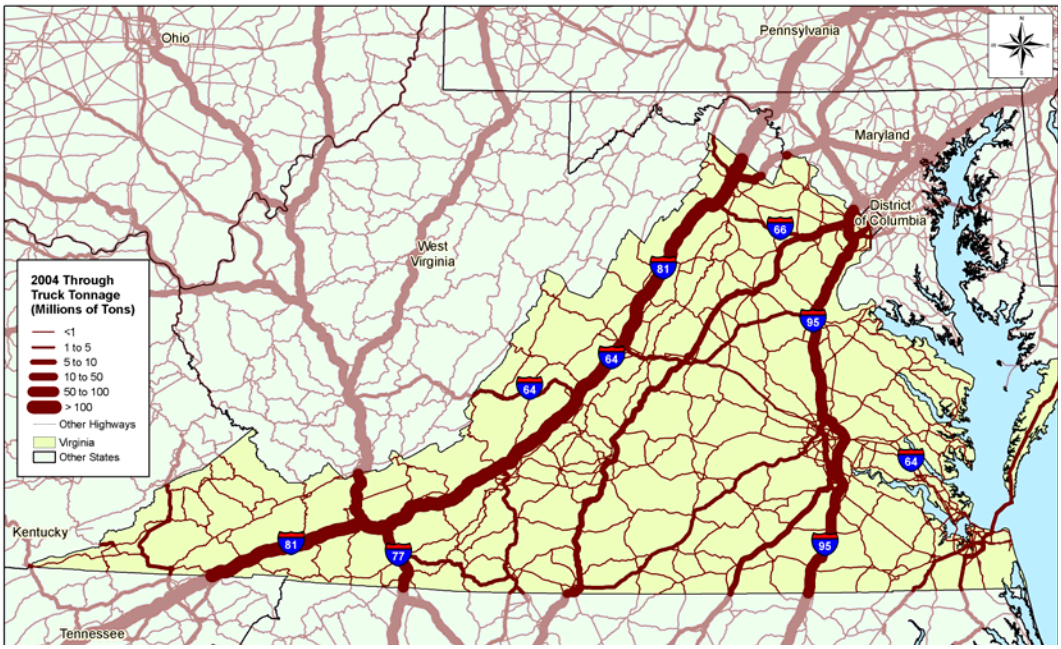
Truck tonnage that is passing through Virginia as part of trips to and from other states shows a very different distribution, as shown in Figure 4.13. It is very heavily concentrated on I-81, which is a part of a major corridor linking Louisiana and New York/New Jersey and points between, as well as Midwestern markets via connecting routes such as I-77. It is also heavily concentrated on I-95, which is the main link for the entire U.S. eastern seaboard, from New England to Florida. I-77, I-85, and U.S. 29 also emerge as significant through routes. Interestingly, I-64, I-66, U.S. 13, and U.S. 460 – which are important for Virginia trucking – play less of a role in accommodating through trucks.

Figure 4.12 Virginia Truck Tonnage
Inbound, Outbound, and Internal, 2004



Source: TRANSEARCH database.

Figure 4.13 Truck Tonnage Passing Through Virginia
2004



Source: TRANSEARCH database.

As previously noted, the flows depicted in Figures 4.12 and 4.13 are based on assignments, and are not consistent in every respect with AADT counts. Further data collection should resolve these issues. For present purposes, the general patterning of flows depicted in Figures 4.12 and 4.13 is considered to be a useful approximation.

Bridge and Pavement Condition

Table 4.7 below describes average bridge and pavement condition and performance across all highway segments. The reference "IRI" stands for the International Roughness Index. IRI measures the cumulative deviation from a smooth surface in inches per mile – in other words, the sum of all the up-and-down road imperfections, from potholes to barely noticeable bumps or road roughness, which a vehicle will encounter over one mile. The ranges of values correspond to the pavement condition as follows (IRI in inches per mile): very good (0 to 85); good (86 to 110); fair (111 to 140); poor (141 to 175); very poor (more than 175). There also are road condition measures that apply to bridges; as presented in the National Bridge Inventory, "red" is the lowest of the three levels of "General Condition Ratings" that can be assigned to a bridge. Roadways with poor to very poor IRI ratings are highlighted.

Table 4.7 Key Characteristics of Virginia's Primary Highways

Highway	2004 IRI	Percent of Bridges in "Red" Condition
I-81	80	0.74%
I-95/395/495	114	0.24%
I-77	110	0.00%
I-295	140	0.00%
I-66	**147**	0.00%
I-64	127	0.00%
U.S. 220	**183**	0.38%
I-264	**190**	0.00%
I-664	**182**	0.00%
U.S. 58	**168**	0.54%
U.S. 301	**196**	0.00%
U.S. 460	**182**	0.00%

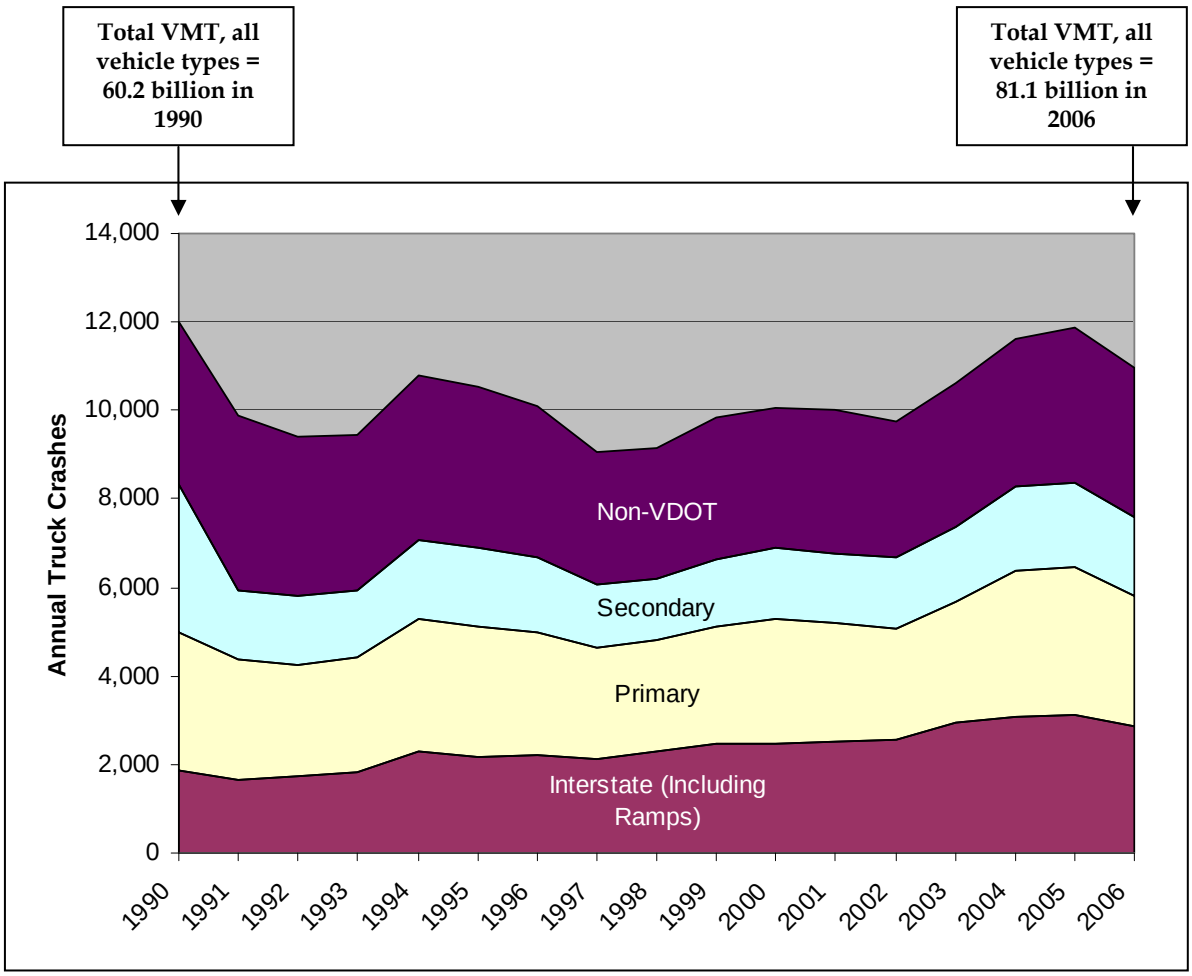
Source: PB Americas Inc. analysis.

Virginia's most heavily used freight corridors – I-81, I-95/395/495, and I-77 – are rated fair or better with respect to pavement and bridge condition. However, pavement condition issues have been noted for I-66, U.S. 220, I-64, I-664, U.S. 58, U.S. 301, and U.S. 460.

Safety

Total vehicles miles of travel over the Commonwealth's roads have increased more than 33 percent since 1990 (from 60.2 billion miles to 81.1). Yet the number of truck crashes in 2006 (10,971) was actually lower than in 1990 (12,018). However, the number of truck crashes on Virginia's interstates has increased steadily; this increase has been offset primarily by a larger decrease in crashes on noninterstate facilities, as shown in Figure 4.14 below.

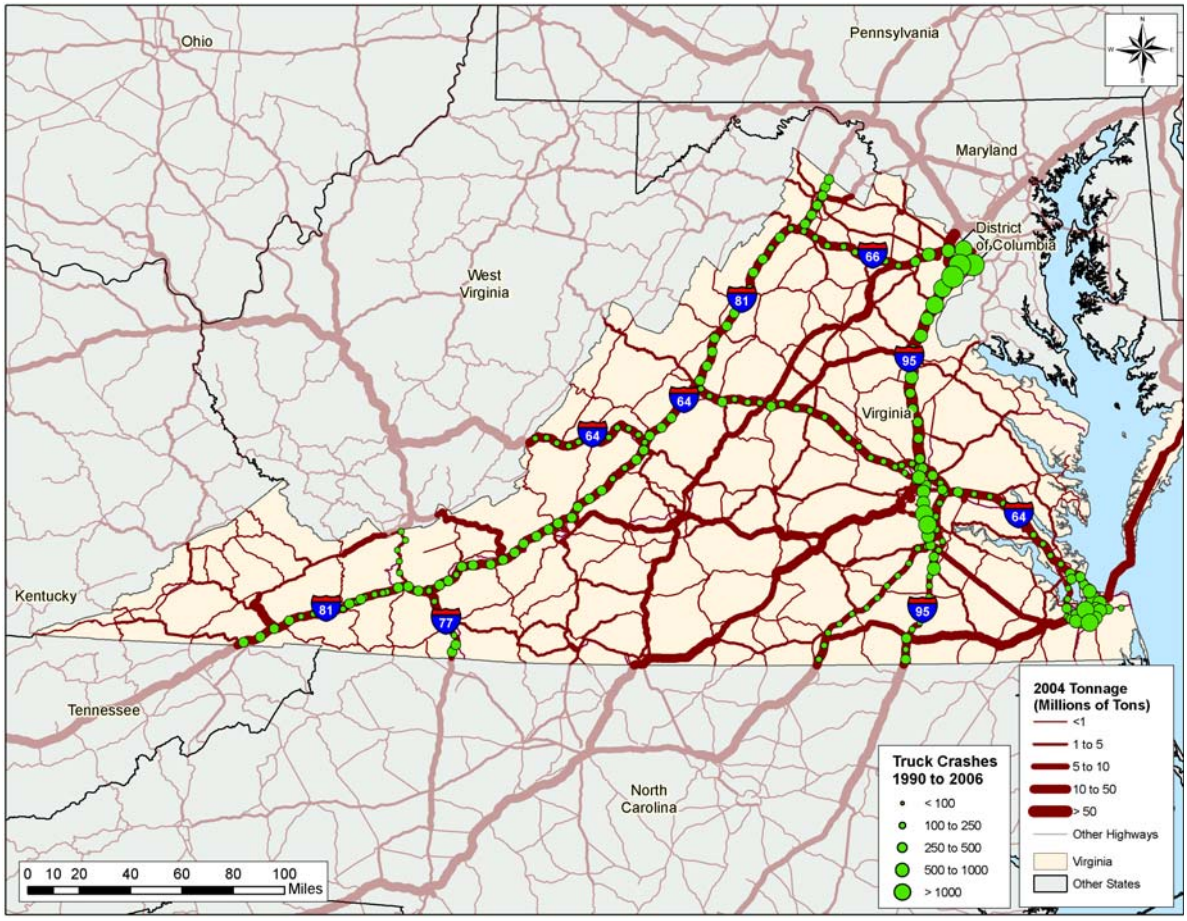
Figure 4.14 Truck Accidents by Type of Facility
1990 to 2006



Locations of accidents, involving trucks between 1990 and 2006 on Virginia's interstate highways, are mapped on Figure 4.15 below. The greatest number of accidents involving trucks is reported in and around Hampton Roads, Northern Virginia, and Richmond, where trucking activity takes place against a backdrop of significant automobile travel. By

corridor, the greatest number of accidents is on I-95, and then I-81; these two routes are followed by I-64, I-264, I-66, I-77, and I-85.

Figure 4.15 Truck Accident Locations on Virginia's Interstates
1990 to 2006



As shown in Figure 4.16 below, the greatest number of truck crashes (shown as vertical bars) is found on I-95, followed by I-81 and I-64. These three routes account for nearly 74 percent of all crashes on Virginia's interstates.

On a per-mile basis, the number of crashes per mile is actually fairly low on both I-81 and I-64, due presumably to the low density of background auto traffic. By comparison, truck crashes per mile are highest on I-495 (the Capital Beltway), I-395, and I-95, where background auto traffic is extremely high.

The interstate segments with the highest number and density of truck crashes are found on: I-95, with 39 miles of highway reporting an average of 190 accidents per mile; on I-495, with 15 miles of highway and 124 accidents per mile; and I-66, with 20 miles of

highway and 101 accidents per mile. By contrast, the highest-accident segment of I-81 is 30 miles at an average of 33 accidents per mile.

Figure 4.16 Truck Crashes on Virginia Interstate Highways
Total and Per Mile, 1990 to 2006

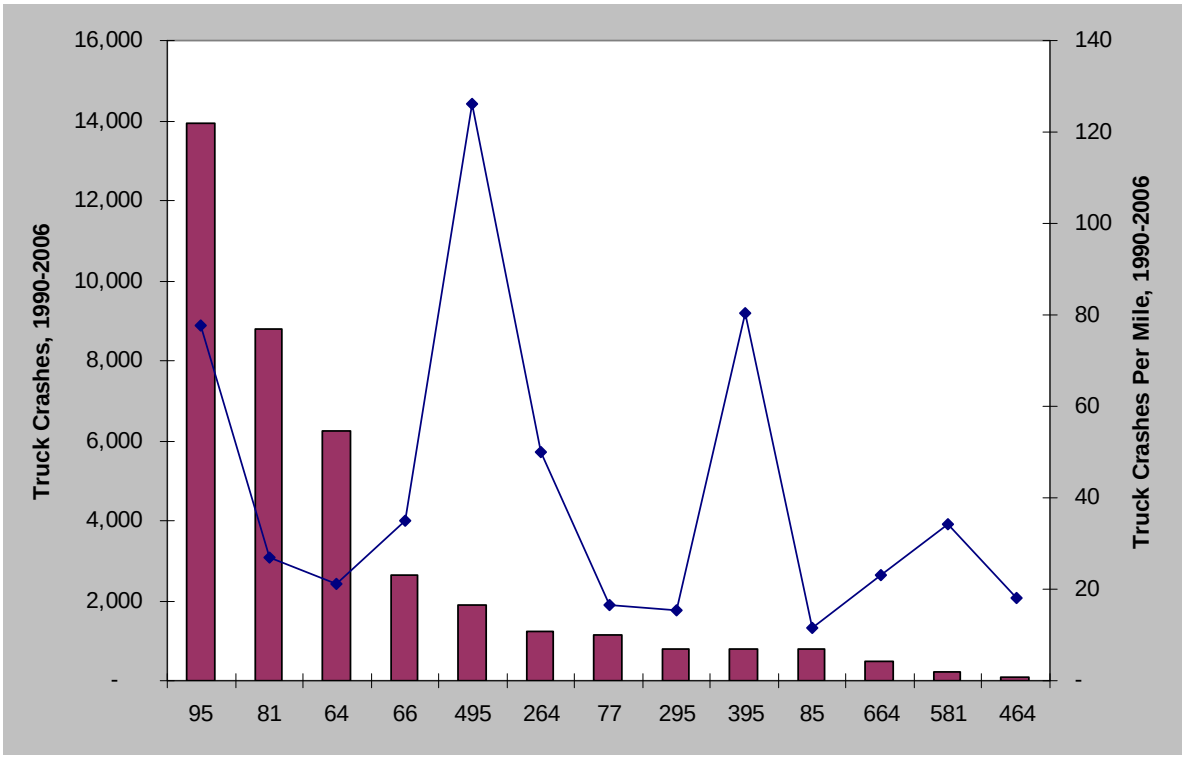
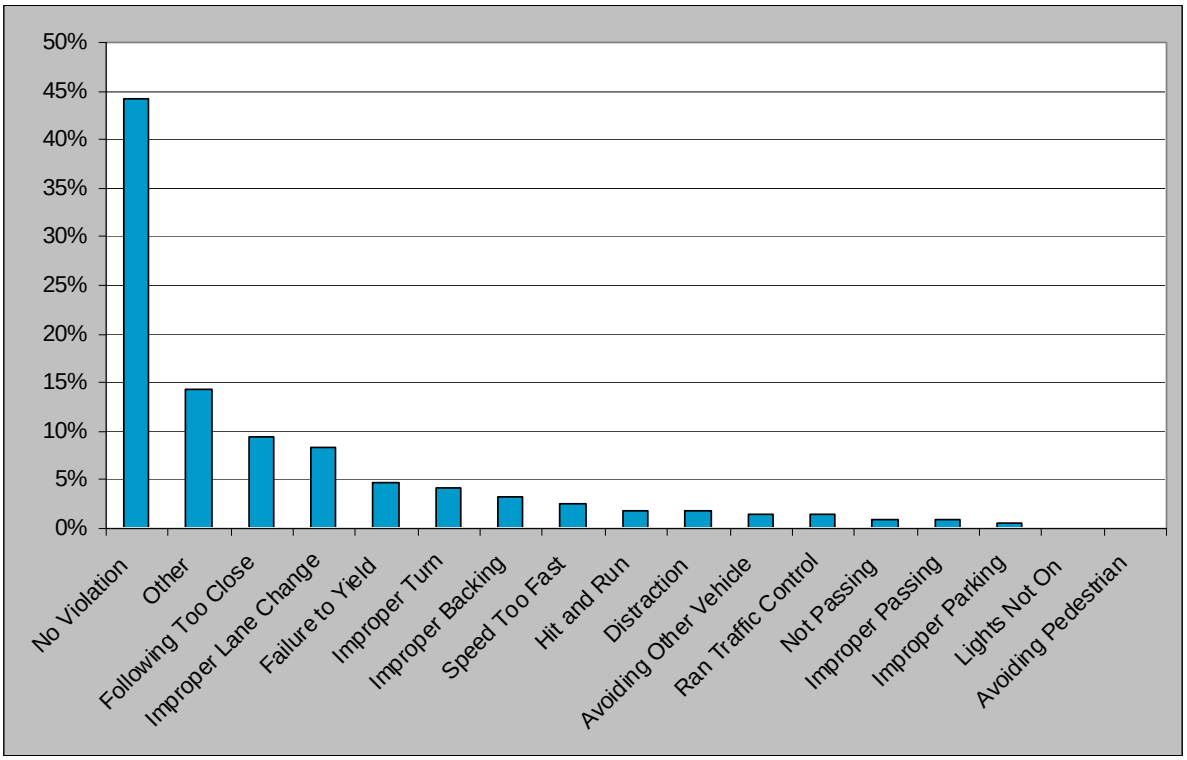


Table 4.8 Highest Truck Crash Segments on Virginia Interstate Highways
1990 to 2006

Route	Highest Accident Areas	Crashes Per Mile
I-95	Miles 140-179	190
I-495	Miles 0-15	124
I-66	Miles 45-65	101
I-264	Miles 6-17	86
I-95	Miles 51-105	78
I-64	Miles 255-295	70
I-81	Miles 139-169	33

The leading causes of truck-related accidents in 2006, according to data compiled by the Virginia Department of Motor Vehicles, are shown in Figure 4.17 below. For nearly half of all accidents involving trucks, there was no traffic violation. The leading violations contributing to accidents were: following too close; improper lane change; failure to yield; improper turn; improper backing; and driving too fast. Less than half of one percent of accidents involved truck driver alcohol impairment. Less than four percent of trucks involved in crashes had some form of defect (lights, brakes, steering, tires, motor, etc.).

Figure 4.17 Causes of Virginia Crashes Involving Trucks
Twin Tractor-Trailers, Tractor-Trailers, and Single-Unit Trucks



4.3 Railroads

4.3.1 Rail Services and Railcar Types

Virginia's rail network is almost entirely privately owned, as are the terminals and "rolling stock" (locomotives and railcars) moving over the system. Virginia's rail freight traffic can be generally classified as:

- **Unit Train** (long trains consisting of a single commodity, like coal). On a tonnage basis, coal accounts for more than two-thirds of all Virginia rail freight traffic. Most of this is moving east-west, between the coalfields of Appalachia and Hampton Roads, or between the coalfields and Tennessee/North Carolina. About one-half of the coal moving over Virginia's rail system is through traffic.

- **Carload** (trains of different lengths, consisting of different commodities and car types, such as tank cars, hopper cars, flatcars, or traditional boxcars). Carload traffic (agricultural products, chemicals, paper, lumber, food, etc.) represents more than 25 percent of Virginia tonnage, and moves primarily in the north-south direction, paralleling I-95 and I-81. Like coal, about half of this is through traffic.

- **Intermodal/Auto** (long trains consisting of specialized railcars designed to carry intermodal shipping containers or automobiles). Intermodal containers represent around 19 percent of Virginia's rail freight traffic on a per-unit basis, but only three percent on a per-ton basis, because containers tend to carry lower weight, higher value commodities. Intermodal traffic moves both north-south and east-west over Virginia's rail network. Around one-half is moving between Virginia origins and destinations (Virginia Port Authority facilities and other intermodal terminals) and Illinois, where it may interchange with the western Class I carriers. The remainder consists mostly of through traffic in the Florida-New Jersey and Illinois-North Carolina corridors.

Figure 4.18 Examples of Unit Train, Carload, and Intermodal Rail Services

4.3.2 Rail System Inventory

The Commonwealth of Virginia's rail system is operated by 12 freight railroad railroads and two passenger railroads. Of the 12 freight railroads, two are Class I national railroads (line-haul freight railroads exceeding $319.3 million in annual operating revenue) and 10 are Class III railroads (line-haul carriers with annual revenues less than $25 million). (There are no Class II Railroads in Virginia.)

Freight Railroads

The vast majority of Virginia's freight rail track infrastructure is in the possession of the two Class I railroads, Norfolk Southern (approximately 60 percent) and CSX (approximately 30 percent). Five local freight railroads and two switching railroads also operate on the system. Table 4.9 below identifies selected characteristics of Virginia's freight railroads.

Table 4.9 Virginia's Freight Railroads

Freight Railroad Name	Class I	Class III	Terminal/ Switching	Miles Operated in Virginia
Norfolk Southern Corporation	√			2,100
CSX Transportation	√			1,051
Buckingham Branch Railroad		√		219
Bay Coast Railroad		√		68
Chesapeake and Albemarle Railroad		√		29
Winchester and Western Railroad		√		26
Commonwealth Railway, Inc.		√		17
Virginia Southern Railroad			√	59
North Carolina and Virginia Railroad			√	4
Norfolk and Portsmouth Belt Line			√	4

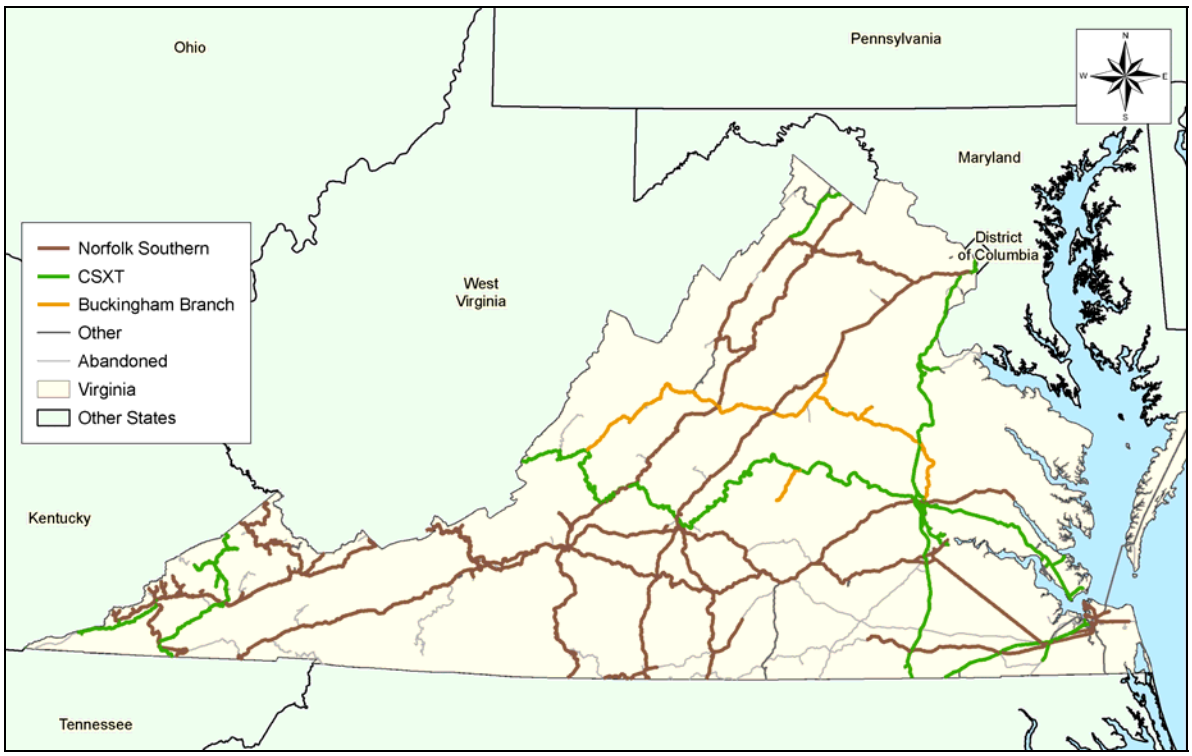
Virginia's freight rail network is comprised of tracks, bridges, sidings, and terminals. The network includes more than 3,000 miles of privately owned and operated track. Norfolk Southern and CSX Transportation, the two Class I railroads that operate within the Commonwealth, are the largest owners of rails. Both freight railroads offer major east-west connections (their most important lines) between Hampton Roads and West Virginia/Kentucky/Tennessee – the majority of Virginia's freight rail network with regard to the national network runs roughly north-south, while the major lines for Virginia tonnage run east-west.

- **Norfolk Southern's** Virginia north-south mainline runs from Alexandria to Danville, and then south to Atlanta via Greensboro and Charlotte, North Carolina, and Spartanburg, South Carolina (the Piedmont line). NS also has a mainline that parallels I-81 between Front Royal and Roanoke (the Shenandoah line), and serves the Commonwealth's Inland Port in Front Royal. Their most heavily used line runs from Hampton Roads to the West Virginia border in Southwest Virginia.

- **CSX's** Virginia north-south mainline runs from Alexandria to Richmond, and then further south via Petersburg and Emporia, generally paralleling I-95. The most

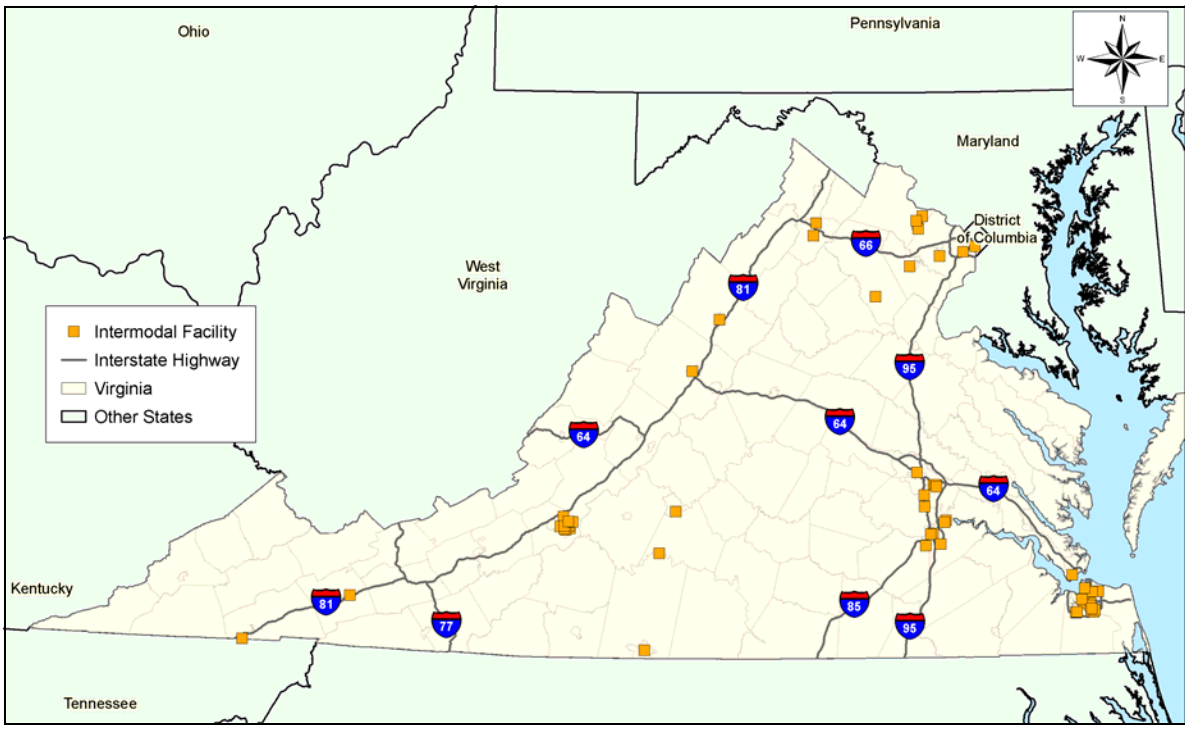
heavily used CSX line runs from Hampton Roads to the West Virginia border in Central Virginia.

Figure 4.19 Overview of Virginia's Freight Rail Network



Along with the major lines, the freight railroads operate an extensive network of rail yards and intermodal terminals. The intermodal terminals enable transfers of goods between trucks and rail. While many of the Commonwealth's intermodal terminals and transfer facilities are privately owned, they represent a critical source of economic development, and support for these facilities strengthens Virginia's connection to the national and global economy. Figure 4.20 below identifies Virginia's intermodal facilities that are served by, or linked to, the Commonwealth's rail infrastructure.

Figure 4.20 Virginia's Major Intermodal Facilities Served by Rail
As Defined by the U.S. Bureau of Transportation Statistics



Passenger Railroads

There currently are two passenger rail services operating on Virginia's freight railroad trackage via shared access agreements:

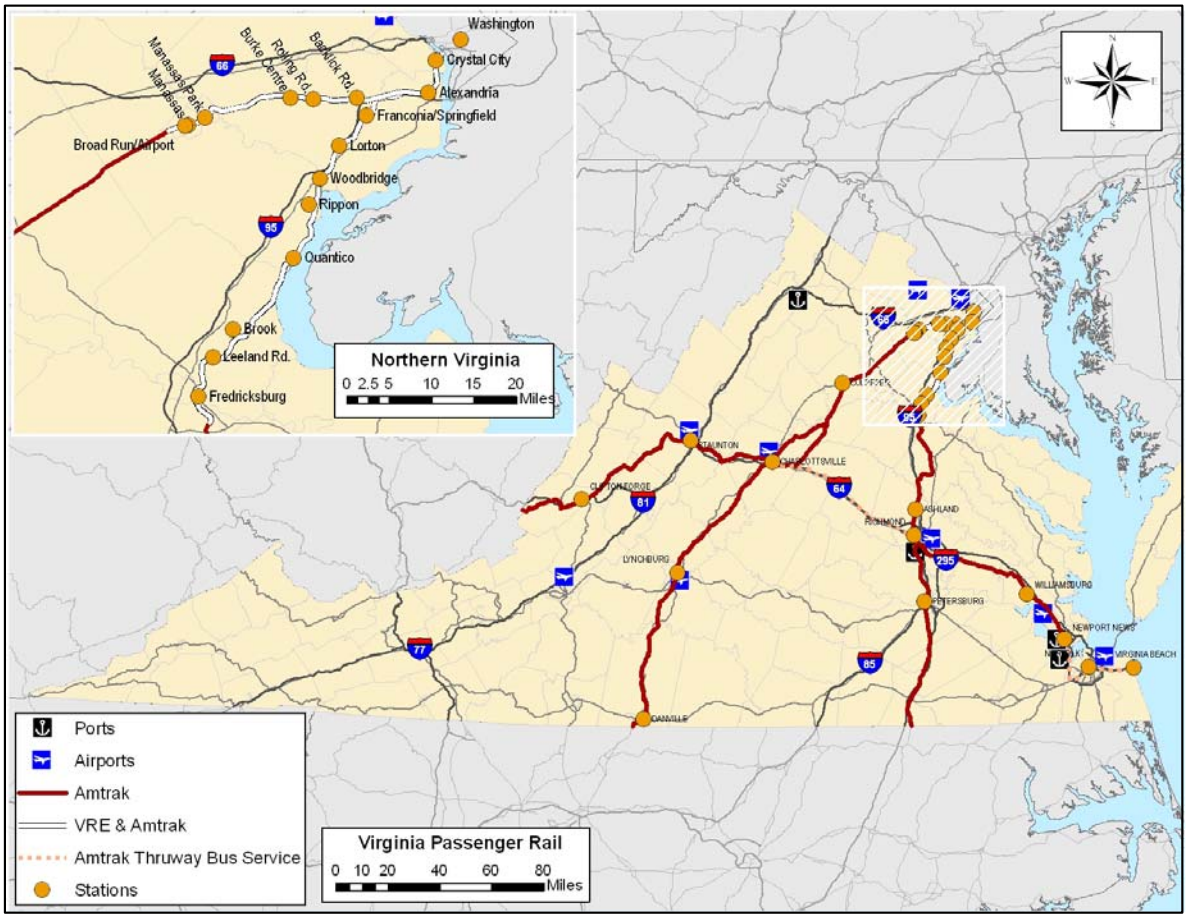
- **Virginia Railway Express (VRE).** The VRE operates passenger service on an 80-mile system connecting Washington, D.C. with Fredericksburg and Manassas. Two lines share a common trunk for 9.6 miles and diverge just south of Alexandria. VRE's Fredericksburg service operates on CSX track from Alexandria to Fredericksburg. VRE's Manassas service operates on Norfolk Southern track between Alexandria and Manassas. Rail relocation of CSX track and/or operations in Washington D.C. may have an uncertain impact on VRE services. The VRE fleet is comprised of 19 locomotives and 68 active passenger coaches.[1] Rail service is heavily focused on commuter trips during the morning and evening peaks on VRE's two services: the Fredericksburg Line and the Manassas Line. There currently are 11 daily D.C.-bound trips on the Fredericksburg Line, with eight of the trips scheduled for the a.m. peak. Fredericksburg-bound service is heavily oriented to p.m. peak outbound service from

[1] DRPT, Virginia State Rail Plan, 2005.

Washington, D.C. Around one-half of the trips are Amtrak services that honor VRE passes. On the Manassas Line, VRE also operates 10 D.C.-bound and 10 Manassas-bound trips per day. Similar to the Fredericksburg Line, the majority of the inbound to Union Station service occurs in the a.m. peak and the majority of Manassas-bound service are scheduled for the p.m. peak. Two inbound and two outbound trips occur on regularly scheduled Amtrak service featuring cross-honoring. Ridership on VRE has grown rapidly, from approximately two million annual passengers in 2000 to 3.5 million in 2005, although it has declined slightly since then.

- **Amtrak.** Amtrak operates over 20 trains daily in Virginia. These include the Regional service to Richmond and Newport News as well as six other long-distance trains. In addition, the Carolinian operates daily service between New York City and Charlotte via Richmond.

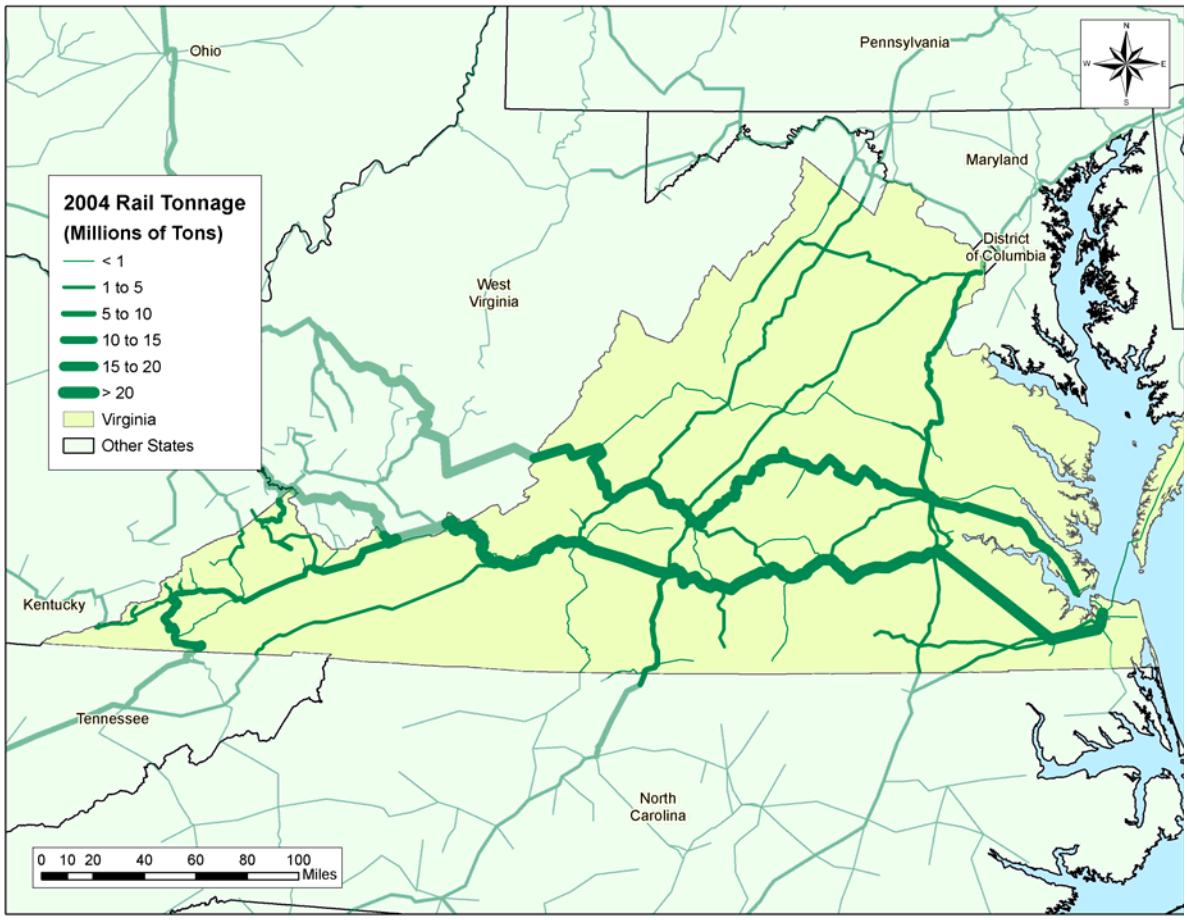
Figure 4.21 Passenger Rail Operations over Freight Rail Lines



4.3.3 Rail System Utilization

The Virginia TRANSEARCH dataset includes a set of rail network flow maps, based on model assignments. Discussions with Virginia's railroads indicate that actual routings are somewhat different; adjustment of the TRANSEARCH routings is a contemplated future work effort. For present purposes, however, review of TRANSEARCH rail flow maps supports some interesting observations. Figure 4.22 below suggests that for Virginia-based tonnage (moving inbound, outbound, or within the Commonwealth), the highest volume flows are east-west, and focused on Hampton Roads; coal represents a large share of current rail tonnage in this corridor. The north-south movement of Virginia rail traffic is a lesser share of rail business.

Figure 4.22 Virginia Rail Tonnage
Inbound, Outbound, and Internal, 2004

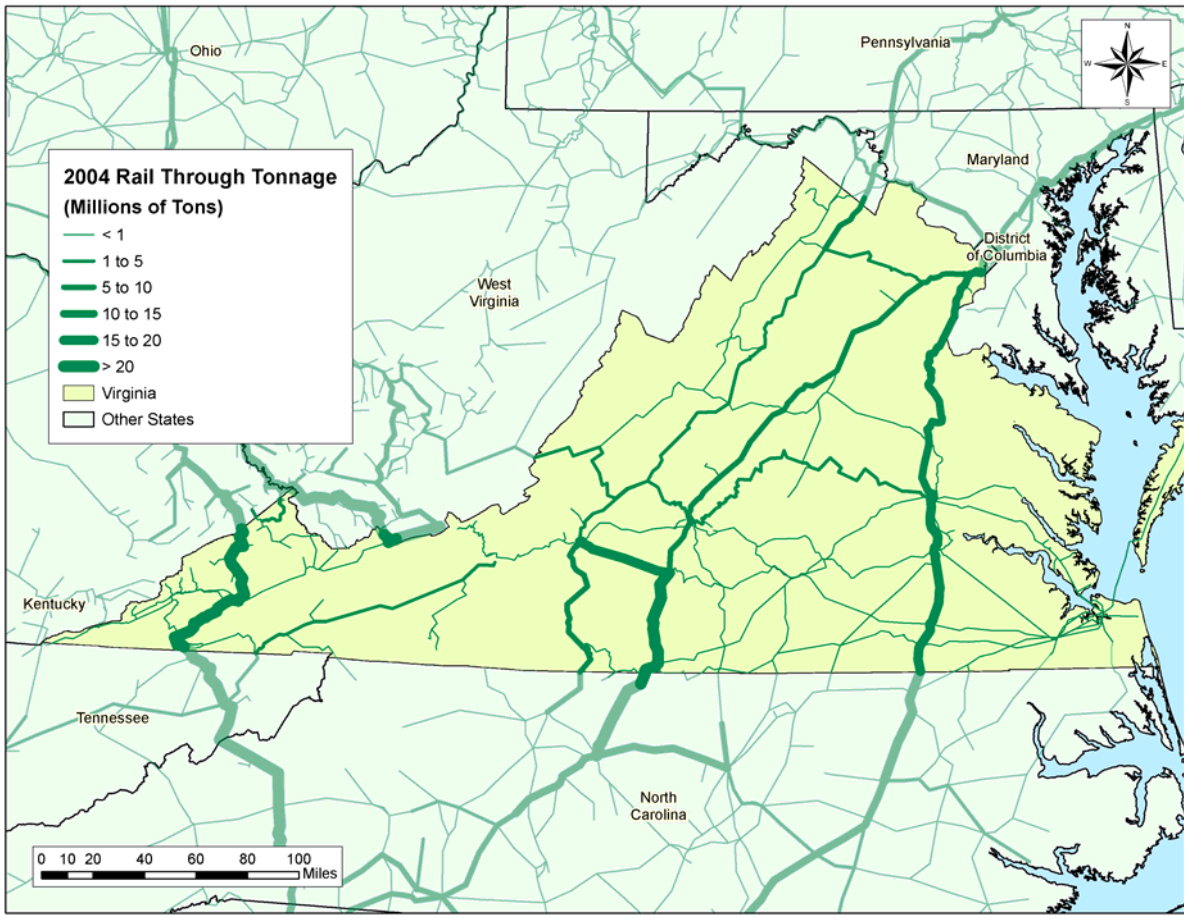


Source: TRANSEARCH database.

Rail tonnage that has both an origin and a destination outside of Virginia, but is passing through Virginia along the way, shows – like trucking – a very different distribution.

TRANSEARCH suggests that pass-through traffic is primarily utilizing the north-south network. (Again, please note that the route assignments may be adjusted by future analysis.)

Figure 4.23 Rail Tonnage Passing Through Virginia
2004



Source: TRANSEARCH 2004.

In 2006, there were 24 crashes between trains and vehicles in Virginia. Five of these crashes were due to vehicles running traffic controls, five to failure to yield, three to illegal or improper parking, and one to driver distraction.

4.4 Waterways, Ports, and Warehouse/Distribution

4.4.1 Cargo, Vessel, and Terminal Types

The U.S. "Marine Transportation System" accommodates a wide range of commodities. Most commodities have an affinity for a certain method of handling, which affords them the appropriate characteristics of cost, speed, reliability, and security. The major marine cargo handling types are as follows:

- **Containerized General Cargo.** Containerized general cargo is any commodity that is moved in an intermodal shipping container. Containers come in different lengths, between 20 feet and 45 feet for international trades and up to 53 feet in domestic trades.

- **Roll-on/Roll-off (Ro-Ro) General Cargo.** Ro-Ro general cargo is driven onto and off of vessels, and can include automobiles, construction equipment, boats on trailers, containers mounted on trailers, truck trailers, etc.

- **Breakbulk and Neobulk General Cargo.** Breakbulk general cargo is typically packaged in relatively "human scale" units (pallets, bags, etc.) that can be handled by conventional stevedoring equipment. Neobulk cargo consists of larger or heavier units – such as coiled steel or large machines – that requires special handling, and is sometimes called "project cargo."

- **Liquid Bulk.** Liquid bulk is any liquid product that is shipped without packaging into smaller units, such as petroleum in the hold of a vessel.

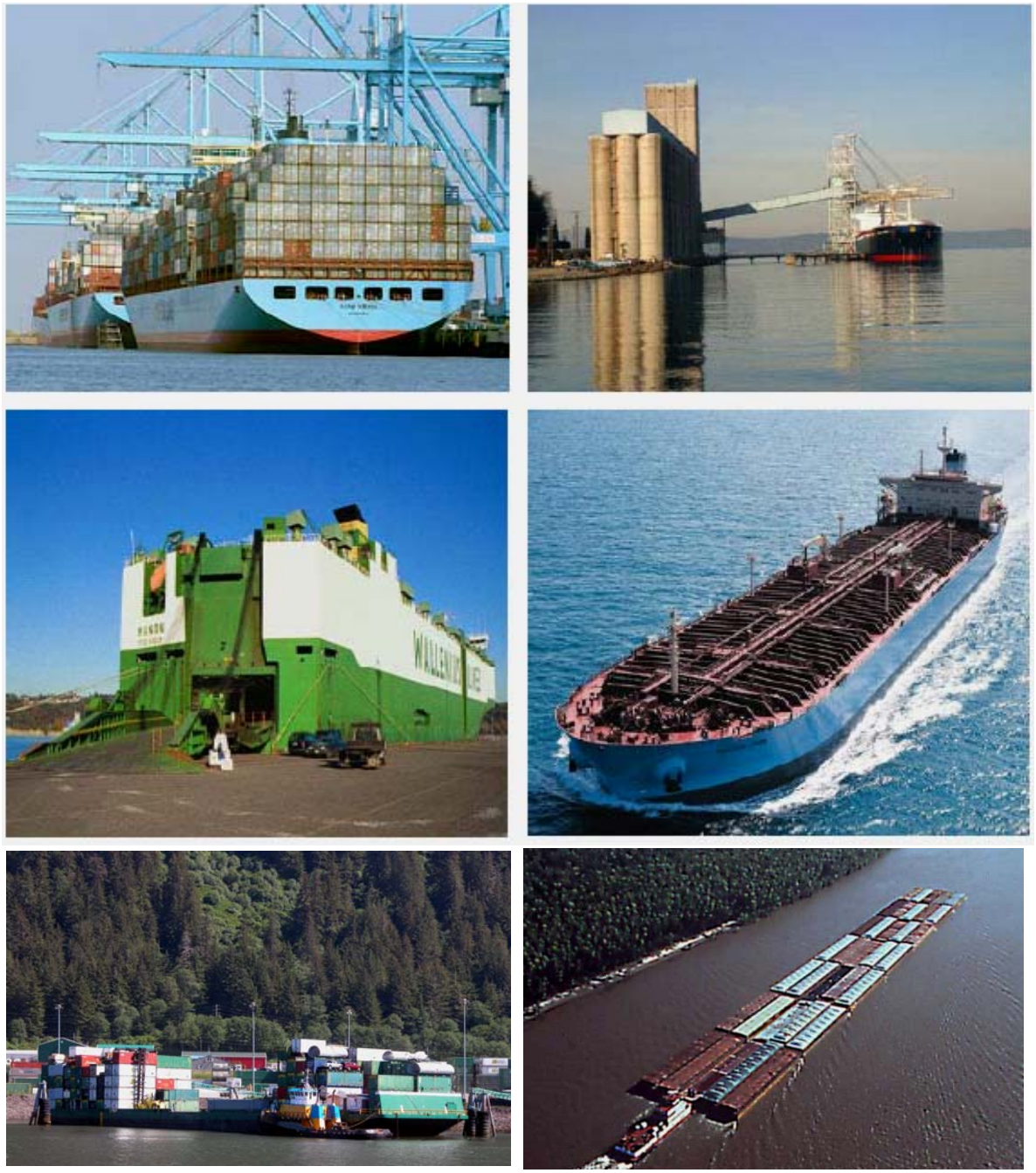
- **Dry Bulk.** Dry bulk is any dry product that is shipped without packaging into smaller units, such as coal in the hold of a vessel.

Each of these cargo types is handled by a particular type of vessel, depending on whether the waterway is "deep draft" or "shallow draft."

Table 4.10 Characteristic Vessel Types by Cargo and Waterway

	Deep Draft (Typically 30- to 50-Foot Water Depth)	Shallow Draft
Containers	Dedicated containerships, ocean-going barges	Container barges
Ro-Ro	Dedicated Ro-Ro ships, barges, combination vessels	Ro-Ro barges
Breakbulk/Neobulk	Break/neobulk carriers, combination vessels	Open or covered barges
Liquid Bulk	Dedicated liquid bulk tankers, Combination vessels	Covered barges
Dry Bulk	Dedicated dry bulk tankers	Open or covered barges

Figure 4.24 Representative Cargo Vessel Types in U.S. Trades



Source: MARAD, USACE, www.shipspotting.com.

Note: Clockwise from top left: containership, dry bulk tanker, liquid bulk tanker, barge tow, container barge, and ro-ro vessel.

Virginia's ports are located on deep-draft harbors and shallow-draft rivers, and handle a diverse range of commodities. Their operations depend on a logistics chain that includes

four major components: the waterways that accommodate vessel movements, the marine terminals that transfer cargo between vessels and landside transportation and landside users, the landside connectors (trucks, rail, and in some cases barges) that distribute cargo to and from marine terminals, and the warehouse and distribution facilities that often serve as the "point of rest" immediately before or after the marine terminal. Each of these functional attributes – waterways, terminals, intermodal connectors, and warehouse/ distribution capability – can act as a competitive advantage for marine transportation, or as a disadvantage.

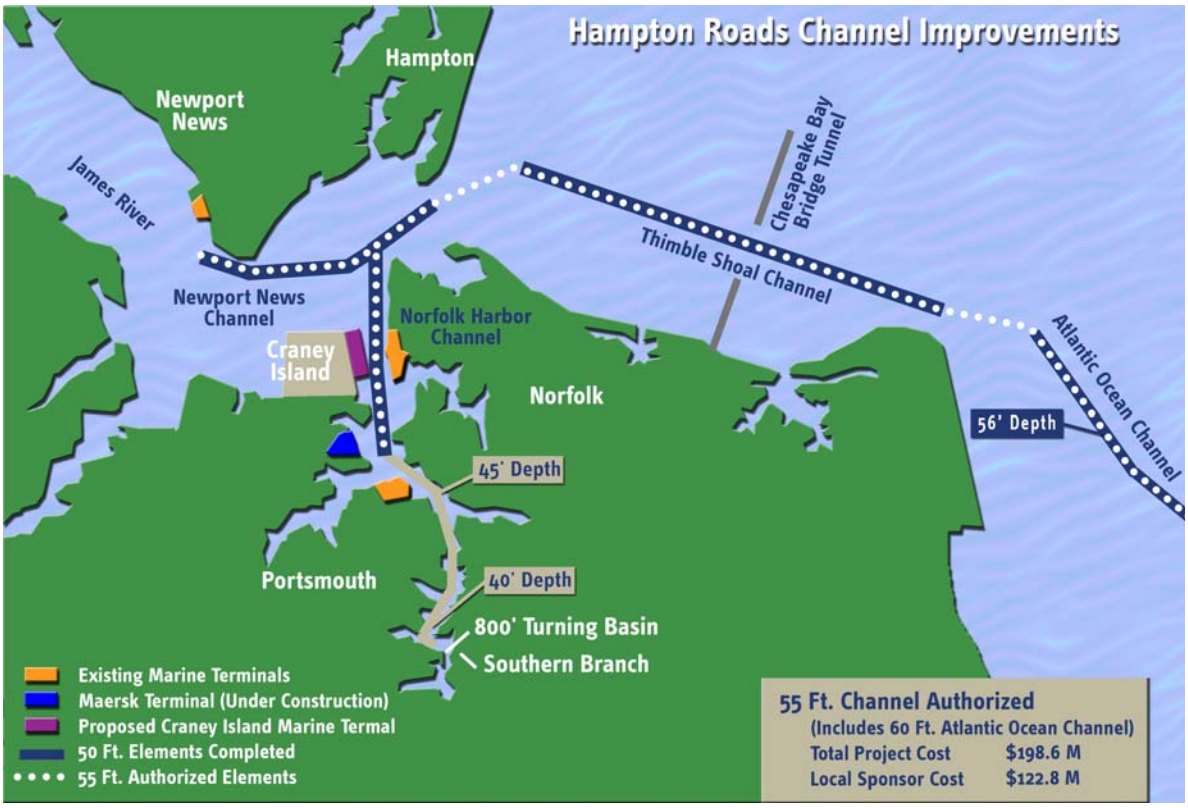
4.4.2 Waterways and Marine Terminals Inventory

Waterways and Marine Terminals

Virginia boasts the single best water transportation asset on the East Coast of the United States: the Chesapeake Bay and its tributaries. The Chesapeake Bay is the largest estuary in the United States, and provides the deepest channels for waterborne transportation on the East Coast. The channels are ice free year-round. Keeping the channels at needed depths is easier and more cost-effective than several other East Coast locations due to soft channel bottoms and a nearby dredged material disposal area. Cargo terminals are located predominately along the natural deepwater harbors formed by the confluence of the rivers Elizabeth, James, and Nansemond. Ships entering Hampton Roads follow a course between Cape Henry and Cape Charles via the Thimble Shoal Channel into the deep waters of Hampton Roads. The southern approach to the Thimble Shoal Channel is the Atlantic Ocean Channel. This channel is approximately 1,300 feet wide, 11.1 miles long, with a depth of 50 feet and is authorized to 55 feet. This makes marine terminals at Hampton Roads the only U.S. facilities on the Atlantic coast capable of handling next-generation "mega containerships," which require drafts of 50 feet or more.

Benefits from this natural harbor extend past the Hampton Roads area. Waterborne freight entering Hampton Roads continues on to the Port of Richmond up the James River and north to Baltimore and other major destinations. There are over 350 miles of navigable channels with drafts exceeding 22 feet. Over 5,000 commercial vessel sailings occur annually destined for Hampton Roads. More than 10,000 sailings occur annually when military vessels and commercial vessels destined for Baltimore are included.

Figure 4.25 Hampton Roads Navigation Channels With Locations of Virginia Port Authority and Maersk Terminals



Using U.S Army Corps of Engineers data, over 325 commercial terminals can be identified as residing on Virginia waterways. Many are smaller concerns and the list includes private marina and smaller seafood locations. For this report marine terminal facilities are categorized as follows:

- Hampton Roads – Virginia Port Authority;
- Hampton Roads – Private Container Terminals;
- Hampton Roads – Private Coal Terminals;
- Hampton Roads – U.S. Government Facilities;
- Other Virginia Public Port Facilities; and
- Other Virginia Private Port Facilities.

Hampton Roads – Virginia Port Authority (VPA) Terminals

The Virginia Port Authority (VPA), along with its operating affiliate, Virginia International Terminals, Inc. (VIT), develops, maintains, and operates world-class cargo

facilities. For fiscal year 2006, VPA handled over two million TEUs of containerized cargo, second highest on the Atlantic Coast behind New York/New Jersey.

- **Norfolk International Terminals.** Norfolk International Terminals (NIT) is the largest of the VPA facilities, with approximately 670 acres of land, two 1,320-foot cargo piers, and 6,000 feet of wharf currently served by 11 container cranes that can reach across 22 to 26 containers and thus service the largest vessels expected to arrive in Virginia. Channel depths are 50 feet. Master Plan improvements at NIT will upgrade terminal infrastructure, increase capacity, and convert from warehouse-based bulk cargo operations to straddle carrier-based containerized cargo operations.

- **Portsmouth Marine Terminal.** Portsmouth Marine Terminal (PMT) is the second largest of VPA's facilities, with approximately 225 acres of land and nearly 3,530 feet of wharf with pier depths up to 43 feet, served by nine container cranes. APM (Maersk) operates a private containerized cargo facility with two cranes they own on approximately 86 acres leased from VPA and adjacent to PMT. Sometime after 2007 when Maersk opens its new facility in Portsmouth, PMT will bring the 86 leased acres into its operations. PMT was the first VPA facility to utilize a more efficient straddle carrier-based cargo operation. Master Plan improvements at PMT are intended to upgrade terminal infrastructure and maximize the use of undeveloped areas in order to increase container storage capacity. In addition, the completion of the Virginia Department of Transportation Pinners Point Interchange project has improved truck access from multiple directions with interstate quality.

- **Newport News Marine Terminal.** Newport News Marine Terminal (NNMT) is the third largest of VPA's facilities, with approximately 140 acres of land, four cargo berths with pier depths up to 40 feet, and five container cranes. NNMT is primarily a break bulk cargo and Ro/Ro (roll on/roll off vehicles) facility and also features 510,000 square feet of multiuse warehouse area.

- **Craney Island Marine Terminal.** Craney Island, a new container terminal, is expected to be under construction through 2032. It will be constructed in phases, covering 660 acres upon completion. Phase I will provide approximately 220 acres of facility when completed. The construction of Craney Island requires significant upfront effort for site development. Major work begins 12 years prior to the arrival of the first cargo ship.

Figure 4.26 Norfolk International Terminals (NIT)

Hampton Roads – Private Container Terminals

- **APM Maersk Terminal Portsmouth Virginia.** The newly opened 450-acre APM Maersk terminal in Portsmouth, Virginia, has direct artery access to the I-164 via a dedicated service road, ramp, and exit from the I-164. The terminal has on-dock rail service that allows it to connect to the Norfolk Southern and CSX Class I lines directly. Capacity at APM is expected to exceed two million TEU.

Hampton Roads – Private Coal Terminals

Coal demand fluctuates somewhat but has been mostly flat since declines from highs reached in the 1980s. There are no forecasts for significant increases in Hampton Roads coal dumpings, in part due to the availability of cheaper foreign sources such as Australia. Since 2001, coal volumes in Hampton Roads have ranged between 20 million and 24 million tons. Capacities at the coal terminals in Virginia are deemed sufficient until a global change in demand occurs.

- **Norfolk Southern Lamberts Point.** Lamberts Point Coal Terminal is the largest coal-transloading terminal in the Northern Hemisphere. About 50 percent of the 24 million tons in 2005 coal volumes for Hampton Roads flow through this facility. Norfolk Southern Railway Company operates this Coal Trans-Loading Facility on the Elizabeth River in Norfolk, Virginia, and transfers coal from rail cars to ships. Annual through-put capacity is 48 million tons. With current coal volumes ranging between flat and slightly rising, the capacity at Lamberts Point should be sufficient for the foreseeable future.

- **Dominion Terminal Associates.** Dominion Terminal Associates (D.T.A.) has an annual capacity of 22 million tons. Coal is received from the coal fields in West Virginia via CSX rail. At pier side, D.T.A. matches the harbor's 50-foot depths. D.T.A. handled just under six million tons in 2005.

- **Kinder Morgan Pier IX.** Kinder Morgan is slightly larger than D.T.A. at 6.7 million tons of coal handled in 2005. Located just north and adjacent to D.T.A., Pier IX also is served by the CSX rail system.

Figure 4.27 Lamberts Point Coal Terminal

Hampton Roads – U.S. Government Facilities

Virginia, and Hampton Roads specifically, is home to a significant military presence. The major U.S. government port and terminal facilities that appear to handle significant cargo are described in this section. Cargo volumes are not disclosed by the U.S. military and it is therefore difficult to segment their impact on the transportation infrastructure. On the whole, recurring inland movements of this cargo may appear in AADT total vehicle counts used to determine demand on the transportation network. The 2005 BRAC commission has several tentative or pending recommendations that could affect several of the military facilities located in Virginia that utilize the Commonwealth's waterway transportation network. All research indicates that the military presence and its demand on Virginia's transportation network to move freight will experience limited growth between now and 2030. The military's stated goal is to continue to find avenues to increase capabilities without increasing manpower requirements.

- **Hampton Roads.** Hampton Roads is home to the world's largest naval base. The Navy owns 36,000 acres and more than 6,750 buildings in the area. There are some 108,000 Navy and Marine Corps personnel stationed in the area, and the Navy employs more than 41,000 civilians. There are more than 23,000 retired Navy men and women living in Hampton Roads, and approximately 118,300 dependents of active duty, and civilian personnel. The total Hampton Roads Navy community numbers some 318,000 people. There is a large military presence in Hampton Roads, with each branch of the armed forces representing over $11 billion annually entering the local economy. Some estimation of military linked facilities on the water that move cargo can be determined through researching the functions for those facilities. The facilities identified are shown and discussed below.

- **Norfolk Naval Air Station.** Norfolk Naval Station (NNAS) is located adjacent to Virginia Port Authority's (VPA's) Norfolk International Terminal, in Norfolk Virginia. NNAS is the largest naval complex in the world. In terms of generating freight movements, NNAS provides port services for all ships under naval control in coordination with Atlantic Fleet commands and other activities concerned.

- **Norfolk Naval Shipyard.** The Norfolk Naval Shipyard (NNSY) is the oldest shipyard in the United States devoted exclusively to ship repair and overhaul dating to 1767. The shipyard is located along the Southern Branch of the Elizabeth River and Paradise Creek, near the mouth of Chesapeake Bay. The mission of Norfolk Naval Shipyard is to provide logistic support for assigned ships and service craft and perform work in connection with conversion, overhaul, repair, alteration, dry-docking, and outfitting of ships.

- **Fort Eustis/Fort Story.** Fort Eustis is located on the James River at the northern tip of Newport News. Fort Eustis is the home of the U.S. Army Transportation Corps, which includes the Transportation Center and School, the Aviation Logistics School, and the Noncommissioned Officer Academy. Fort Story is a subinstallation of the U.S. Army Transportation Center and Fort Eustis. Fort Story is located in the city of Virginia

Beach, Virginia. It is the Army's Logistics-Over-The-Shore (LOTS) training and test site.

- **Naval Weapons Station Yorktown.** Naval Weapons Station Yorktown is three miles from Yorktown, Virginia, and 35 miles from Norfolk, Virginia. The station provides ordnance logistics, technical, supply, and related services to the Atlantic Fleet. The station occupies a total of 10,624 acres. The station is serviced by three major highways (I-64, U.S. 17, and U.S. 60), one railroad, two major commercial air terminals, two military air terminals, two civilian port facilities, one military port facility, one pier facility at the weapon station and two explosive anchorages.

- **Craney Island Fuel Depot.** Craney Island Fuel Terminal, Portsmouth, Virginia is the Navy's largest fuel facility in the United States. It possesses 1,100 acres of above- and below-ground fuel storage tanks. The Fuel Department provides fuel, lubricants, and fuel-related service to approximately 256 fleet and industrial customers with an average throughput of 15 million barrels of fuel per year. Facilities include 60 storage tanks and over 100 miles of pipeline.

- **Norfolk Shipbuilding & Dry-Dock Corporation (NORSHIPCO).** NORSHIPCO is a subsidiary of United States Marine Repair, Inc. (USMR), America's largest nonnuclear ship repair, modernization, conversion, and overhaul company. The facility stretches over 110 acres on the Southern Branch of the Elizabeth River with frontage of approximately 5,000 feet.

- **Newport News Shipbuilding.** Newport News Shipbuilding is a division of Northrop-Grumman, the largest nongovernment-owned shipyard in the United States. The company's principal facilities are located in Newport News, Virginia, on approximately 550 acres at the mouth of the James River. Its facilities include seven graving docks, a floating dry dock, two outfitting berths, five outfitting piers, a module outfitting facility, and various other shops. Dry Dock 12 is the largest in the Western Hemisphere, and has recently been extended to 662 meters. Dry Dock 12 is serviced by a 900-metric ton capacity gantry crane that spans the dry dock and work area.

Other Virginia Public Port Facilities

- **The Port of Richmond.** The Port of Richmond is a 121-acre domestic and international multimodal freight and distribution hub on the James River serving waterborne, rail, and truck shippers throughout the mid-Atlantic states. The Port is owned by the City of Richmond, managed by the Port of Richmond Commission, and operated by Federal Marine Terminals, Inc., a private company. The Port handles containers, break-bulk, bulk, and livestock cargo. The Port of Richmond reported that it handled 414,000 tons in 2004. While no long-range forecasts for the Port of Richmond were identified, data obtained (e.g., three-year growth of cargo and rail shipments exceeding 40 percent) indicates that the Port of Richmond should grow at a relatively rapid rate close to or exceeding other ports.

- **Virginia Port Authority Virginia Inland Port.** The Virginia Inland Port (VIP) is an inland Intermodal Container Transfer Facility (ICTF) with rail service directly to NIT, encompassing approximately 163 acres in Front Royal, Virginia, which is approximately 210 miles from NIT. VIP is located near Interstate 66, Interstate 81, and other major transportation routes, and features good rail access via Norfolk Southern (NS). Containers from the marine terminals in Hampton Roads are conveyed to VIP via the NS line. From there, they continue on to Midwest markets via either rail or truck. Planned Master Plan improvements at VIP are intended to increase cargo handling area, provide on-site warehouse space, and improve rail capability.

Figure 4.28 The Virginia Inland Port

Other Virginia Private Port Facilities

The U.S. Army Corps of Engineers identifies over 300 business facilities that are listed with commercial water access. Segmenting these facilities using a combination of business type, berth length and facility size, and drafts over a minimum 10 feet, almost 90 locations in five categories were identified that are sizeable enough to generate freight movements that warrant mention. Much of the raw material locations generate barge movements. These locations include cement, metals, chemical, concrete, and stone

facilities. Petroleum includes refineries, fuel storage and delivery, and power generation facilities.

Table 4.11 Private Marine Freight-Handling Terminals by Commodity

Freight Category	Number of Terminals
Raw Materials	41
Petroleum	19
Seafood	14
General Cargo	11
Coal	4

4.4.3 Waterway and Marine Terminal Utilization

Tonnage and Commodity Mix

Virginia imports and exports a wide range of commodities by water – some in containers, some in bulk form (like petroleum or coal), some on pallets or sacks, etc. Among all U.S. states, Virginia ranked ninth in total international waterborne tonnage, with nearly 38 million tons handled in calendar year 2005.

In terms of total tonnage (international plus domestic), the complex of port facilities at Hampton Roads rank 15th in the U.S. with 49 million tons; the Port of Richmond also ranks among the top 125 with 1.8 million tons, while the port of Hopewell ranks in the top 150 with just over one million tons.

Each of Virginia's ports handles a unique mix of commodity types. In Hampton Roads, the dominant commodities are coal and containerized goods (manufactured products, food, etc.), but there is also handling of petroleum, chemicals, and crude materials. York River facilities primarily handle petroleum; Richmond and Appomattox River facilities primarily handle crude materials; and Hopewell primarily handles chemicals.

In terms of container traffic (measured in TEUs, or twenty-foot equivalent units), in year 2005, Hampton Roads ranked eighth in the U.S. with almost two million TEUs, virtually tied for second on the Atlantic coast; Richmond ranked 35th, with just over 40,000 TEUs.

Table 4.12 International Waterborne Trade by State
2005, In Thousands of Tons

Rank	State	Total	Exports	Imports
1	Texas	364,993	73,347	291,646
2	Louisiana	198,285	80,667	117,618
3	California	166,209	44,350	121,859
4	New Jersey	72,422	9,820	62,602
5	Washington	67,217	40,780	26,437
6	Florida	67,075	18,361	48,714
7	New York	44,230	2,812	41,418
8	Pennsylvania	39,740	1,072	38,668
9	Virginia	37,859	24,956	12,903
10	Alabama	31,379	10,155	21,224
Total		**1,498,712**	**401,827**	**1,096,885**

Source: U.S. Army Corps of Engineers.

Table 4.13 Leading U.S. Ports by Total Tonnage
2005, International and Domestic

Rank	Port and State	Tonnage
1	South Louisiana, LA	212,245,241
2	Houston, TX	211,665,685
3	New York/New Jersey	152,131,674
4	Huntington – Tristate	83,888,903
5	Long Beach, CA	79,857,710
6	Beaumont, TX	78,886,680
7	Corpus Christi, TX	77,646,945
8	New Orleans, LA	65,875,811
9	Baton Rouge, LA	59,293,661
10	Texas City, TX	57,839,378
11	Mobile, AL	57,664,833
12	Los Angeles, CA	54,894,373
13	Lake Charles, LA	52,724,998
14	Tampa, FL	49,173,959
15	Hampton Roads, VA	48,952,650
	...	
123	Richmond, VA	1,827,016
	...	
146	Hopewell, VA	1,007,278

Source: American Association of Port Authorities.

Table 4.14 Commodities Moved Through Virginia's Public and Private Marine Terminal Facilities

2005, In Thousands of Tons

Port/Waterway	Commodity	Total	International	Domestic
Hampton Roads	**Total**	**49,107**	**34,280**	**14,827**
	Coal	23,365	16,725	6,640
	Petroleum and petroleum products	3,180	582	2,598
	Chemicals and Related	2,458	2,137	321
	Crude Materials except Fuel	5,964	2,745	3,219
	Primary Manufactured Goods	3,621	3,298	323
	Food and Farm Products	4,299	3,805	494
	Manufactured Equipment	5,706	4,499	1,207
	Other	514	489	25
York River	**Total**	**6,129**	**2,771**	**3,358**
	Petroleum and Petroleum Products	5,843	2,700	3,143
	Chemicals and Related	104	70	34
	Crude Materials except Fuel	158		158
	Primary Manufactured Goods	16		16
	Food and Farm Products	6		6
	Manufactured Equipment	1		1
	Other	1	1	
Appomattox River	**Total**	**3,150**	**–**	**3,150**
	Crude Materials except Fuel	3,150		3,150
Richmond	**Total**	**1,827**	**499**	**1,328**
	Petroleum and Petroleum Products	309		309
	Chemicals and Related	179	179	
	Crude Materials except Fuel	1,091	74	1,017
	Primary Manufactured Goods	108	108	
	Food and Farm Products	39	39	
	Manufactured Equipment	96	96	
	Other	2	2	
Hopewell	**Total**	**1,037**	**333**	**704**
	Coal	15		15
	Petroleum and Petroleum Products	176		176
	Chemicals and Related	846	333	513

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., 2005. Note that USACE totals for Hampton Roads and Hopewell are slightly different than AAPA's figures.

Table 4.15 Leading U.S. Container Ports by TEUs
CY 2005

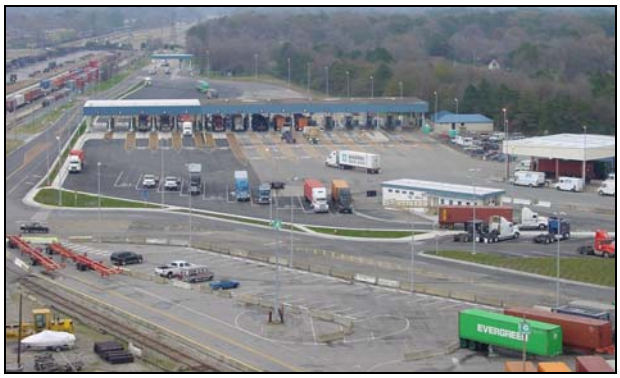
Rank	Port	TEUs
1	Los Angeles	7,484,624
2	Long Beach	6,709,818
3	New York/New Jersey	4,785,318
4	Oakland	2,272,525
5	Seattle	2,087,929
6	Tacoma	2,066,447
7	Charleston	1,986,586
8	Hampton Roads	1,981,955
9	Savannah	1,901,520
10	San Juan	1,727,389
	...	
35	Richmond VA	41,963

Source: American Association of Port Authorities.

Port-Related Truck and Rail Flows

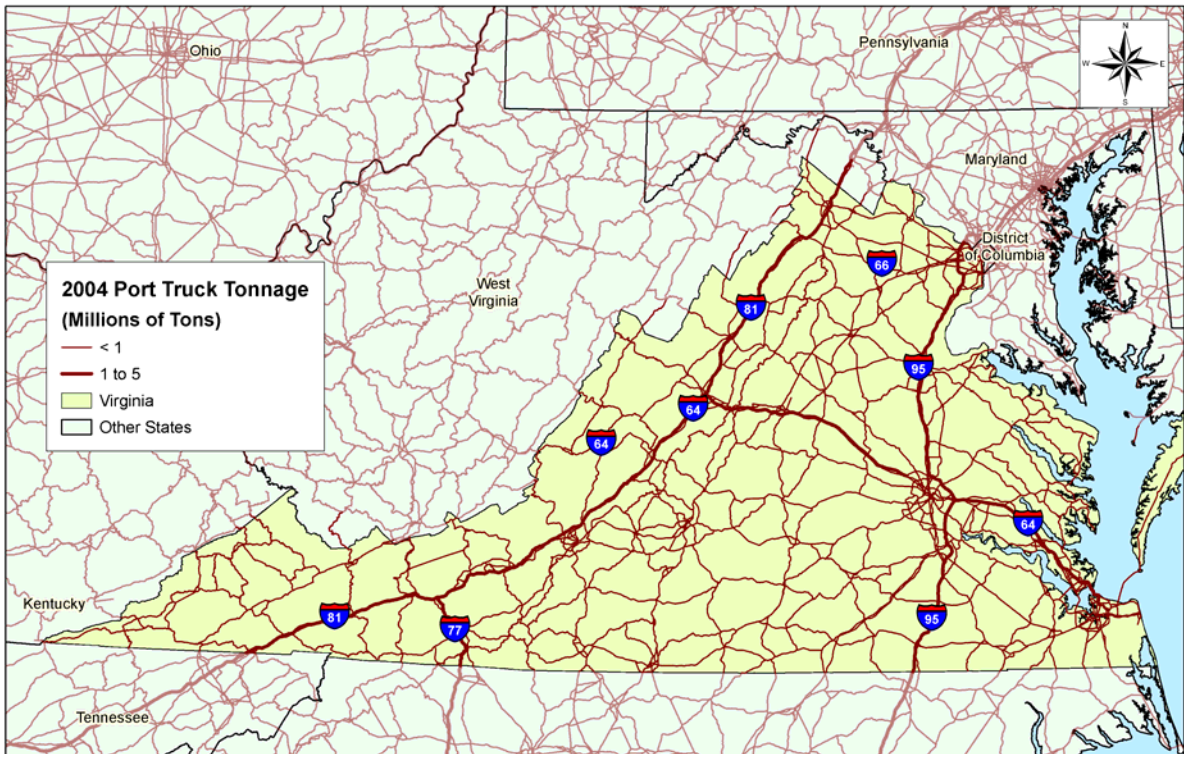
There were 1,136,292 truck trips through the VPA terminal gates in 2006. A further 300,000 containers move by train. About 10 percent of the truck movements take place between the terminals and the rail yards. Within the "last mile" truckloads originating or terminating at VPA terminals head to connection points along I-64, I-664, I-164, and U.S. 58.

Figure 4.29 NIT Truck Gate and On-Dock Intermodal Railyard



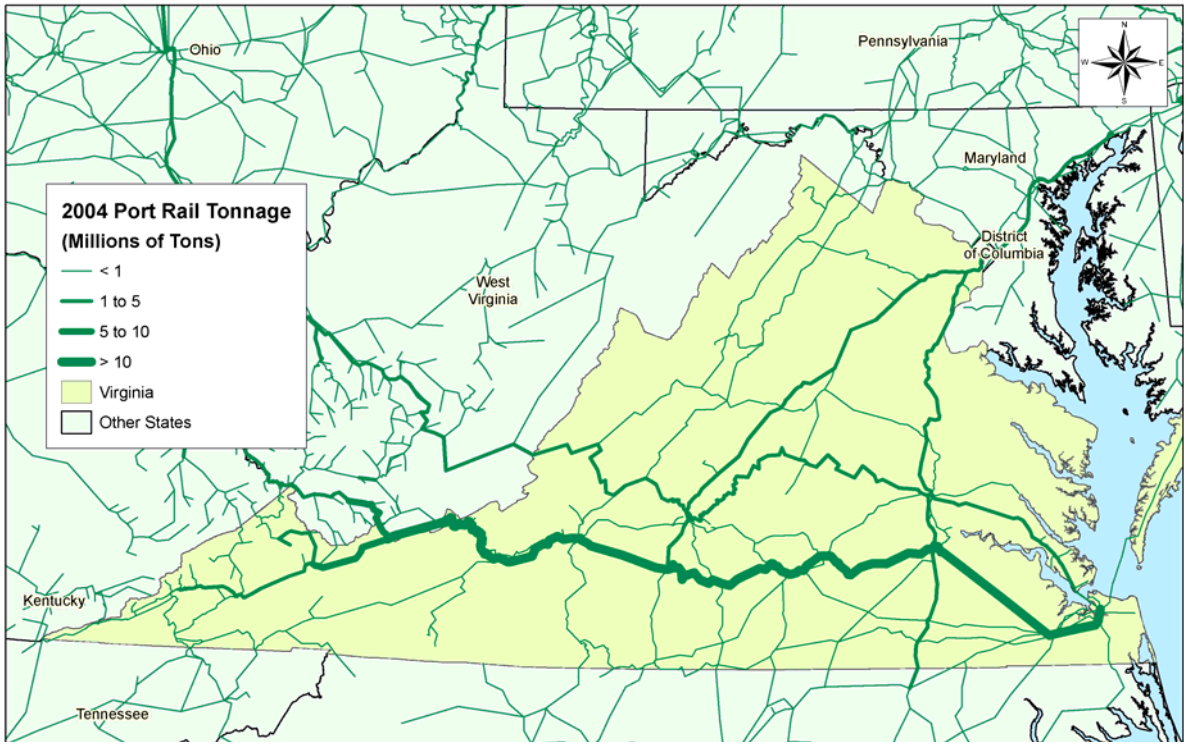
The TRANSEARCH database includes modeled approximations of port-related truck and rail flows, which are presented in Figures 4.30 and 4.31 below. These are useful illustrations of the approximate direction and magnitude of port-related flows.

Figure 4.30 Estimated Port-Related Truck Flows
2004



Source: TRANSEARCH database.

Figure 4.31 Estimated Port-Related Rail Flows
2004

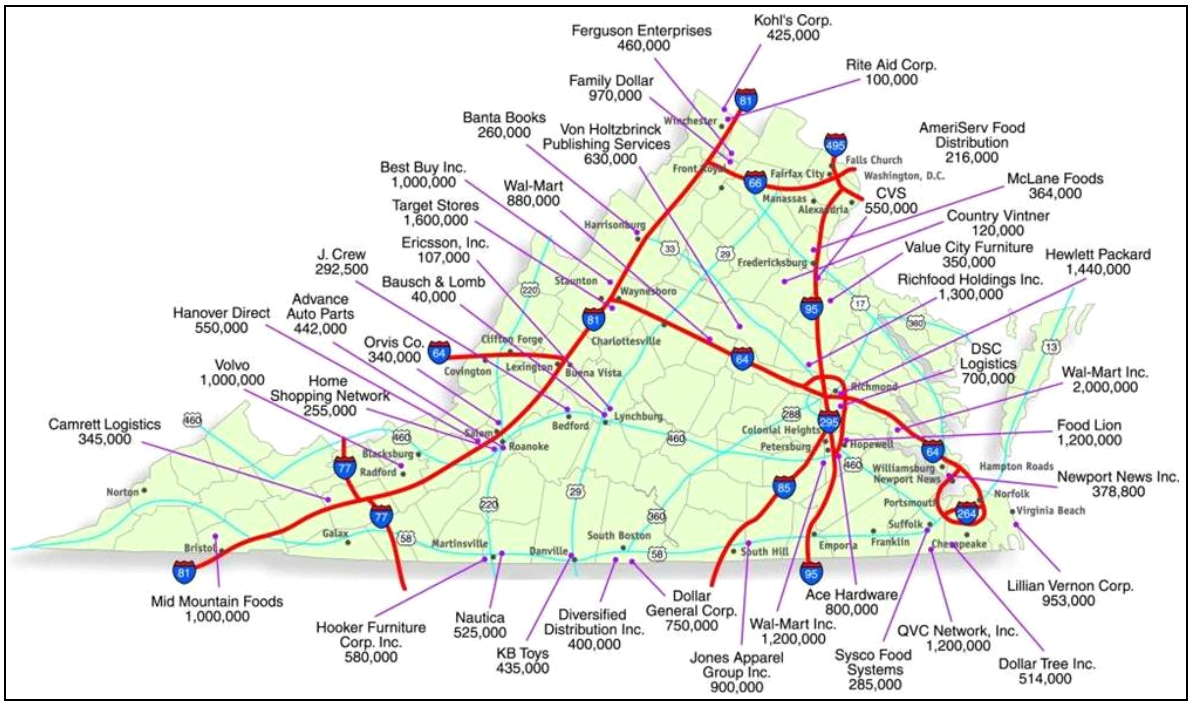


Source: TRANSEARCH database.

4.4.4 Warehouse/Distribution Facilities

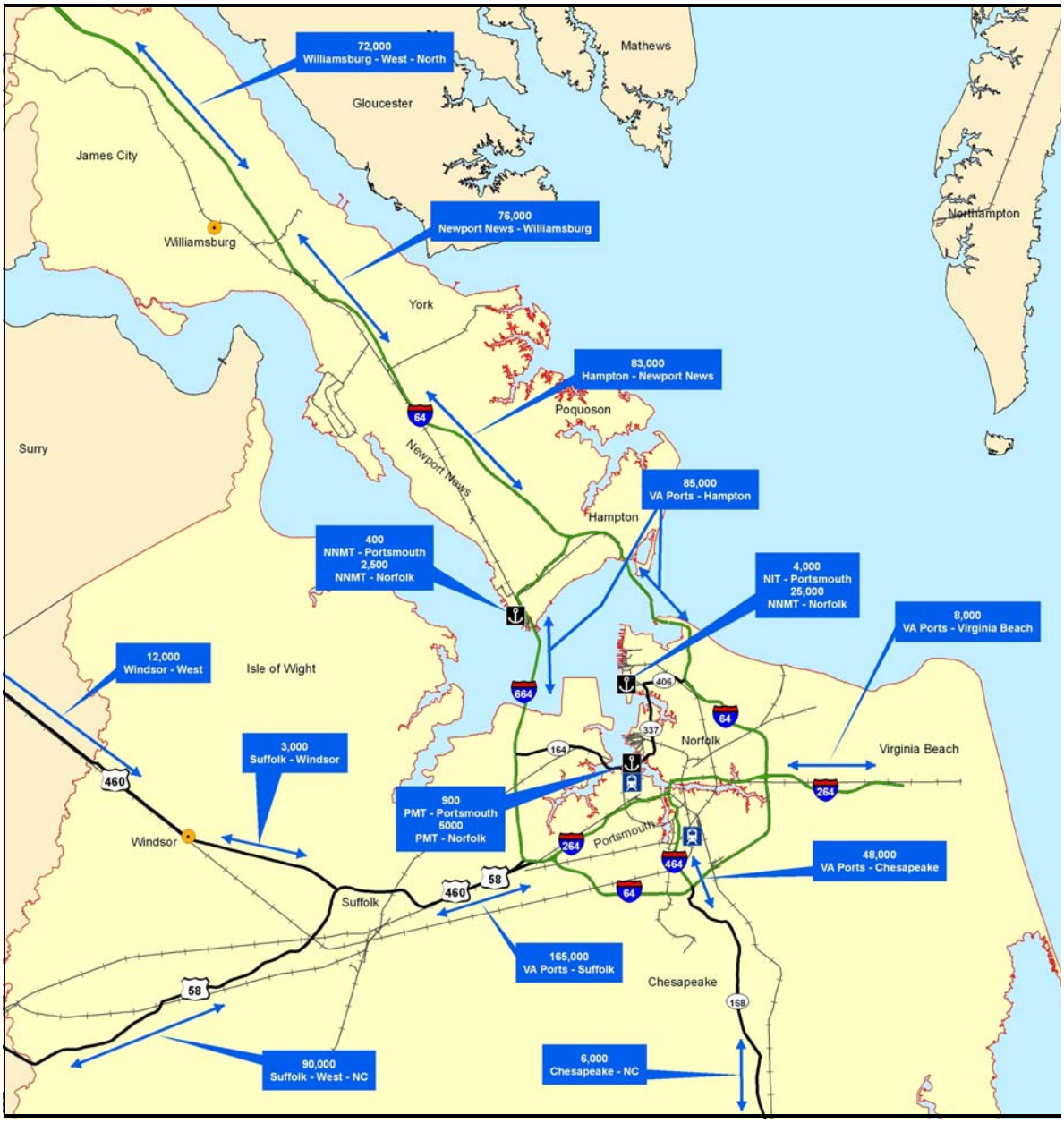
Virginia has experienced marked growth in large-scale warehousing development often associated with high-volume, or "big box" importers. These importers' supply chains are highly dependent upon the uninterrupted flow of cargo – primarily containerized – through Virginia's ports, and subsequently through its highways and rail connections. Demand from the so-called "Big Box" national retailers such as Wal-Mart and Target resulted in over 13 million square feet of new warehousing space being built in Hampton Roads alone since 2000, according to the Virginia Economic Development Partnership. However, significant warehouse and distribution facilities are distributed throughout the Commonwealth, not just in Hampton Roads.

Figure 4.32 Major Virginia Distribution Facilities and Square Feet of Warehousing Space



Within the Hampton Roads area, the relationship between port activity and warehouse/distribution centers is particularly important, since these warehouse/distribution centers often serve as the first "point of rest" for import containers. Key truck travel routes between VPA terminals and warehouse/distribution clusters are illustrated in Figure 4.33 below.

Figure 4.33 Annual VPA Truck Trips Related to Known Warehouse/Distribution Activity
Excludes Nonwarehouse/Distribution Related Truck Trips



4.5 Air Cargo

4.5.1 Service Types

Air cargo is handled in very small units compared to other modes, because size and weight in an aircraft is at a premium. Air cargo is typically handled on pallets or in small, specialized containers called "unit load devices" that are shaped to fit different aircraft types. Air cargo can be handled on dedicated all-cargo planes (like the fleets operated by UPS and FedEx), or on passenger planes, as "belly cargo."

4.5.2 Air Cargo System Inventory

Of the 67 public-use airports in Virginia, eight, as shown in Table 4.16 below, provide for almost all of the air cargo tonnage reported. Four of these facilities – Dulles, Richmond, Norfolk, and Roanoke – can be considered significant cargo airports in terms of volume, although all provide important freight services.

Figure 4.34 Locations of Virginia's Major Cargo Airports

4.5.3 Air Cargo Operations

Volumes and Rankings

As shown in Table 4.16 below, air cargo is handled at eight airports in Virginia – the four major facilities (Dulles, Richmond, Norfolk, and Roanoke) plus smaller operations at National Airport, Charlottesville, Lynchburg, and Newport News. In 2005, Washington Dulles (IAD) handled 303,012 metric tons of cargo, which ranked IAD 23rd among all U.S. airports; Richmond ranked 72nd, Norfolk 86th, and Roanoke 112th.

Table 4.16 Virginia's Cargo Airports

Airport	2006 Freight (Pounds)	Percent Change versus 2005
Dulles (IAD)	80,861,753	13.8%
Richmond (RIC)	30,106,039	6.9%
Norfolk (ORF)	15,759,155	0.6%
Roanoke (ROA)	10,957,422	14.2%
National (DCA)	2,088,966	61.4%
Charlottesville (CHO)	33,346	21.7%
Lynchburg (LYH)	17,496	-48.9%
Newport News (PHF)	11,574	-197.0%

Table 4.17 Characteristics of Virginia's Major Cargo Airports

Airport	2005 Total Air Cargo (Tons)	Airline Service/ Capacity[a]	Number of Commercial Length Runways	Length of Longest Runway	Distance to Connecting Transport[b]	Cargo Warehouse (Square Feet)	On-site Customs and Agriculture Inspections	FTZ Access	Average Customs Clearance Time Required
IAD	303,012	40, 5	3	11,500	14, 35, 60, 50	1,229,128	Yes	Yes	1 hour
RIC	49,614	8, 3	2	9,000	5, 5, 30, 25	142,000	Yes	Yes	2 hours
ORF	31,791	7, 3	2	9,000	5, 5, 5, 5	88,000	No	Yes	2 hours
ROA	14,333	5, 3	2	6,800	5, 10, 150, 120	N/A	No	No	Unknown

Source: 2005 Airport Directory, Air Cargo World, 2006.

[a] First number is total carriers and second is all-cargo (including integrated) carriers.

[b] Numbers, in order, are distance, in miles, to major highway, truck terminal, major water port (inland), and intermodal center.

Table 4.18 North American Airports Air Cargo Rankings
2005, With Virginia Airports

ACI Rankings	Airport	2005 Activity Total Freight (Metric Tons)[a]	Annual Growth 2005/2004
1	Memphis	3,598,501	1.2%
2	Anchorage	2,553,937	13.4%
3	Los Angeles	1,938,430	1.3%
4	Louisville	1,815,155	4.4%
5	Miami	1,754,633	(1.4%)
20	Seattle-Tacoma	338,591	(2.6%)
23	**Washington-Dulles**	**303,012**	**(2.5%)**
25	Minneapolis/St. Paul	282,422	(5.8%)
50	Milwaukee	100,958	8.9%
72	**Richmond**	**49,614**	**(2.1%)**
75	Buffalo	45,655	(10.2%)
86	**Norfolk**	**31,791**	**(0.3%)**
100	Allentown (PA)	21,216	(0.2%)
112	**Roanoke**	**14,333**	**15.8%**
125	Chattanooga (TN)	4,140	54.4%
126	**Washington-Reagan**	**3,969**	**(21.8%)**

[a]Airports Council International (ACI) 2006 data.

Critical Success Factors

Washington Dulles International Airport is clearly a cargo gateway with significant wide-body aircraft capacity to dozens of major international destinations. Richmond, Norfolk, and Roanoke international airports also are all served by the major integrated carriers (DHL, FedEx, and UPS) with multiple jet aircraft (some of Virginia's reliever and general aviation airports accommodate integrated carrier feeder aircraft to handle only early morning express freight).

Many of the world's recent air cargo success stories at airports have been directly attributable to the correct timing, placement, and sizing of cargo facilities that enable the cargo industry to keep pace with – and help drive – the world's global economy. In today's air cargo industry, freight forwarder and air carrier networks are optimally designed to route freight through operationally efficient, cost-effective airports that enable the provision of the highest level of customer service. Large volumes of air cargo are sometimes trucked hundred and even thousands of miles before being loaded onto an aircraft.

There are several key factors that determine whether or not an airport is a viable cargo airport. The leading factors affecting an airport's cargo potential include the following:

- Local and regional air cargo demand patterns;
- Available aircraft cargo capacity, including international and wide-body flights;
- Sufficient airport cargo infrastructure such as runway length, aircraft parking ramp, air cargo warehouse space, and truck maneuvering and parking space;
- Connectivity to interstate highway system; and
- A critical mass of logistics and freight forwarding companies to support cargo consolidations.

The fact that air cargo is, in most cases, extremely fluid and has many airport options means that, unless an airport meets almost all of the above key factors, it is not likely that its "fair" share of the cargo market is captured. These factors are important to consider with regard to the potential of the Virginia cargo airports to contribute to the Commonwealth's freight infrastructure.

The ultimate efficiency of airport cargo facilities depend on largely on the connectivity between the freight forwarding community, cross-dock and warehouse facilities, and off-airport properties. Access in and out of the airport is critical to cargo business, as truck transportation is the critical link to the end-user/customer. As the sheer volume of cargo expands, more and larger trucks are required to transport freight to/from the airport – placing a premium on roadway access and truck-maneuvering space.

Another of the primary drivers of any airport cargo facility development plan is the ability to efficiently utilize its cargo warehouse space. One indication of this efficiency can be gauged by the number of annual tons processed through the airport's total warehouse square footage. The utilization ratio can vary significantly from airport to airport depending on the composition of cargo carriers. For example, an integrated carrier, such as DHL, FedEx, or UPS, generally experience much higher building utilization rates do to the more time-sensitive nature of their business and the speed of cargo transfer from airside to groundside. International and heavy freight activity tends to experience more dwell time in the cargo warehouse and therefore lower the utilization rate accordingly.

Table 4.19 Building Utilization for Virginia's Major Cargo Airports

Airport	2005 Activity		Aggregate Cargo Building Utilization (Tons Per Square Foot)
	Total Freight (Metric Tons)[a]	Air Cargo Facilities (Square Feet)*	
Washington-Dulles	303,012	1,229,128	0.25
Richmond	49,614	142,000	0.35
Roanoke	14,333	N/A	–

[a]From *Air Cargo World, 2006 World Airports Directory* and official airport web sites.

N/A = Not available.

Role of Out-of-State Airports

In today's environment, trucking is approximately 12 to 13 times cheaper than air transportation. Much of Virginia is within a one-day drive of a larger cargo airport, such as JFK, Chicago O'Hare, Memphis, and Atlanta. Many air cargo shippers, receivers, forwarders, etc. opt for lower costs and better schedules offered by these major hubs, and accept the long truck haul as part of the cost of doing business. While air eligible commodities are generally time sensitive due to the physical or economic perishable nature of the goods, the major cargo gateways exert a very strong "gravitational" pull largely due to the immense cargo capacity provided on wide-body passenger flights. The belly cargo capacity on these flights is incrementally priced, often three to four times cheaper than main-deck freighter capacity, which is extremely attractive to the freight forwarding and logistics communities.

Role of Other Virginia Airports

Washington Reagan-National accommodated 3,969 metric tons of cargo in 2006, and ranked 126th out of 160 on the Airports Council International list (Table 4.18). However, while DCA is a major airport in the mid-Atlantic airport system and has a very large number of daily departures, it does not function as a major cargo airport for several reasons. First, while the airport averages several hundred jet operations per day to an expanding range of destinations (including Seattle, Las Vegas, Los Angeles and Phoenix due to exceptions to the "perimeter rule" restricting most flights to a 1,250-mile radius), all are performed by narrow-body aircraft with limited cargo capacity. The airport has a relatively short runway (6,800 feet) that limits overall aircraft weight. There is little land to accommodate cargo warehouse space and provide aircraft parking. Finally, highway connectivity is limited, via I-395, I-66, and Route 1, which constrains the ability to truck cargo activity to and from the airport.

Most airports in Virginia currently lack some of the most important key factors to be effective in handling substantial air cargo. The primary lacking factors are local air cargo production and consumption demand, and airline service to accommodate significant volumes of air cargo. The result is that the majority of Virginia's airports, including all of the reliever and general aviation airports and even some of the primary and commercial airports like Lynchburg, Charlottesville, Newport News/Williamsburg, and Shenandoah Valley airports, do not handle substantial amounts of air cargo.

4.6 National Highway System Intermodal Connectors

NHS intermodal connectors are short roadway segments averaging less than two miles in length that link airport, seaport, and rail terminal facilities to the National Highway System (NHS). They tend to carry less volume at lower speeds than the rest of the NHS and are therefore often designed to lower standards. Because of their key freight role, however, they are used by large and heavy trucks. Those with design deficiencies or in poor condition can slow freight movement or damage goods in transit. Intermodal connectors also support defense mobilization and national security.[2] The FHWA identifies 12 freight-related intermodal connectors in Virginia:[3]

1. Norfolk International Airport
   Norview Avenue (Entrance to I-64)

2. Richmond International Airport
   Fox Road (Entrance to Airport Drive), Airport Drive (Fox to Route 60), Route 156 (Route 60 to I-64)

3. Roanoke Municipal Airport
   Aviation Road (Entrance to Route 101)

4. Dulles International Airport
   Served by an Existing NHS Route

5. Port of Hampton Roads – Lamberts Point
   Orapax Road (Entrance to Raleigh Avenue), Raleigh Avenue (Orapax to SR 337)

6. Port of Hampton – Newport News Terminal
   25th Street (Entrance to Huntington), Huntington Avenue (25th to 26th, 26th Street

[2] FHWA, NHS Intermodal Freight Connectors: Report to Congress.

[3] Official NHS Intermodal Connector Listing: Virginia, http://www.fhwa.dot.gov/hep10/nhs/intermodalconnectors/virginia.html.

(Huntington to I-664), 25th Street (Entrance to Huntington), Huntington (25th to 23rd), 23rd (Huntington to I-664)

7. Port of Hampton Roads – Norfolk International Terminal
   Served by an Existing NHS Route

8. Port of Hampton Roads – Portsmouth Terminal
   Served by an Existing NHS Route

9. Port of Richmond – Deepwater Terminal
   Deep Water Road (Entrance to Connector), Connector Road (DW Road to Comm.), Commerce Road (Connector Road to I-95)

10. Alexandria Intermodal – Norfolk Southern
    Metro Road (Entrance to Van Dorn Street), Van Dorn Street (Metro Road to I-95).

11. Chesapeake Intermodal – Norfolk Southern
    Atlantic Avenue (Entrance to SR 168), SR 168 (Atlantic to I-64)

12. Virginia Inland Port
    Route 340 (Entrance to I-66)

As freight traffic through Virginia's marine terminals grows, stress on the intermodal connectors will increase. Terminal capacity additions are planned in response to forecasted freight demand. As this demand comes on-line, the key intermodal connectors feeding freight to and from the NHS also will need to be upgraded.

5.0 Stakeholder Input

5.1 Overview

Stakeholders across Virginia and the nation have a vital interest in the state of the Commonwealth's freight transportation system. Enterprises engaged in goods movement, manufacturing, farming, mining, and retailing depend on efficient freight transportation for their operations. Knowledgeable people working for firms in these industries as well as leaders of various public agencies and private organizations with particular interests in freight supplied important feedback on the State of Virginia's freight transportation system. This feedback was provided through two primary channels: stakeholder phone interviews and the Virginia Freight Advisory Committee.

5.2 Stakeholder Phone Interviews

5.2.1 Process

Extensive outreach to Virginia freight system stakeholders was made via phone interviews. Many of these interviews were scripted, with each stakeholder answering the same series of questions. This allowed results to be compiled from a wide range of stakeholders and provided a broad snapshot of information and opinions. A smaller subset of phone interviews were conducted by experienced freight professionals without a script. These free-ranging interviews sometimes revealed important information from specific firms that would not have been generated using the standard script.

Phone interviews were conducted over the course of several months. The interviewers uncovered the opinions of the stakeholders on topics such as:

- The primary problems or issues related to Virginia's freight system;
- What they are doing to address or ameliorate the problems they have related to freight system performance; and
- What they think the Commonwealth of Virginia should be doing to improve the freight system.

5.2.2 Profile of Interviewees

Over 180 stakeholders, representing a wide range of firms and organizations within Virginia, participated in the interview process. Manufacturing firms accounted for most of the interviewees, followed by distribution firms (trucking firms, wholesalers, etc.), and an assortment of retail, mining, agricultural, and other firms. Firms of all sizes were included with 68 percent of those interviewed representing firms with less than 250 employees and 11 percent representing firms with more than 1,000 employees. Stakeholders from every region of the Commonwealth were interviewed.

Figure 5.1 Type of Firm

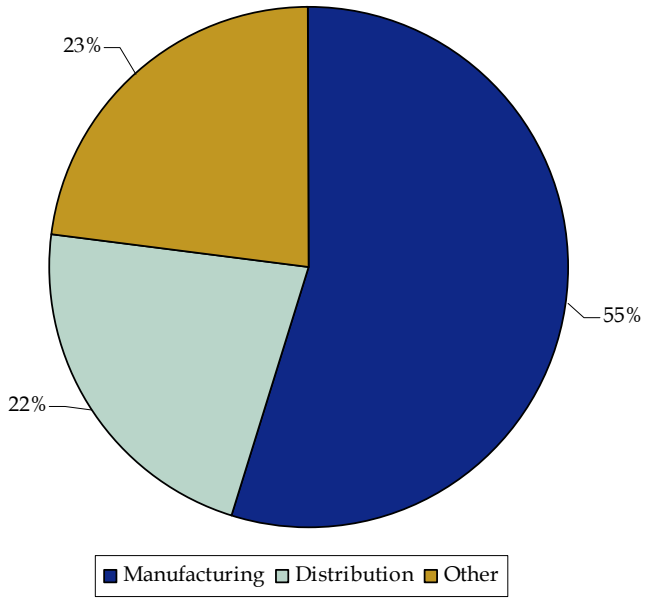
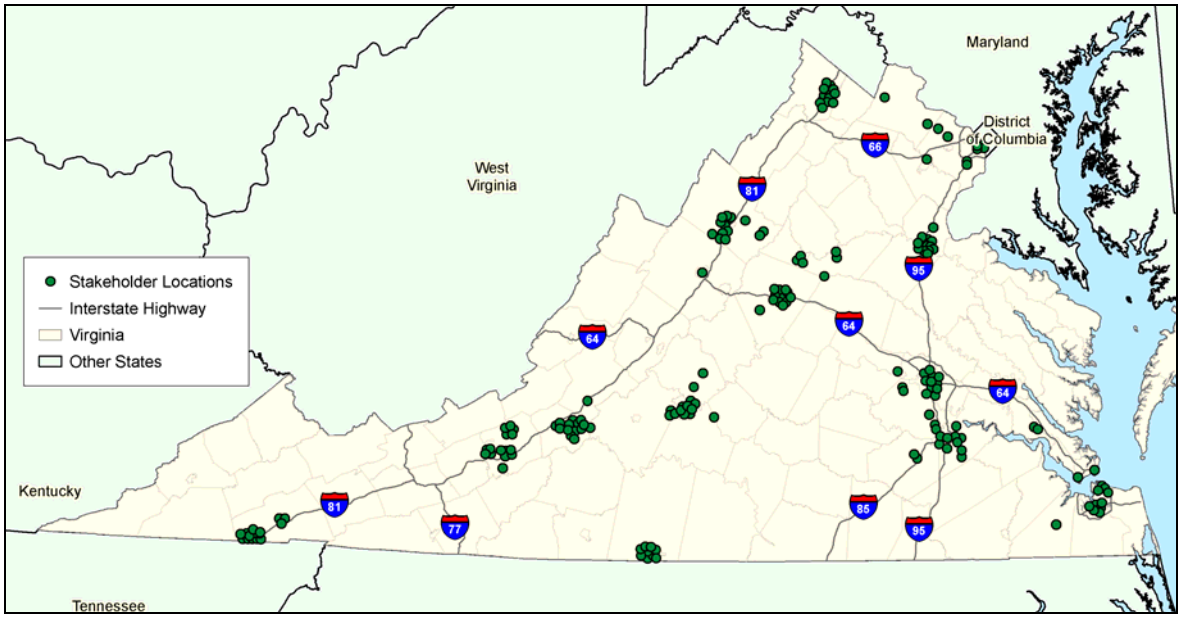


Table 5.1 Size of Stakeholder Firms Interviewed

Number of Employees	Respondents	Percent
> 1,000	11	6%
500-999	13	7%
250-499	27	15%
100-249	54	29%
50-199	31	17%
< 50	40	22%
No Response	10	5%
Total	**186**	**100%**

Figure 5.2 Geographic Distribution of Interviewees

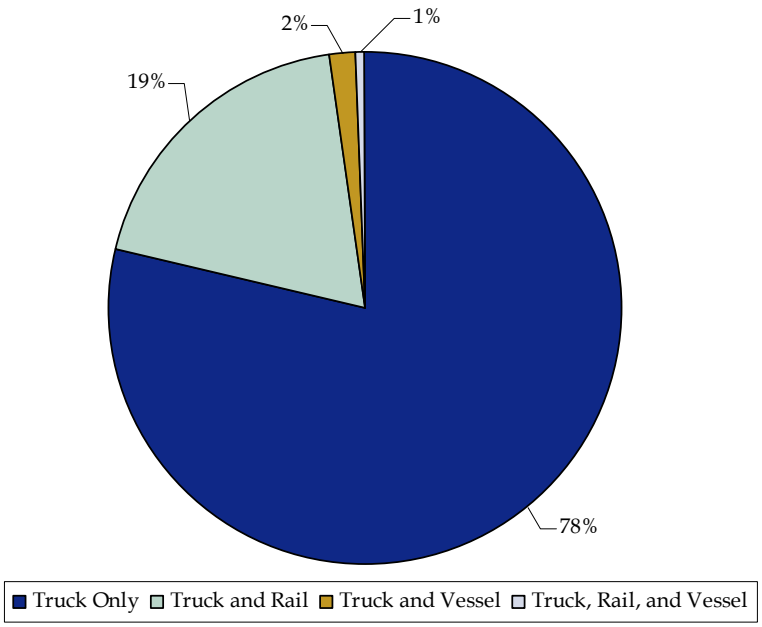


The majority of firms (79 percent) report that they have "truck only" facilities with no direct access to any other mode. A significant portion (38 percent) of firms report that freight received or shipped from their facility utilizes some other mode during its trip. These intermodal movements combined either rail and truck, vessel and truck (containers), or airplane and truck.

Table 5.2 Interviewees Reporting Intermodal Shipments

Type of Intermodal Service	Percent of Interviewees
Truck/Rail	12%
Truck/Vessel	13%
Truck/Air	12%
Total	**38%**

Figure 5.3 Modes Available at Interviewee's Facility



5.2.3 Issues Identified

When directly asked whether or not the freight system in Virginia is adequate for their needs, 63 percent of the respondents said yes. Regionally, the proportion of affirmative responses varied from over 80 percent in the Blacksburg region to just 25 percent in the Northern Virginia region (see Figure 5.4 below).

The problem or bottleneck most often cited by respondents was highway congestion. The likelihood of a respondent reporting that the freight system in Virginia is adequate is directly related to where that respondent is located. Those located in congested areas were most likely to report that the system is inadequate. Respondents reported that the Northern Virginia and Hampton Roads regions were the most congested and that the I-81, I-95, and I-64 (east of Richmond) corridors had significant congestion problems as well.

While congestion was the most frequently mentioned issue, there also were a number of other problems reported. These include driver shortages, high fuel costs, and problems with permitting and regulations along with a variety of others as outlined (see Figure 5.5 below).

Figure 5.4 Responses (by MPO Region) to the Question "Is Virginia's Freight System Adequate?"

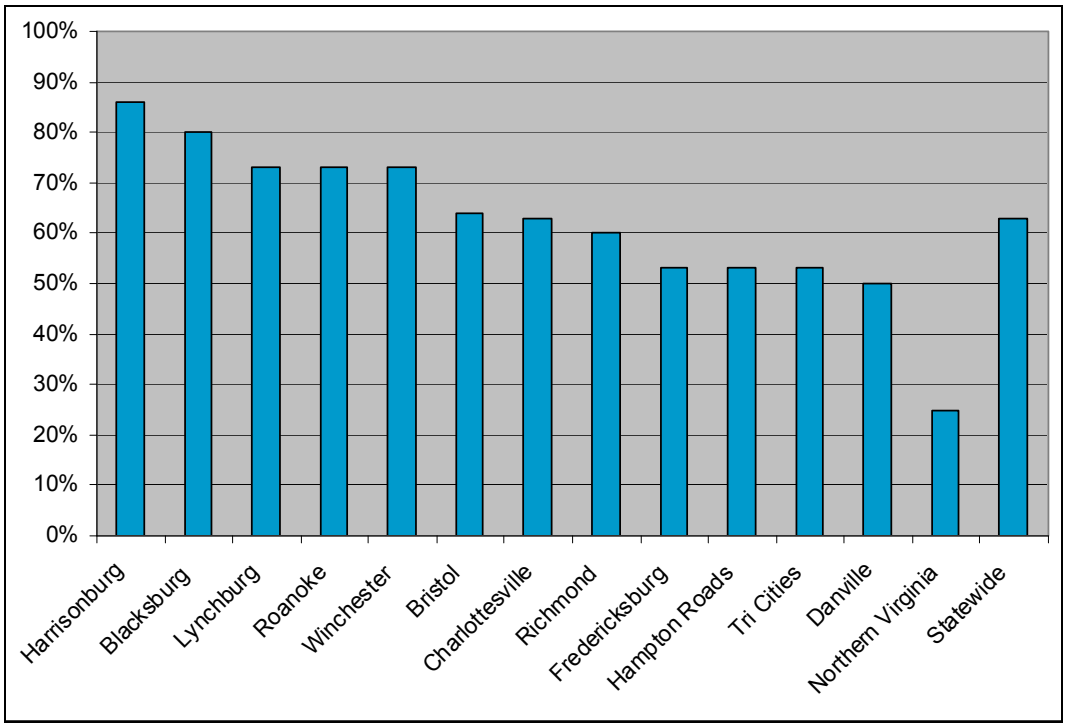


Figure 5.5 Freight Issues Reported by Stakeholders

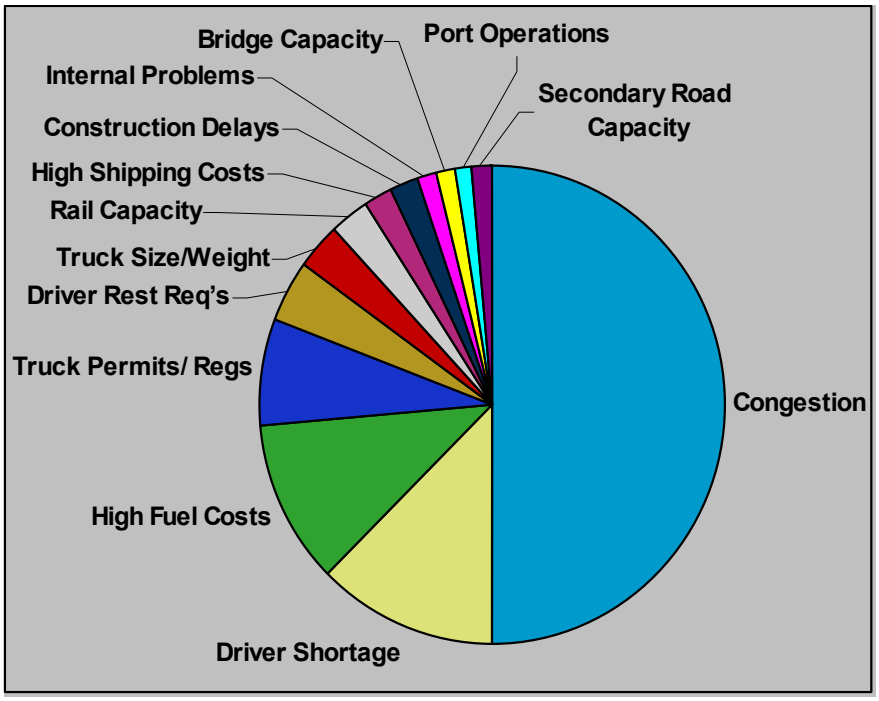


Table 5.3 Locations of Problem Congestion

Regions	Percent Mentioning as Problem
Northern Virginia	19%
Hampton Roads	12%
I-81 Corridor	5%
I-95 Corridor	4%
I-64 Corridor (East of Richmond)	2%
Richmond	1%

Several stakeholders commented at some length on the congestion problems facing users of the freight system in Virginia. Representative comments include:

- "Approximately 60 percent of company product is shipped out of state. Not many problems until trucks reach Northern Virginia."
- "We face congestion issues throughout the United States, but there are only a few places as bad as Northern Virginia and Tidewater. We operate in New York, Miami, Los Angeles, Atlanta, and other metropolitan areas – and Northern Virginia is one of the worst locations to efficiently move freight."
- "Congestion and rest area issues are the same in other states; it's difficult for drivers to get to rest areas within time constraints of hours of service mandates."
- "Today [we are] concerned that plans to increase [port] capacity could be impacted if the inland transportation infrastructure does not keep pace."
- "[We, an air cargo shipper, feed a large] sort facility on New York Avenue and the [truck] restrictions on I-66 inside the Beltway increase travel time and distance for the company … [we must] use the Dulles toll road to I-495 to I-395 to New York Avenue, which is a much longer distance. The recent improvements at the Springfield interchange have helped significantly but if the aircraft are as much as 30 minutes late, this route becomes extremely difficult."

5.2.4 Potential System Improvements

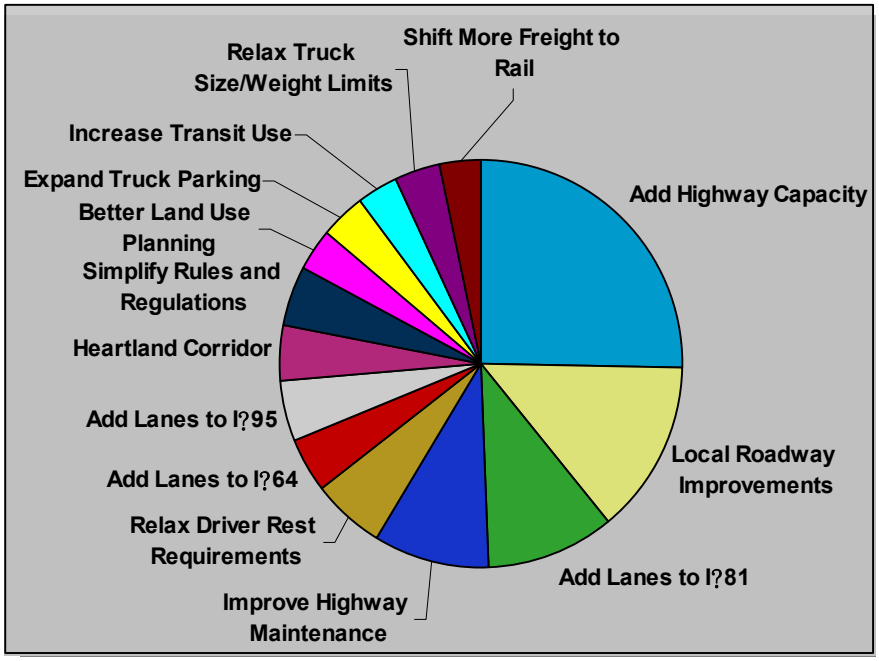
When asked about potential improvements, most respondents focused on adding highway capacity in one form or another – generically throughout the system, or locally in the vicinity of their facilities, or specifically on I-81, I-64, and I-95. Other trucking-oriented suggestions included: improving highway maintenance; relaxing driver hour of service

requirements and size/weight limits; and expanding truck parking. Suggested rail improvements included construction of the Heartland Corridor and shifting more freight to rail. Finally, a few respondents identified better land use planning and increased transit use as strategies that could benefit freight transportation in the Commonwealth.

Table 5.4 What Virginia Should Do?

Action	Number of Mentions	Action	Number of Mentions
Add Highway Capacity	22	Implement Heartland Corridor	4
Make Various Local Improvements	12	Simplify Rules and Regulations	4
Add Lanes to I-81	9	Better Land Use Planning	3
Improve Highway Maintenance	8	Expand Truck Parking	3
Relax Federal Driver Rest Requirements	5	Increase Transit Use	3
Add Lanes to I-64	4	Relax Truck Size and Weight Restrictions	3
Add Lanes to I-95	4	Shift More Freight to Rail	3

Figure 5.6 Freight Strategies Suggested by Stakeholders



Specific improvements identified by stakeholders are listed below. (These are not study recommendations at this time, and are cited for informational purposes only.)

Blacksburg

- Install a traffic signal at Scattergood and Franklin (Route 460 BUS) to connect Scattergood to Independence Boulevard.

Bristol

- Upgrade I-81 with dedicated truck lanes;
- Add more lanes to I-81; and
- Improve Lee Highway.

Charlottesville

- Add traffic light at U.S. Route 250 and Hunter's Way (Humagen entrance).

Danville

- Replace the Robertson Bridge over the Dan River;
- Build U.S. 29 to U.S. 58 West Bypass;
- Build U.S. 29 to SR 41 Bypass;
- Widen U.S. 29 near Gainesville, VA or make bypass; and
- Make bypass around Charlottesville, VA.

Fredericksburg

- "Too many heavy trucks on Route 17. Need Outer Connector or similar facility, even if it has to be tolled and even if it is a truck only facility";
- "The Interstate 95 corridor needs immediate improvements to include HOV to Massaponax and South, additional exits at Fall Hill Avenue and Route 208 in the Fredericksburg area, and both U.S. 1 and Interstate 95 need additional lanes";
- Interstate 81 needs to be improved and more lanes should be added;
- VDOT needs to partner with cities and counties on growth and highway needs, so the need for roads is considered as part of the growth planning
- Landsdown Road should be upgraded;
- Relax time-of-day constraints on permitting restrictions for wide loads; and

- "Virginia should look into working with other states to ensure permit time limits are reasonable given heavier traffic congestion and length of travel time for delivery between states."

Hampton Roads

- "The Third Crossing is of great importance to the area. Providing interstate quality movement instead of city streets will be vital to maintaining mobility for Hampton Roads. The Third Crossing is not just a port-truck solution and is needed for the world's largest Naval Base and the residents in the area."

- "Improving U.S. 460 to interstate quality between Hampton Roads and Richmond is another important improvement that should have a high priority. Somewhere in the near future the combination of Portsmouth Marine Terminal, APM Terminal, and then Craney Island Marine Terminal will result in the majority of the more than six million cargo movements occurring on the Portsmouth side of the Elizabeth River. This cargo must be able to access efficient transportation systems."

- "The Heartland Corridor will provide great efficiencies to move cargo to the Midwest [and should be implemented]."

- Build truck stop on Virginia Peninsula.

- Reduce traffic congestion on Interstate 64 between Williamsburg and Richmond.

- Reduce delays through the Hampton Roads Bridge Tunnel.

- Expand Interstate 64 between Hampton Roads and Richmond.

- Need rail relocation at SR 164.

- Need the planned U.S. 460 expansion.

- Improve interchange between I-64 and I-264.

- Increase the use of short-sea shipping.

- Use more rail going to western destinations from the Port of Norfolk.

- Relax truck restrictions on Hampton Boulevard in Norfolk, Virginia. This is the preferred route for most truckers to the NIT marine terminal.

Harrisonburg

- Create western bypass around Harrisonburg.

- Add truck climbing lanes on hills.

- Improve intermodal capacity between trucks and rail.
- Need more troopers for enforcement. Use cameras at the "hot spots" to improve enforcement.
- Build a ring road around Harrisonburg.
- Simplify rules, regulations, and procedures.
- Streamline and expedite permits process.

Richmond

- Increase channel depth in James River.
- Ease truck weight restrictions.
- More accessibility for drivers at scaling (precert and more avenues – scale locations).
- Increase truck parking areas.
- Resurface / repair I-295 around Richmond.
- Consider reducing competing traffic by incentivizing commuter transition to local bus/metro-trams.
- Improve U.S. 460 to Hampton Roads.
- Improve operations and safety at the I-81 and I-64 interchange.
- Reduce wait times for oversize/overweight permits/provide adequate staff at the permit office.
- Repair the many potholes on I-95 and I-295. Build additional flyovers. Increase breakdown lane width to reduce accident delay times.

Roanoke

- Add truck lanes on I-81.

Tri Cities

- Reduce the number of permits required to move a load – often there is a VDOT permit and multiple local permits.

- Site access improvements needed including adding a traffic signal at Route 460 and Enterprise Drive along with a center turn lane at Route 460. (Food Lion, 6500 Enterprise Drive, Disputanta, VA).

- Need rail crossing signals at plant entrance off of Route 460. (Tindal Corporation, 5400 Olgers Road, Dinwiddie, VA).

- Upgrade Route 460 to an Interstate-style facility.

National Capital Region

- Build (another) major bypass around the Washington, D.C. area.

- Develop a campaign to help people look for short cuts and alternative routes. People don't know about side roads, etc. Other available roads are not being used.

- Ensure that residential development pays for its transportation impacts.

- Build new bridges across the Potomac.

- Add lanes to I-95 between the Capital Beltway and Fredericksburg.

- Promote transit alternatives to reduce congestion.

- Provide relief on Federal hours of service regulations for local drivers.

Winchester

- Improve snow removal preparations.

- Add another lane in each direction on I-81.

- Look at route restrictions – [those on] Hwy 17 between I-66 and Rte 50 added to our company's transit time and fuel costs.

5.2.5 Logistics Responses

Freight shippers and receivers are actively responding to freight transportation challenges, in various ways. For example:

- A manufacturer in northwest Virginia also commented on the operational difficulties they face due to the congestion in and around Washington, D.C. To better serve their customers they plan to invest in a new forwarding facility in the region to improve delivery times to their D.C. area customers.

- A Lynchburg area manufacturer that currently receives about 40 percent of inbound materials by rail is planning to divert more of this freight to trucks due to shipping delays related to rail congestion in the Lorton area.

- "[We] recently built two alternative import destinations in the United States. One is in Houston, the other south of Chicago serviced by Seattle/Tacoma port."

- "[We are] currently investing millions of dollars in technology to coordinate inbound and outbound for fewer empty trucks on a dead head leg."

- "[We have] expanded operations to seven days a week."

- "[We] try to maximize loads on each truck to reduce number of trips."

- "[We] have had to expand our footprint (new facilities) to meet on-time performance expectations."

The most frequently cited stakeholder-driven logistics approaches are summarized in Table 5.5 below.

Table 5.5 Stakeholder-Driven Approaches to Mitigating Problems with the Freight System

Action	Number of Mentions	Action	Number of Mentions
Improve Route Planning/ Scheduling	21	Improve General Productivity	5
Negotiate with Carriers	20	Replace Trucks	2
Improve Packaging and Shipping Process	13	Purchase New Trucks	2
Increase Capacity/Build Warehouses	6		

Opportunities for the Commonwealth to support its industries in seeking and implementing logistics-based solutions should be further explored, in tandem with potential improvements to freight transportation infrastructure.

5.3 Virginia Freight Advisory Committee (VFAC)

The Virginia Freight Advisory Committee (VFAC) includes public agency representatives and high-level private-sector freight stakeholders. The private-sector participants work hand in hand with public agency personnel to study potential freight system improvement related to improving the Commonwealth's intermodal rail service (including intermodal rail access to Virginia's ports) addressing the freight transportation labor shortage, applying improved freight technology systems, and investigating short-sea shipping (or "marine highway") opportunities. Many of these issues and opportunities were also raised in the stakeholder interviews. Findings and recommendations from the VFAC and its subcommittees are incorporated into the discussion in Section 6.0.

6.0 Virginia Freight Transportation Challenges and Opportunities

6.1 Overview

Virginia's freight transportation system is performing, overall, at a level sufficiently high to support the Commonwealth's vibrant economy, and to accommodate high levels of global trade as well as pass-through traffic. Yet some elements of the system are showing signs of strain – congestion, aging infrastructure, insufficient capacity, operational difficulty, etc. To address these issues, Virginia is currently making or planning hundreds millions of dollars worth of transportation improvements that will benefit freight, many in partnership with the private sector.

This section is intended to: discuss the general benefit of making freight investments; define some of Virginia's most critical freight chokepoints, bottlenecks, and issues; look ahead to potential issues and impacts in the year 2035; summarize important freight enhancement projects and initiatives underway; and outline additional innovative strategies and opportunities that could be part of Virginia's "critical path" for freight advancement.

6.2 A "Return on Investment" Framework for Approaching Freight Challenges and Opportunities

6.2.1 Performance-Based Planning and ROI Analysis

Some of the challenges facing Virginia's freight system are apparent, because they are shared by both passengers and freight users – highway congestion and delay, rail service availability and reliability, related environmental impacts, etc. Others are more deeply hidden within infrastructure that the public at large does not see, or within logistics chains that are not transparent except to their participants.

Broadly speaking, we can define a freight challenge as any physical, operational, or institutional issue or deficiency that prevents Virginia's multimodal freight system from meeting desired performance standards. We can also, more or less interchangeably, term these challenges "bottlenecks" or "chokepoints."

Many elements of Virginia's multimodal transportation system are already measured using performance-based planning approaches. Some elements – particularly highways – are designed and tracked against established standards for "acceptable" performance, but for others there is no comparable standard for what constitutes "acceptable" performance, and these evaluations must be made case-by case.

The best approach for case-by-case evaluations is a rigorous benefit-cost approach, one that considers the public benefits and costs of Commonwealth action against the "opportunity costs" (loss of potential benefits) and actual costs of not acting. In this spirit, it is useful to begin an examination of freight challenges in the Commonwealth with a brief discussion of the benefits, costs, and performance measures associated with freight improvements.

6.2.2 Types of Freight Benefits

The nature of costs and benefits generated from freight-oriented transportation investments differs from those of more traditional transportation improvements (such as highway, transit, or airport/airway projects) that primarily serve passengers and only secondarily serve freight.

The main difference is that the benefits of freight-oriented projects apply in two ways: first, as **direct transportation and economic benefits** to a chain of private-sector manufacturing, logistics, and distribution processes; and then, as **secondary benefits** to producers and consumers who may realize economic benefits, to transportation system users who may realize improved network performance, and to the public at large who may realize improved environmental quality, safety, security, and other related benefits.

The major types of direct transportation and economic benefits are:

- **Faster average travel time,** due either to facility design enhancement, capacity expansion and/or reduction in congestion;
- **Lower travel cost,** due to improved productivity of the transportation system, from improved cycling of vehicles or railcars, or the ability to handle larger loads (including double-stacked containers, larger vessels or heavier vehicles);
- **Higher reliability** in delivery times, due to reduction in the frequency or severity of traffic incidents or to reduction in unpredictable congestion;
- **Improved capacity** in terms of capability to serve growth in freight demand without degraded performance; and
- **Improved safety, security, and/or environmental effects** due to design improvements, reduction in congestion, upgraded technology, removal of operational impediments, improved enforcement of applicable regulations, improved information about the nature and security of shipments, etc.

It is vital to recognize, and account for, the fact that different users of the freight transportation system value these factors differently:

- A shipper of diamonds, for example, will probably care most about reliability, safety and security, and less about cost; a shipper of perishable goods such as orchids will probably care most about travel time; a shipper of lower value bulk goods such as coal will probably care most about unit cost, and less about time or reliability.

- Repeatedly, major international importers cite reliability as their most critical transportation factor – they run just-in-time systems with minimum inventory, and careful control of their entire end-to-end logistics process is vital.

- Virginia's freight stakeholders most often cited highway congestion as Virginia's top freight issue, because so many of them depend on trucking, whether alone or in combination with rail, water, and air – and because congestion means higher costs, less reliability, and more difficulty in operating their businesses. According to Federal Highway Administration (FHWA) studies, congestion adds $7 billion per year to shipper inventory costs nationally. Cowan Systems, a trucking firm based in Maryland, reports that the "unpredictability of pickup or delivery can increase load cost by 50 percent to 250 percent." UPS reports that in Maryland, their average truck delivery is delayed 36 minutes versus free flow, costing $1.1 million annually (no comparable estimate is available for Virginia).

- Communities that host freight operations are usually most sensitive to the environmental effects of those operations, even if they are supportive of the economic benefits that the operations generate.

6.2.3 Types of Freight Improvements

Regardless of which factors are most important to different stakeholders, most of the key benefits can be expressed quantitatively – as the value of jobs supported and created, the tax revenues to state and local governments, the value of avoided congestion and accidents and pollution, etc.

Some representative types of freight improvement projects and examples of some associated transportation benefits and performance metrics are listed in Table 6.1.

The transportation benefits listed in Table 6.1 have related economic benefits, which are typically measured as: shipper/receiver cost savings; carrier cost savings; reduced transportation system capital and operating costs; nonfreight transportation system user cost savings (from reduced congestion); reduced producer and consumer costs; lower highway construction and maintenance costs; and jobs, business output, personal income, and tax receipts created. They also have related environmental benefits, which are typically measured as reductions in emissions, noise and vibration, accidents, and other incidents.

Table 6.1 Typical Freight Projects, Benefits, and Performance Metrics

Project Type	Mode	Transportation Benefits	Metrics
Add general purpose lanes	Highway	Congestion – travel time savings	Travel time
		Reliability – reduced incident impact	Nonrecurrent delay
		Potential accident reduction	Accidents
Add truck-only lanes	Highway	Congestion – travel time savings	Travel time
		Reliability – reduced incident impact	Nonrecurrent delay
		Potential accident reduction	Accidents
Add track/new link	Rail/Hwy	Congestion – time savings/car cycling	Travel time, cycle time
		Potential reliability – queue impact	On-time performance
		Diversion to rail reduces hwy congestion and impacts	Volume, travel time
Upgrade track (speed, weight, clearance)	Rail	Improved travel time, railcar cycle time	New weight/speed
		Potential reliability	On time performance
		Potential safety	Accidents
Upgrade/eliminate grade crossing	Rail/Hwy	Potential speed/travel time savings	Average speed
		Accident reduction – reliability Savings	Accidents
Channel/berth deepening	Water	Increased vessel drafts reduces costs	Cost per unit
		Potential safety/incident and reliability	Accidents
Tunnel upgrades	Rail	Double-stack potential – car cycle time	Direct cost
Correct design deficiencies	All	Local congestion/travel time	Average speed
		Reliability – reduced incident impact	Incident delay
		Accident reduction – reliability savings	Accidents
Channel deepening	Water	Increased vessel drafts reduces costs	Cost per unit
Air Draft improved	Water	Increased vessel drafts reduces costs	Cost per unit
Added lift capacity	All	Increased throughput – delivery speed	Throughput per acre
Terminal capacity	All	Increased throughput – delivery speed	Throughput per acre
Gate capacity	All	Increased throughput – delivery speed	Throughput per acre
Roadway geometrics	Highway	Local congestion	Average speed
		Reliability – reduced incident impact	Incident delay
		Accident reduction – reliability savings	Accidents
Track alignments	Rail	Local congestion	Average speed
		Reliability – reduced incident impact	On time performance
		Accident reduction – reliability Savings	Accidents

Table 6.1 Typical Freight Projects, Benefits, and Performance Metrics (continued)

Project Type	Mode	Transportation Benefits	Metrics
Signalization, electronic control	Highway	Local congestion – travel time	Travel time, network model
	Rail	Local delay – travel time	Travel time delay
Intelligent Transportation Systems	All	Congestion benefits – time savings	Travel time, network model
		Reliability, incident management	Incident delay
Long Combination Vehicle (LCV) Upgrades	Highway	Productivity – cost savings	Unit costs
Extended hours of operation	All	Congestion benefits – time savings	Travel time
Intermodal connectors	All	Congestion benefits – time savings	Travel time
		reliability – not related to incidents	
Rail on/near dock	Rail/Water	No direct benefit, secondary only	Cost per unit
Gap closure	Rail/Hwy	Congestion benefits – time savings	Travel time
		Reliability – not related to incidents	
Short-haul rail	Rail	Potential speed or capacity improvements	Travel time
		Potential reliability	Throughput

6.2.4 Measuring Performance and Benefit in Virginia

Good performance measurement is essential for sound planning and investment in Virginia's freight infrastructure. There have been significant efforts to evaluate the performance, economic benefit, and potential return on investment from Virginia's different freight modes and potential projects; the available tools, while useful, are at different stages of development and involve different approaches. One of the recommendations of this study is that the Commonwealth build on these available tools to develop a set of next-generation tools that allow for the comprehensive, system-level multimodal evaluation of its freight performance, the true value of its freight assets, and the public return on investment from potential freight improvements.

Currently available tools and data are discussed briefly below.

Highways

One of the best-established performance measurement tools is the Federal Highway Administration's Highway Performance Monitoring System (HPMS), which feeds the Highway Economic Requirements System (HERS) model. A HERS analysis performed for this study found that in year 2005, trucks on Virginia's roads experienced an estimated 8.4 million hours of delay versus free flow conditions, with an equivalent cost (in travel time, congestion, accidents, emissions, etc.) of $278 million. The HERS model suggests that with average annual roadway maintenance and improvement expenditures of $2.7 billion per year – close to what Virginia currently spends – Virginia truck delay could increase to 14.0 million hours in year 2035, with an equivalent cost of $466 million, in current dollars. These are primarily direct costs, and exclude multiplier effects. One key benefit from highway investments benefiting freight would be reductions in congestion and related costs.

Benefit-cost ratios for specific highway improvements can vary considerably depending on the particulars, but the analytical tools to estimate such ratios are available. HERS includes a benefit-cost estimation routine that captures some of the more easy-to-get-at primary benefits. A few states (Montana and Indiana, for example) have developed tools to link estimates of primary highway improvement benefits with their secondary multiplier effects. Experience in other states suggests that benefit ratios in the ballpark of between 3:1 and 6:1 are typical for general highway projects recommended for advancement.

Rail

The Virginia Department of Rail and Public Transportation has developed a very detailed spreadsheet analysis tool to estimate the public benefit of rail projects in which the Commonwealth may invest or participate. Projects with positive benefit-cost may become high-ranking candidates for Commonwealth participation. Several other states (Florida and Louisiana, for example) have developed similar tools for evaluating the public return on investment (ROI) from rail freight investments. There is no national rail system tool comparable to HERS.

Ports

Project-level investment decisions and supporting revenue and benefit-cost analyses are undertaken by the Virginia Port Authority on an as-needed basis, in the course of their capital program development. In 2008, the College of William and Mary developed a comprehensive economic impact study of the benefit of port operations (see Figure 6.1 below).

Figure 6.1 Economic Impact of VPA Operations
2006

The total Virginia economic activity produced or facilitated by the FY 2006 VPA port operations was revenues of $41.1 billion, with Virginia employee compensation of $13.5 billion to 343,001 employees. This economic activity generated state and local income, sales, and real property taxes amounting to an estimated $1.2 billion, plus other government fees and taxes.

The U.S. Maritime Administration has developed a public-use model, known as PortKit, that allows ports and their host regions to develop order-of-magnitude estimates of economic impact and benefit. Almost every major U.S. port uses PortKit, university researchers, or consultants to develop facility-level benefit estimates. However, we are aware of only one state – Florida – that has developed a benefit-cost approach for specific seaport investment projects. This is largely a response to the unique conditions in Florida, where the state Department of Transportation provides some limited funding for on-port and offport improvements, but the funding must be equitably distributed among 14 independent deepwater ports.

Airports

The Virginia Department of Aviation performed a study of statewide economic impacts of airport operations in its 2004 Virginia Airport System Economic Impact Study. The published study reflects all types of operations, and supplemental analysis will be needed to isolate the freight contributions from the passenger contributions. The key finding is that "Virginia public use airports, including Dulles International and Ronald Reagan Washington National airports, contributed a total economic impact of more than $10.7 billion to the Virginia economy."

Airports, in developing their capital investment programs, typically go through a project-level analysis process similar to seaports. We are not aware of any state that has developed a statewide benefit-cost tool for evaluating potential airport improvements.

Multimodal

Multimodal performance measures for the Commonwealth's transportation system are presented in *Virginia's Transportation Performance Report 2006*. The report reflects Virginia's aggressive commitment to performance-based planning, and provides key measures in the areas of: transportation investment; safety and security; preservation and management; mobility, accessibility, and connectivity; economic vitality; land use and quality of life. One of the most innovative features of this effort is that there is no separate "freight" chapter – rather, freight issues are interwoven with passenger issues, reflecting the reality that their infrastructure and operations are interwoven. These metrics provide informative snapshots of system conditions, and suggest avenues where further work could develop expanded metrics.

6.3 Challenges and Opportunities by Mode

6.3.1 Highway and Trucking

National Bottleneck Assessments

A study of freight bottlenecks for the Federal Highway Administration[1] identified truck chokepoints on the U.S. interstate and arterial highway system related to interchanges, geometry, capacity, and signals. The methodology used the national HPMS and a simple arithmetic comparison of modeled demand versus estimated capacity. The results shed little light on capacity issues, but are useful in highlighting interchange and geometry issues:

- Virginia's arterial interchanges are generally considered to be performing well, but there are problem locations in Northern Virginia, Hampton Roads, and Richmond (see Table 6.2); and

- Virginia has a very high concentration of geometry-related issues. Two locations on I-81 account for almost half the annual hours of delay. Locations on connecting routes such as I-64 and U.S. 220 also high on the list, along with several Piedmont routes (see Table 6.3).

Table 6.2 FHWA Freight Bottlenecks
Intersections

Rank	Routes	Location	Annual Hours of Delay, All Trucks
1	I-66 @ I-495 (Capitol Beltway) Interchange	Northern Virginia	588,500
2	I-64 @ I-264 Interchange	Hampton Roads	563,700
3	Centreville Rd @ I-66	Northern Virginia	563,500
4	I-95 – Woodrow Wilson Bridge	Northern Virginia	364,100
5	I-64 @I-264 Interchange	Northern Virginia	274,700
6	I-64 @ I-95 Interchange	Richmond	254,000
7	I-664 @ U.S.-13 Interchange	Hampton Roads	196,900
8	I-264 @ Downtown Tunnel	Hampton Roads	152,100
9	I-195 @ SR-76 Interchange	Richmond	72,400
10	U.S.-1 @ Chippenham Pkwy	Richmond	69,700
11	I-66 @ U.S.-29 Interchange (E. Falls Church)	Northern Virginia	34,500
12	I-64 (Hampton Roads Tunnel)	Hampton Roads	22,200
	Total		**3,156,300**

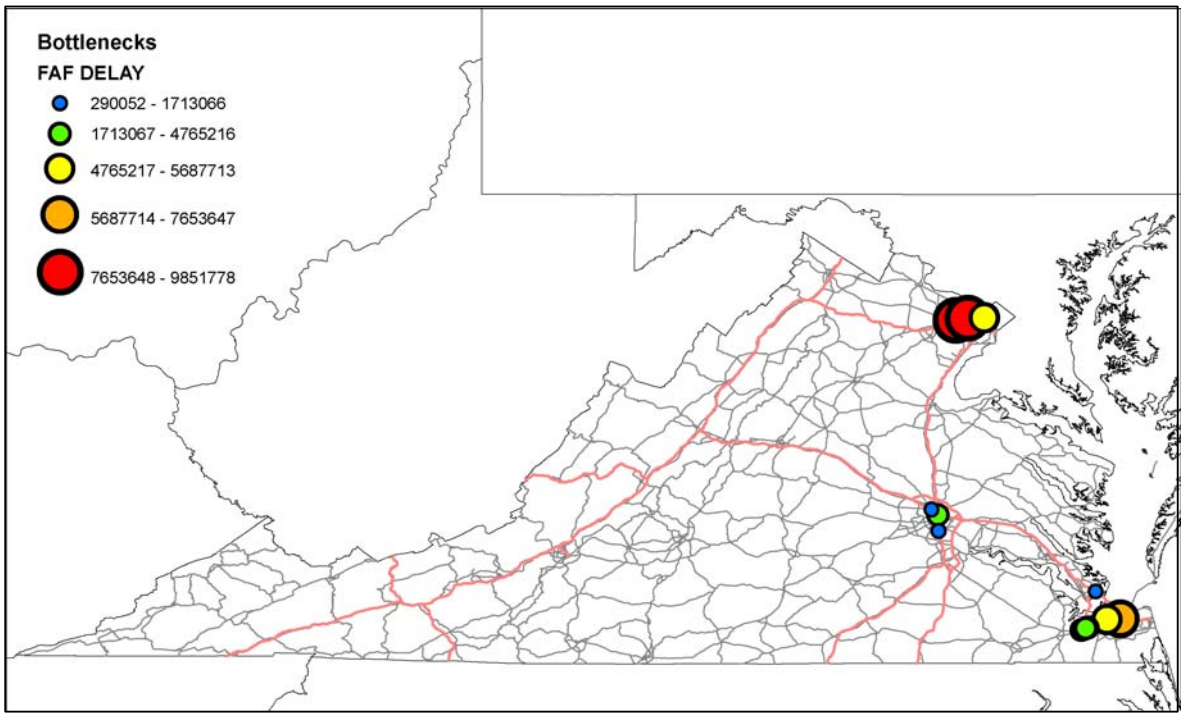
[1] *An Initial Assessment of Freight Bottlenecks on Highways*, October 2005. http://www.fhwa.dot.gov/policy/otps/bottlenecks/bottlenecks.pdf.

Table 6.3 FHWA Freight Bottlenecks
Geometry

Rank	Route	Location	Annual Truck Hours of Delay
1	I-81	Montgomery, VA	456,645
2	I-81	Smyth, VA	352,215
3	U.S. 220	Franklin, VA	104,076
4	I-64	Rockbridge, VA	102,800
5	I-64	Alleghany, VA	94,404
6	U.S. 220	Henry, VA	57,441
7	U.S. 58	Halifax, VA	49,200
8	U.S. 220	Henry, VA	43,555
9	U.S. 522	Frederick, VA	33,149
10	U.S. 29	Nelson, VA	29,315
11	U.S. 301	King George, VA	26,070
12	U.S. 29	Campbell, VA	25,006
13	SR 307	Nottoway, VA	20,100
14	U.S. 29	Greene, VA	19,798
15	U.S. 340	Page, VA	16,960
16	SR 7	Clarke, VA	16,469
17	U.S. 211	Fauquier, VA	14,865
18	SR 40	Pittsylvania, VA	14,159
19	U.S. 33	Greene, VA	12,576
20	U.S. 211	Shenandoah, VA	11,880
	All Other		**162,799**
	Total		**1,663,483**

Truck delay measures derived from the U.S. DOT's Freight Analysis Framework are shown in Figure 6.2 following. They show the highest truck delays in Northern Virginia, followed by Hampton Roads, and then by Richmond. Outside of these three areas, truck delays are not reported as significant. Again, this methodology clearly misses some "hot spots" that more detailed analysis will reveal, but the information is useful from a diagnostic standpoint.

Figure 6.2 FHWA Freight Analysis Framework (FAF) Truck Delay
Minutes per Year



Virginia Bottleneck Assessments

The Commonwealth has developed a high-level estimate of level of service over its *Statewide Planning System*. Level of service (LOS) "A" represents free flow conditions, while LOS "F" represents full utilization under highly congested conditions. LOS "C" is generally acceptable in nonurban areas, while LOS "D" is generally acceptable in urban areas.

As shown in Figure 6.3 following, the lowest levels of service are seen in Northern Virginia, Richmond, Hampton Roads, and on the larger I-95, I-81, and I-77 corridors. Except for I-81 and I-77, this information is consistent with the bottleneck locations highlighted in the FHWA FAF Truck Delay data, as well as the highest AADT volume segments as discussed in Section 4.0 of this report.

More detailed analysis of the I-81 corridor was performed as part of a recent Corridor Improvement Study, and that analysis (see Figure 6.4 following) found significantly better current levels of service on I-81. (For future year conditions, however, the Statewide Mobility System estimates and the I-81 Corridor Improvement Study agree that much of I-81 sees significant declines in levels of service, or "goes to red" – see discussion following.) The Corridor Improvement Study also identified geometry deficiencies on I-81 (steep grades, etc.), consistent with the FHWA Bottlenecks analysis.

Figure 6.3 Estimated Level of Service on the Statewide Mobility System
2005

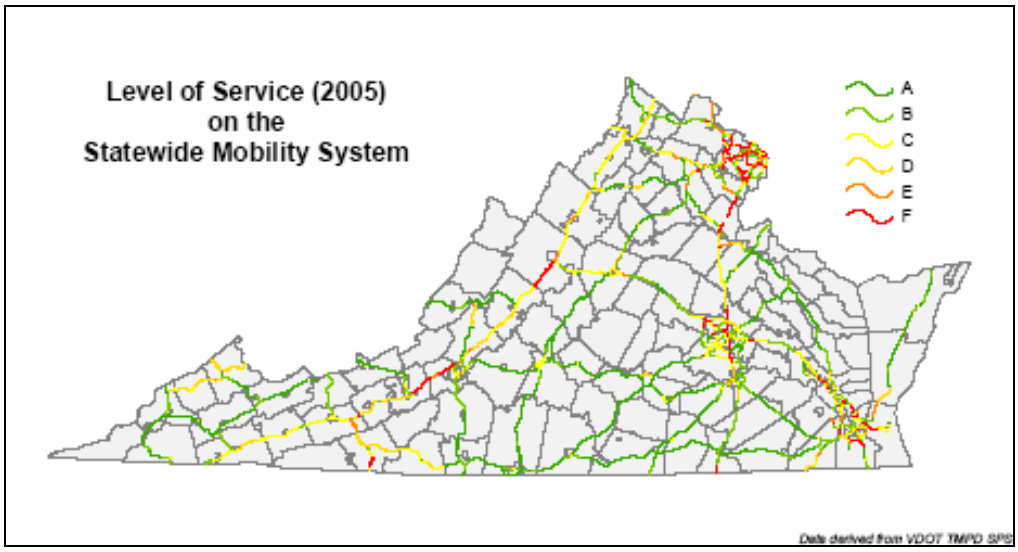
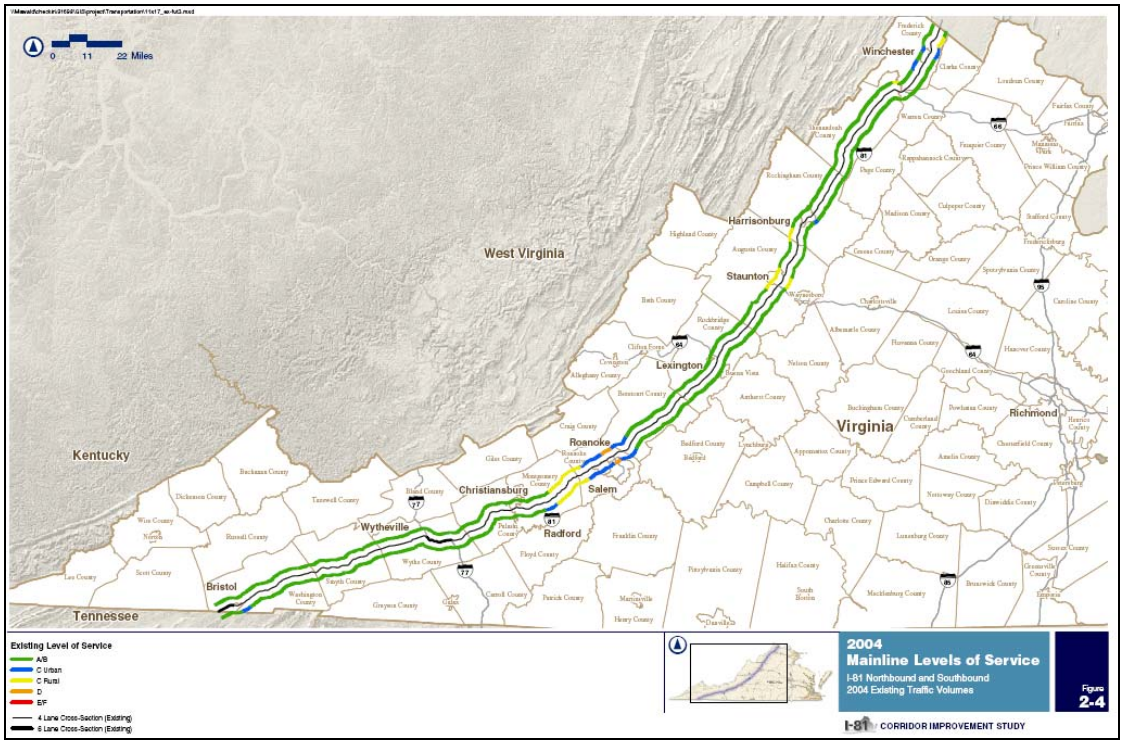
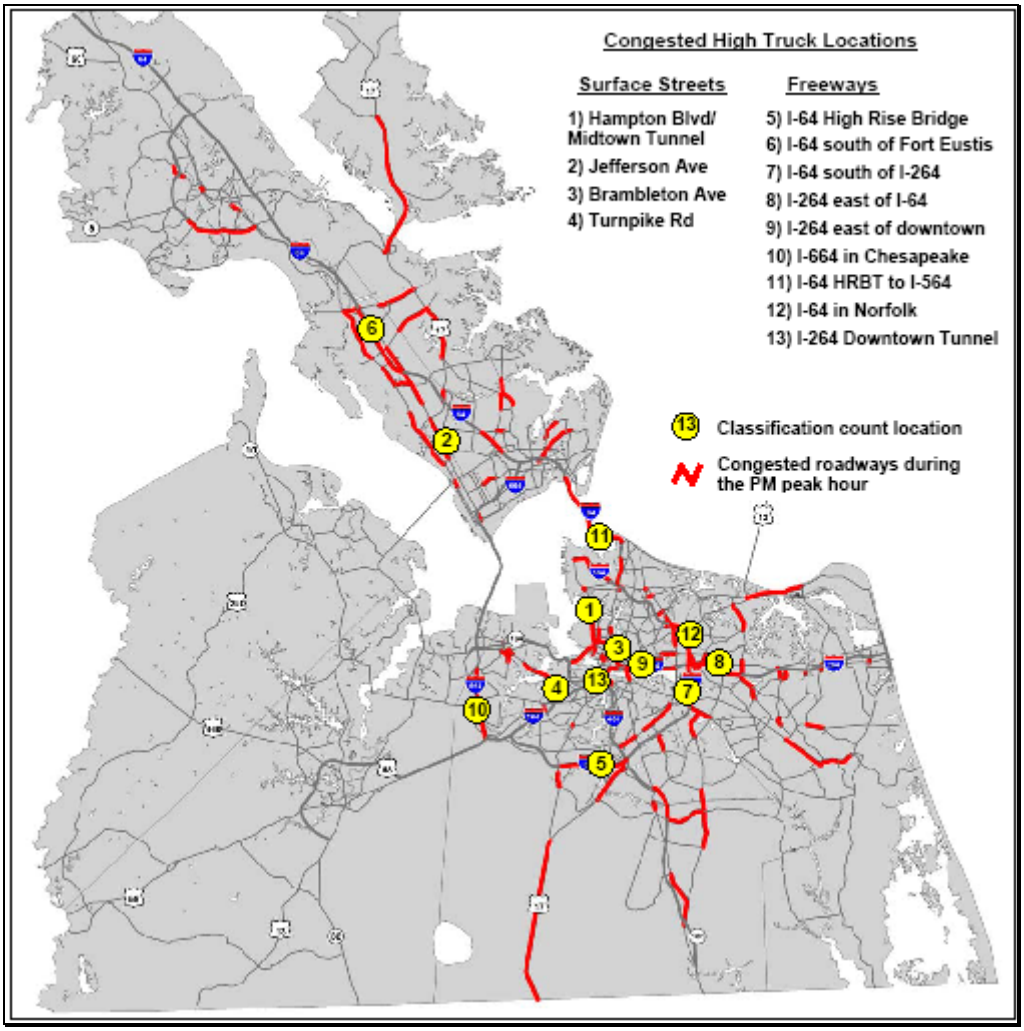


Figure 6.4 Current I-81 Level of Service Estimate
From the I-81 Corridor Improvement Study



Additionally, the Hampton Roads Planning District Commission performed an assessment of high truck/high congestion roadway segments, as shown in Figure 6.5 following.

Figure 6.5 Congested Truck Segments, Hampton Roads Area



Synthesis of Truck Bottlenecks

A review of the information described above makes it clear that there are multiple ways of defining highway bottlenecks. Each approach reveals different information. Based on the information described above, data on the most heavily used truck segments (from Section 4.0), and interview findings (from Section 5.0), Table 6.4 shows a synthesis of the major highway segments that can be viewed as the Commonwealth's primary truck bottlenecks.

Table 6.4 Virginia's Major Truck Bottlenecks
A Synthesis View

Region	Location
Southwestern Virginia	• I-77, from near Galax to WV • I-81, from Radford and east
Southeastern Virginia	• I-64, Norfolk through Newport News • I-264/I-664, Norfolk through Newport News • U.S. 460/U.S. 58/ U.S. 13, from Port through Suffolk County
Western Virginia	• I-81, Radford to Harrisonburg • I-64 through Charlottesville • U.S. 29 through Charlottesville • U.S. 220, Roanoke to I-64
Central Virginia	• I-95, Emporia and south • I-95, Petersburg to Doswell • I-95 through Fredericksburg • U.S. 460 Corridor • U.S. 17 through Fredericksburg
Northern Virginia	• I-95, Fredericksburg to Washington DC • I-495 Capital Beltway • I-66, Washington DC to Manassas/Gainesville • I-66, Front Royal to I-81 • I-81, below I-66 through Winchester

These are, of course, not all of the segments or locations where there are current problems or potential future problems – but the list is as good a place as any for a statewide analysis to start. More detailed corridor-specific assessments – some underway, some planned – are appropriate to work through the unique issues of these and other important Commonwealth truck routes at a suitable level of detail. Also, the development of more robust statewide truck modeling tools will be invaluable in providing more consistent, quantifiable measures of highway performance, and in further refining the bottleneck list.

Impacts of Projected Growth in Trucking

Looking ahead to 2035, all signs point to these identified problems worsening significantly. As shown in Table 6.5 following, truck tonnage in Virginia, of all types – inbound, outbound, internal, and through – is projected to more than double.

Table 6.5 Virginia Truck Tonnage Estimates
2004 and 2035

Year	Inbound	Outbound	Internal	Through	Mode Total
Truck Tons, Year 2004	122,558,887	98,413,261	164,223,717	293,653,650	**678,849,515**
Truck Tons, Year 2035	271,476,007	214,012,575	376,348,397	599,494,760	**1,461,331,738**
Absolute Increase	148,917,120	115,599,314	212,124,680	305,841,110	**782,482,223**
Ratio of 2035 to 2004	2.2	2.2	2.3	2.0	**2.2**
Compound Annual Growth	2.6%	2.5%	2.7%	2.3%	**2.5%**

Source: TRANSEARCH database.

With this additional truck tonnage, and with continuing growth in Virginia's population and its automobile traffic, what might Virginia's highway system look like in the future? Virginia's Transportation Performance Report 2006 sees much of the system – including most of Virginia's major truck routes – "going to red."

Figures 6.6 and 6.7 following offer hypothetical "what if" network assignments of future truck traffic, assuming no changes in the system (in terms of available capacity) through the year 2035. It should be noted that these are "dumb" assignments, in the sense that the figures simply take current travel patterns and multiply by growth factors, without considering all the reasons why future flows might be different from current flows. Some of these reasons include:

- Levels of freight demand could be lower or higher, based on changes in transportation cost (related to fuel, labor, and equipment), domestic production and consumption (related to the overall health of the U.S. economy), and trade policy (favoring exports versus imports, free trade versus restricted trade);

- The use of trucking versus other modes could be higher or lower, depending on available options and the comparative levels of performance offered by other modes; and

- Trucking routes could be different, particularly as trucks reroute themselves (to the extent practical) to avoid growing congestion in urbanized areas, or as centers of production and warehouse/distribution activities change, or as traffic shifts among various national gateways outside of Virginia.

Substantial further work is necessary to develop "smart" assignments that reflect these factors. For now, Figures 6.6 and 6.7 are useful illustrations of one possible future.

Figure 6.6 Virginia Truck Tonnage (Inbound, Outbound, and Internal)
2035, 2004 Volumes Inset; Assumes No System or Route Changes from 2004

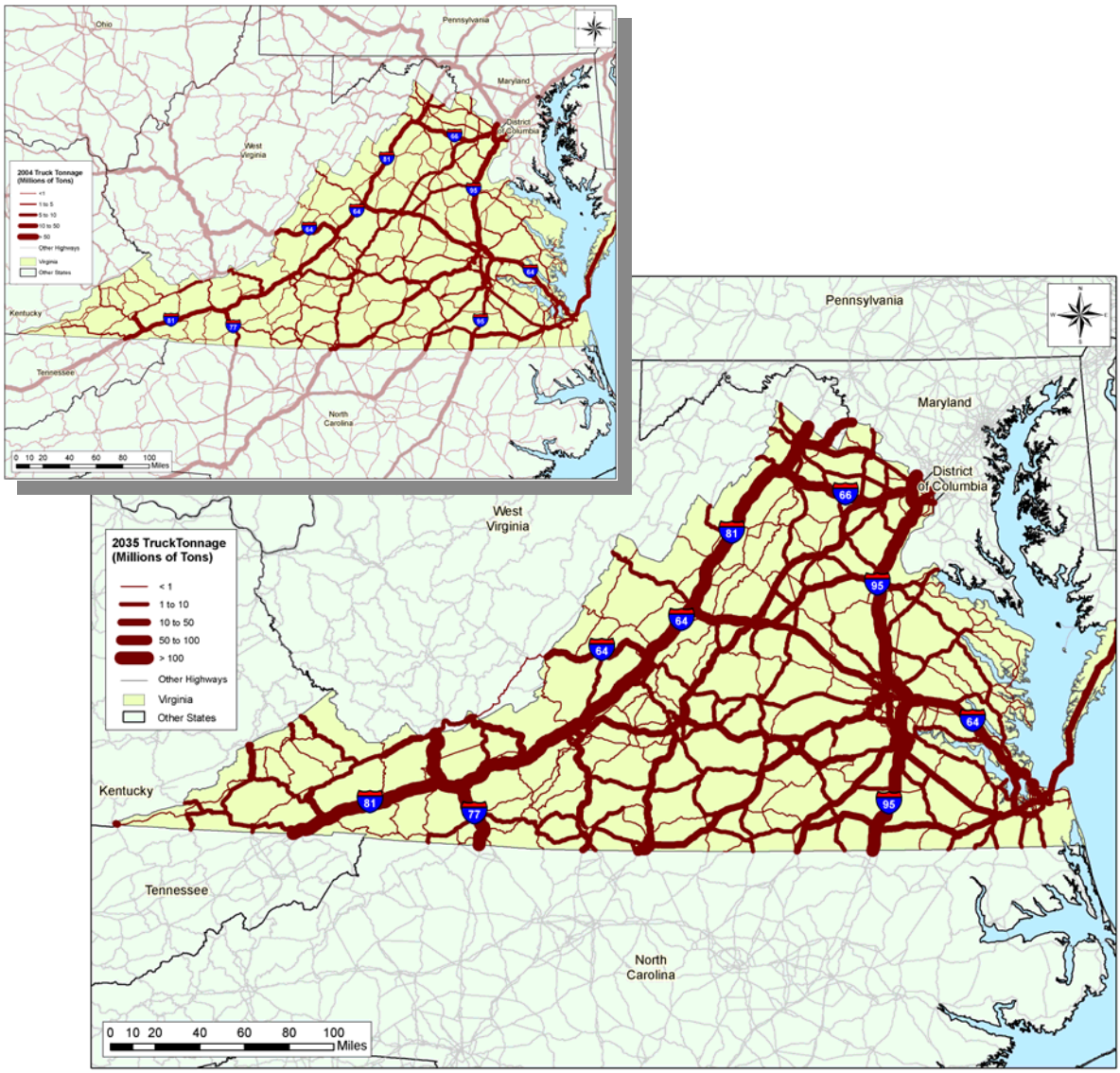
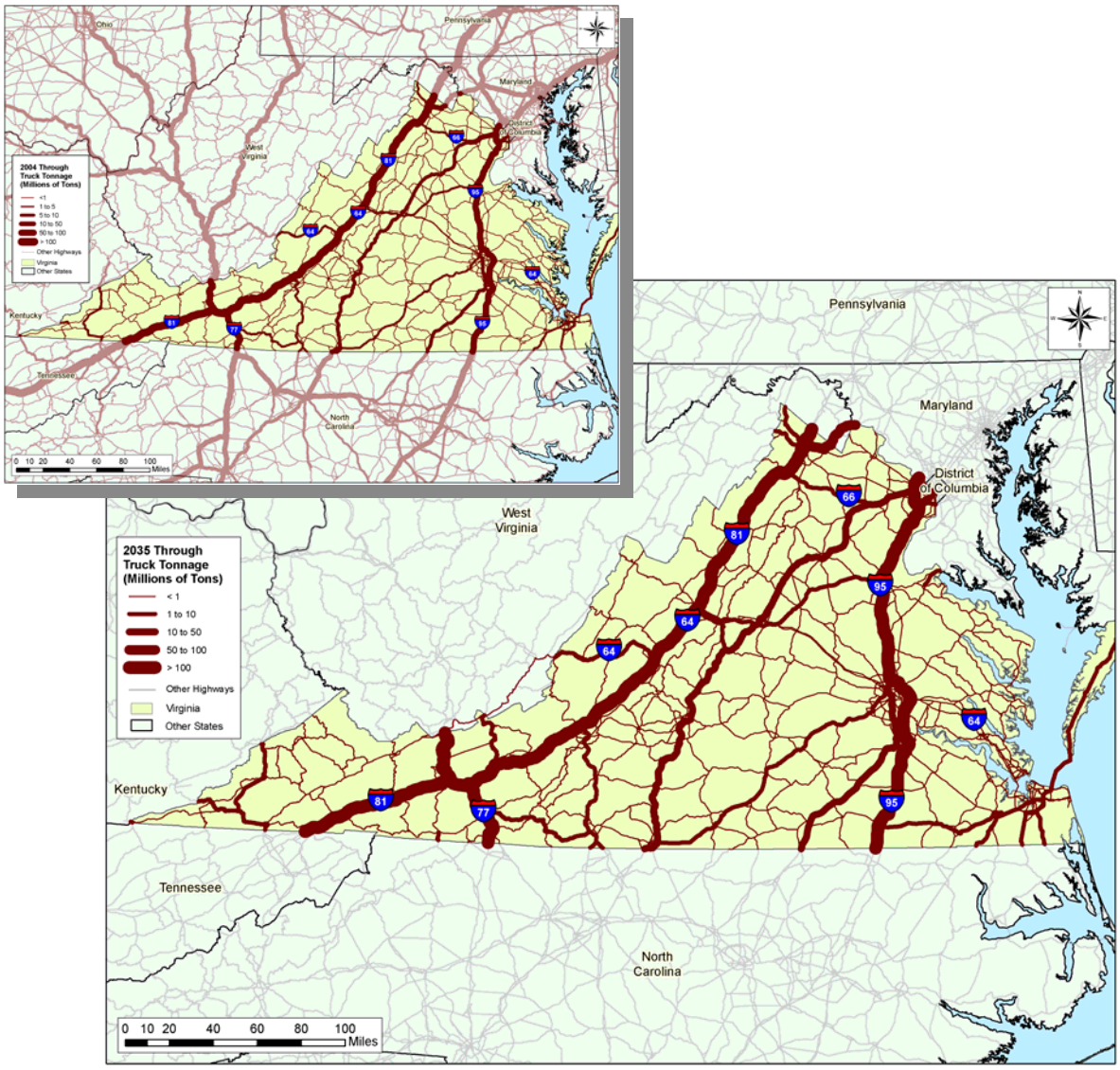
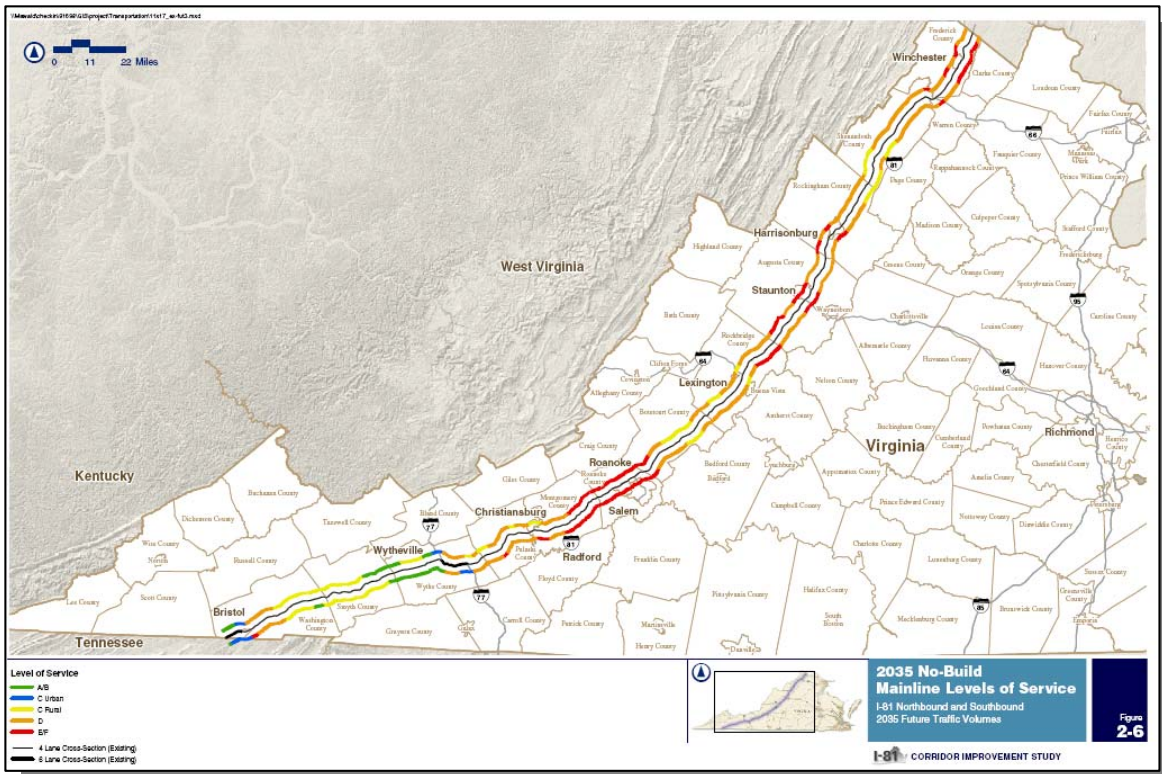


Figure 6.7 Virginia Through Truck Tonnage
2035, 2004 Volumes Inset; Assumes No System or Route Changes from 2004



The I-81 Corridor Improvement Study provides an example of the effect of growth in vehicle traffic and freight movements on level of service. As shown in Figure 6.8 below, under a "no build" scenario with continued truck growth but no infrastructure improvements, most of I-81 is anticipated to operate at poor levels by the year 2035.

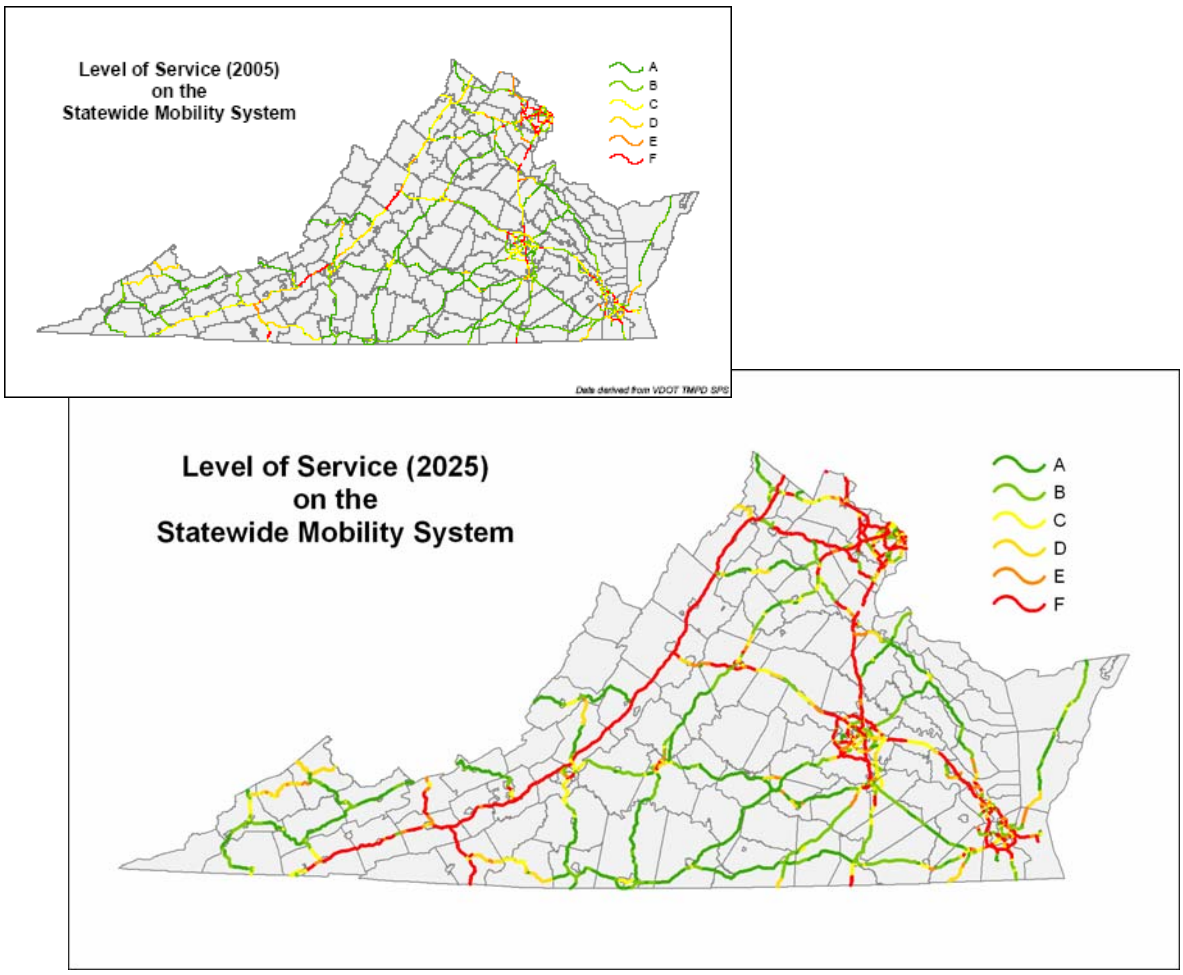
Figure 6.8 Future (2035) "No Build" I-81 Level of Service Estimate
From the I-81 Corridor Improvement Study



Level of service estimates for the Statewide Mobility System as a whole are similar. As shown in Figure 6.9 following, existing level of service deficiencies are projected to intensify substantially through the year 2025. Absent improvements, most of Virginia's major interstates are forecast to operate at poor to unacceptable levels of service – including I-95, I-81, I-64, I-264, I-66, I-295, I-395, I-495, and I-77. A number of other highways are also projected to be deficient, including sections of U.S. 15, U.S. 17, U.S. 29, and SR 7. We emphasize again that these estimates apply to "no build" conditions, and there are programs in place for improvements to many of these routes.

As previously discussed, trucks are the leading mover of Virginia's freight, and "glue" that holds Virginia's multimodal freight system together. Any growing deficiencies in Virginia's highway system will have increasingly negative effects on Virginia's businesses and consumers, as well as its ports and airports.

Figure 6.9 Estimated Level of Service on the Statewide Mobility System
2025, 2005 Level of Service Inset; Assumes "No Build" Conditions



Critical Issues, Current and Future

Today, critical issues for Virginia's highway system include the following:

- **Roadway and bridge/tunnel condition.** Maintaining Virginia's truck network in a state of good repair and providing adequate dimensional capacities on its bridges and tunnels is essential.

- **Safety and emergency response.** Ensuring that truck routes are designed and maintained to provide for safe and secure operation, and that trucks operate in conformance with applicable regulations, is equally essential. One emerging safety issue is the growing use of roadway shoulders for overnight truck parking.

- **System performance.** Trucking operations depend on highway capacity being available when needed. To the extent it is not available, their operations suffer, in the form of slower travel times, less reliable schedules, and higher costs. Within Virginia's urbanized regions – especially Northern Virginia, Hampton Roads, and Richmond – and on critical corridors, peak-period highway system performance is declining. Most of the decline is due to automobile traffic, which makes up the great majority of peak-period travel (even when adjusting for the extra highway capacity used by a truck as compared to an automobile). Trucks contribute to the congestion, but also suffer from it. Virginia must find ways to preserve and improve the performance of its highways, through the appropriate combination of additional capacity and better utilization of existing capacity to accommodate both passenger and freight movement.

- **Intermodal connectivity.** Trucking is the "glue" that holds Virginia's freight system together. While some shippers and receivers have direct service by rail, water, or air, the majority depend on trucks to move their goods – picking up and delivering to rail terminals, seaports, or airports, moving to and from warehouse and distribution centers, or delivering door-to-door. Any deficiencies in Virginia's trucking system will have a direct ripple effect on other transportation modes, and throughout its economy as a whole.

- **Environment.** With increased trucking and increased population, the potential negative effects of freight activities are magnified. Factors such as truck emissions, fuel consumption, noise, and land use conflicts must be considered in freight system planning and regulation.

- **Industry support and partnership.** The trucking industry faces issues of driver attraction and retention, and the Commonwealth could be a partner in providing education and training. Similarly, there may be opportunities for the Commonwealth to expand the types of system information it provides to truckers – and for truckers, in turn, to provide more information on travel patterns and other issues back to the Commonwealth.

- **Time shifting.** In the offpeak-periods, much of Virginia's highway system has excess capacity, apart from work zone related delays. Many long-haul truckers whose schedules allow them to travel through Virginia's congested urban areas at night will do so. Perhaps more truck travel could occur at night, and perhaps some shorter-haul activity could also occur at night. However, much of the short-haul activity will continue to occur in daylight hours for several reasons: that is when most businesses are open, businesses are located in neighborhoods where offpeak/overnight deliveries would be disruptive, people do not want to receive deliveries at their homes at 3:00 a.m., and truck driver availability. Strategies to encourage greater use of offpeak highway capacity are an important opportunity, but must address not only the truckers, but also consider businesses and neighborhoods.

- **Mode shifting.** The Commonwealth has been active in exploring the potential to shift long-haul truck traffic to rail, to the extent this may prove feasible. Several background studies addressing I-81 have been performed, and another addressing

truck-rail diversion is currently underway. The Commonwealth has also participated with its I-95 Corridor Coalition partners on the Mid-Atlantic Rail Operations Study, which considers diversion potential on both I-95 and I-81 routings. These opportunities hold promise, and determining the real benefits and associated costs is important to develop a basis for public investment decisions. Mode-shifting also applies to passengers – more transit use means fewer cars, which means more highway capacity is available for trucks.

- **Funding.** Given that Virginia's funding for needed transportation improvements is highly constrained, and given that the private sector is a direct financial beneficiary of freight improvements, it stands to reason that partnership opportunities – where a portion of the private sector benefit is captured to support needed improvements – should be carefully considered. There is also a need to demonstrate a public sector benefit associated with investments in private sector infrastructure. Ensuring that pass-through traffic (which impacts the Commonwealth in terms of wear and tear on roads, congestion, environmental impacts, etc.) contributes its fair share to Virginia is a concern.

By 2035, the critical issue is: given the significant issues we face today, and the projected growth in population and nonfreight travel, how will Virginia deal with a projected doubling of truck tonnage?

Highway Improvements Being Implemented or Planned

Much of Virginia's transportation planning energy and most of its funding is focused on highway issues and solutions. The point here is not that the Commonwealth should do more because of trucks. Rather, it is that the future of the Commonwealth's truck freight system depends on solving these identified needs, which perhaps adds another layer of urgency to what are already recognized as significant and pressing problems.

I-81 Near-Term Safety Improvements and Corridor Improvement Study

I-81 is one of the State's primary truck corridors for both in-state and through-state traffic. On June 6, 2007 the Federal Highway Administration issued a Tier 1 Record of Decision (ROD) for the I-81 Corridor Improvement Study. The Tier 1 Environmental Impact Statement (EIS) identified a wide range of potential approaches and strategies to address freight and passenger needs in the corridor. The following are included in the decisions made by FHWA in the ROD:

- Advance into Tier 2 the concept of a nonseparated variable lane highway facility that involves constructing no more that two general purpose lanes in each direction, where needed, to address 2035 traffic demands. Along with this concept there is an immediate need for smaller, independent safety and operational improvements that include the construction of truck climbing lanes, the extension of entrance and exit ramps at various interchanges, and the installation and upgrading of guardrail.

- Advance I-81 as a toll pilot facility under Section 1216(b) of the Transportation Equity Act of the 21st Century (TEA-21). This action allows tolling to continue to be pursued as a possible funding mechanism for improvements to I-81. A toll option can be considered for a particular Section of Independent Utility (SIU), but tolls cannot be implemented until completion of the Tier 2 NEPA process for a particular SIU.

- Identified eight sections of independent utility (SIU) for the Tier 2 analysis. The short-term safety and operational improvements are independent of the SIUs and include truck climbing lanes.

- Conduct Environmental Assessments (EA) for Tier 2 and initiate an EIS if significant impacts are identified at any point in the process during study of an SIU.

- The location of the corridor for most of the Tier 2 studies will be the existing I-81 highway corridor. There are two locations, however, along I-81 where the potential impacts for the concept being advanced may rise to the level where a corridor on new location may be prudent. These locations are identified in the ROD.

Following completion of the Tier 1 EIS and prior to the issuance of the ROD by FHWA, the Commonwealth Transportation Board (CTB) adopted a resolution on October 11, 2006 that outlined a strategy for the I-81 corridor that included the following actions:

- Directed the Department of Rail and Public Transportation to conduct an I-81 Freight Rail Study to expedite short term rail improvements and study the potential long term diversion of truck traffic along the I-81 corridor to rail.

- Directed the Department of Transportation to take immediate action to implement safety and operational improvements within the corridor to include, but not limited to, truck climbing lanes, the extension of on and off ramps at various interchanges, the installation and upgrading of guardrails, the modification of major interchanges, and other safety and operational improvements within the I- 81 Corridor.

- Finalize the Tier 1 EIS to improve existing I-81 by constructing not more than two general purpose lanes in each direction, only where needed to address 2035 travel demands; that for the Tier 2 environmental review process, projections of future travel demand be based on then current assumptions of rail diversion and other factors in the corridor taking into account the I-81 Freight Rail Study; that the Department of Transportation shall pursue the ongoing toll pilot project pursuant to Federal law other than for dedicated truck lanes; and that the Tier 2 environmental review process for the corridor improvements may be implemented using the eight logical corridor segments identified in the Tier 1 EIS.

- Future improvements to the I-81 corridor are in compliance with a context sensitive solutions approach and the CTB's policies pertaining to multimodal transportation and land use planning.

Work is underway on the I-81 Freight Rail Study as a part of the Statewide Multimodal Freight Study and will be discussed in a separate document. The Department of

Transportation is no longer pursuing the concept to provide of truck only toll lanes along I-81 as proposed by the private sector.

I-95/I-395/Capitol Beltway Improvements

Along with I-81, I-95 is Virginia's most significant and problematic truck corridor. Although handling less truck tonnage than I-81, it actually handles more truck movements than I-81, and does so while serving the nonfreight transportation needs of major urbanized regions and national pass-through traffic. In Northern Virginia, the I-95 corridor feeds into I-395 and the western side of I-495 (the Capitol Beltway), and we consider these functional extensions of the I-95 Corridor.

Two major recent and current construction projects – the Wilson Bridge replacement and reconstruction of the "Mixing Bowl" (I-95/I-395/I-495 interchange) – should reduce or eliminate major bottlenecks at these two points, substantially benefiting both passenger and freight movement both locally and at the systemwide level.

Beyond these projects, various studies of these routes have been performed:

- The I-95 Corridor Study was a planning-level study to address operational and safety concerns, as well as future capacity requirements, for the I-95 mainline and the three existing interchanges. The study area included 13.5 miles of I-95 in Hanover County and Ashland, Virginia, including interchanges with Route 802, Route 54, and Route 30. The study developed a number of Preferred Concepts, analyzed current and future year traffic volumes, investigated operational and geometric deficiencies, and developed interim- and long-term solutions for meeting travel demands up to 2025. The overall recommendation of this study is for the stakeholders of the I-95 corridor in the study area to consider the Preferred Concepts outlined in the Final Report as well as the interim- and long-term solutions outlined.

- The I-95 Collector-Distributor Access Feasibility Study examined the feasibility of providing collector-distributor (C-D) lanes and additional access to I-95 in the greater Fredericksburg area. The study area extends from the proposed interchange at Route 627 in Stafford County to Route 606 in Spotsylvania County. The study evaluated the impacts and benefits to regional traffic of additional access, and provided an overview of the environmental impacts associated with C-D lanes and additional access. The study identified improvements to existing interchanges as well as viable locations for new interchanges. Three options were advanced for further study.

- The I-95 Extension of HOV Lanes Study was designed to determine if an extension of the existing high occupancy vehicle (HOV) lanes would be an effective strategy to accommodate future peak commuter demands in the I-95 corridor from the Prince William County line south to the vicinity of Route 3 in the City of Fredericksburg. Two build alternatives were examined, but the study determined that the potential role of an HOV facility will need to be examined further in the context of regional roadway and transit system improvements, such as new interchanges and/or C-D

facilities along I-95 and/or improvements and extensions to rail and bus transit services.

- The Capital Beltway Study was begun by VDOT in 1995 to gain a more comprehensive understanding of the current problems and future transportation needs along the Beltway in Virginia. The project area consists of I-495 in Fairfax County, between the I-95/I-395/I-495 interchange and the American Legion Bridge (total length – 14 miles). A 12-lane High-Occupancy Toll (HOT) concept was put forward as the preferred alternative. On June 29, 2006, the Federal Highway Administration issued a Record of Decision (ROD) for the Capital Beltway Study that approved the preferred alternative. The ROD represents the final document in the NEPA process for this study.

- The I-95/I-395 HOV Restriction Study examined the feasibility and impacts of making changes in HOV operations on I-95/I-395 between the 14th Street Bridge and the Prince William County/Stafford County line. The study addressed increasing traffic congestion in a corridor that serves over 200,000 vehicles per day. Among the options being considered is the possibility of changing the HOV requirements from three- to two-person carpools, either on the entire system, or just outside the Beltway. It also considered changes in HOV restricted time periods, provision of a third HOV lane on I-395, and the addition of new HOV ramps. The study determined that any change to HOV operations would bring both positive and negative impacts. In addition, the study identified some relatively minor changes that could be made to improve the efficiency of the HOV system, as well as several potential areas for future study.

What these studies suggest is that while there has been significant attention to I-95 corridor planning, work has largely focused on meeting passenger needs at a subregional level. Passenger improvements will, of course, benefit trucks by reducing background traffic. However, the body of work does not provide any guidance with respect to a truck-oriented, corridor-level strategy. Therefore it is recommended to proceed with a limited, corridor-focused truck-oriented strategy examination – building on these existing and ongoing platform studies – as part of Phase II of the Virginia Statewide Multimodal Freight Study.

I-66 Initiatives

I-66 ranks among Virginia's leaders in adjusted AADT per lane. This is primarily due to the high volumes of auto traffic it accommodates. However, I-66 is an important freight link between Northern Virginia, the I-81 corridor, and points west. There are two studies of interest:

- **The I-66 Study.** The Virginia Department of Transportation (VDOT), and the Department of Rail and Public Transportation (DRPT) have initiated the I-66 Multimodal Transportation and Environmental Study (I-66 Study) for improving mobility along the I-66 corridor from just west of the I-66/I-495 (Capital Beltway) interchange in Fairfax County to the I-66/U.S. 15 interchange near Haymarket in Prince William County. Multimodal transportation improvements in the I-66 corridor were selected in an earlier Major Investment (planning) Study (MIS) to enhance safety and to provide increased capacity for current and projected future travel demands.

- **Idea 66.** This study comprises I-66 westbound between the Rosslyn Tunnel and the Dulles Airport Access Highway. This section of I-66 excludes trucks but, to the extent that passenger improvements are made in the corridor, it can potentially help relieve congestion on other parallel routes used by trucks. This study was undertaken in response to Congressional and state concerns over growing congestion in the I-66 corridor and the impact of such congestion on the corridor's ability to serve as an evacuation route in response to a natural disaster or terrorist incident. The study recommended that the Roadway Widening concept with various managed lane types and advanced system management techniques be advanced for further detailed evaluation as part of a Location Study in accordance with VDOT guidelines and the National Environmental Policy Act (NEPA). On January 12, 2006, the Northern Virginia Transportation Authority recommended moving forward with the proposed spot improvements proposed by the Idea-66 Feasibility Study. On Wednesday, January 18, 2006 the Transportation Planning Board approved the $9.6M funding for the spot improvements.

As with I-95, freight will be a beneficiary of these efforts, but planning for I-66 has not explicitly focused on truck movements at the corridor level. The study recommendation is to proceed with a limited, corridor-focused truck-oriented strategy examination as part of Phase II of the Virginia Statewide Multimodal Freight Study.

Route 460 Location Study

Route 460 is an important freight route, particularly for access to the marine terminals at Hampton Roads. VDOT, in cooperation with the Federal Highway Administration (FHWA), is conducting a three-year study to consider future improvements to Route 460 between Interstate 295 in Prince George County and the Suffolk Bypass (U.S. 58) in Suffolk. The Commonwealth Transportation Board (CTB) passed a unanimous resolution in November 2005 recommending Candidate Build Alternative 1 for construction. The CTB also resolved that that the Commonwealth, along with other stakeholders, continue to study and seek solutions to maximize the use of rail freight in the corridor. In January 2007, the CTB approved a recommendation to slightly modify the location of the candidate corridor to minimize environmental impacts. A Final Environmental Impact Statement (FEIS) is being prepared to document impacts and benefits of the preferred alignment, and to respond to comments on the FEIS and discuss measures to mitigate impacts. The Federal Highway Administration (FHWA) will then sign the FEIS and issue a Record of Decision.

I-64 Improvements

VDOT has included projects in the Six-Year Improvement Program to provide capacity and safety improvements to I-64 from Airport Drive in Henrico County to Jefferson Avenue/Route 143 in Newport News. These projects will be done in phases and will provide a positive impact on freight movements in the corridor. As with I-81 and I-95, the study recommendation is to supplement these ongoing efforts with a limited, corridor-focused truck-oriented strategy examination as part of Phase II of the Virginia Statewide Multimodal Freight Study.

I-564 Connector

I-564 provides interstate access close to but not directly to Norfolk International Terminal (NIT), the largest terminal for the Virginia Port Authority. Completion of this connector would allow arriving and departing over the road trucks to avoid busy and congested secondary roads to handle a large portion of the international cargo that goes through the Port of Virginia. The study recommends pursuing this connector.

Route 29 Corridor Study Phases II and III

Based on current traffic counts, U.S. 29 is not a major freight corridor. However, TRANSEARCH model estimates suggest it may become an important freight route in the future. Continued urbanization between Northern Virginia, Charlottesville, and points south will increase the need for freight services in this corridor.

Phases II and III of the statewide U.S. 29 Development Study covers the area from the North Carolina border to I-64 just south of Charlottesville. Phase I was completed in fall 1997 and covered the area between Charlottesville and Warrenton. Further action to implement the recommendations will be subject to funding and programming specific projects through the normal allocation process under VDOT's Six-Year Improvement Program, detailed environmental studies under the National Environmental Policy Act, and detailed engineering and design studies.

Hampton Roads Third Crossing Concept

This project concept is to construct a third harbor tunnel in Hampton Roads. The proposed alignment would not only provide needed general-purpose travel capacity, but also substantially benefit freight movement to and from the marine terminals in the region. This is a major investment, with costs on the order of several billion dollars, and consensus has not been reached on whether or how it should advance. According to VDOT's web site:

> *"The project was initiated to relieve congestion at the I-64 Hampton Roads Bridge Tunnel and other transportation facilities in the Hampton Roads region. A multimodal solution was developed and unanimously endorsed by the members of the Metropolitan Planning Organization (MPO). This solution, known as Candidate Build Alternative 9, was then selected by the Commonwealth Transportation Board (CTB) to be further developed. The alternative is divided into five segments, each aiding in the reduction of regional traffic congestion. The project is envisioned to carry vehicles, light and heavy passenger rail across Hampton Roads, thereby relieving congestion while improving accessibility, mobility and the movement of goods in the region. Another important benefit is that by carrying rail across Hampton Roads, Southside Virginia is directly connected to the High-Speed Rail Corridor via Newport News to Richmond and to Washington, D.C."*
>
> *"This project is nationally and regionally significant for several reasons, including national defense, regional evacuation, economics and air quality and conformity. Segment one of the project would provide much improved access to Norfolk Naval Base by constructing a new limited access facility. This new facility also provides an additional*

diversion point for traffic during emergency evacuation or major congestion. The project promotes economic development by allowing direct access to the ports of Hampton Roads, thereby removing heavy trucks from local streets. Currently, the ports are second only to New York for volume on the East Coast … Congestion and air quality will continue to get worse without congestion relief provided by this project. VDOT issued a Request for Detailed Proposals (RFDP) on August 29, 2005. The private-sector proposers requested VDOT to extend the mid-December deadline for submitting detailed proposals for up to two more years. VDOT decided to cancel this effort instead."

A project of this magnitude and cost requires extensive technical planning and engineering work, along with identification of funding opportunities, and studies should continue.

Suggestions from the Virginia Freight Advisory Committees and Stakeholders

Aside from infrastructure issues, a variety of truck operational issues have been identified, through the work of the Virginia Freight Advisory Committee (VFAC) and stakeholder interviews. These include:

- **Truck driver retention**. The trucking industry nationwide is having tremendous difficulty retaining current drivers and bringing new drivers into the workforce for sustained periods. Increased security requirements for truck drivers – including fuller background checks for hazmat drivers as well as transportation worker identification credential (TWIC) requirements for port truckers are likely to further worsen the driver retention problem. The VFAC is exploring ways in which the Commonwealth can assist the trucking industry in addressing this serious problem. This was the second most frequently cited problem by freight stakeholders interviewed.

- **Truck rest areas**. Like most states, Virginia is experiencing a significant increase in truck parking outside of designated rest areas and truck stops. This is due to a combination of hours of service limitations (when the clock runs out, the driver stops), and the desire for long-haul trucks to time their trips so they avoid peak congestion in urban areas. Parked trucks can be a safety hazard, and finding a better way to manage this activity – through expanded public and/or private facilities, plus improved information about space availability delivered to the drivers – is a critical need.

- **Use of technology**. In Canada, truck-mounted GPS transponders are used to collect and monitor truck movements and system performance. In the U.S., the FHWA has undertaken a limited pilot program of data collection, but detailed data has not been released and there are, as far as is known, no plans for a comprehensive data collection and release program. The trucking community has voiced significant concerns about privacy, in terms of how automated data would be collected, used, and distributed. The fact that reliable, detailed truck movement data is not available at a system level is a critical shortcoming. In the meantime, planners attempt to fill the gap with region-to-region estimates and model-assigned flows (as in this Report), along with local count programs, necessarily limited in scope due to budget and logistical constraints. The most pressing need is for reliable origin-destination information on a route-by-

route basis. The technology exists to collect this information, but there has been significant resistance at the national level from the trucking industry.

Interviewees for this study also identified hours of service rules (which are Federally mandated), high fuel costs, permitting and regulations, size/weight restrictions on roads and bridges, and road construction and work zone delays as significant operational issues that the Commonwealth might look to address.

Innovative Truck Strategies

There are various strategies emerging in the Commonwealth and throughout the country that can be further explored or advanced by the Commonwealth and its stakeholder partners.

- **Truck toll lanes**. As noted earlier, the Commonwealth reviewed private sector proposals to develop truck toll lanes on the I-81 corridor. Dedicated truck lanes could offer a higher degree of safety, security, and (probably) performance than general purpose lanes. Many states have explored truck only lane concepts, but to date, the only true truck-only road in the country is a short stretch of truck/rail right-of-way along the Mississippi River, at the Port of New Orleans. Part of the issue with truck toll lanes is that they depend on truck revenues, and if the trucker's cost exceeds the value he/she gains (in terms of speed, safety, reliability) it becomes a poor bargain for the trucker – and he/she is likely to find another route. The financial advantage of toll road improvements that combine truck and auto traffic is that there is a larger base of users to share the unit costs, making it a more affordable proposition for each user. This is still an emerging field but may offer future opportunities.

- **HOT (high-occupancy toll) lanes**. A number of HOT lane projects are in the planning stages, and these offer the promise of performance improvements for trucks, to the extent that they are successful in moving cars out of general purpose lanes, and out of the way of trucks. Even though trucks are secondary beneficiaries – and the benefit may vary from day to day – it is a useful and promising approach.

- **Time shifting and supporting strategies**. For trucks, more than any other highway system users, travel time is literally money. Long-haul truckers, who may have some flexibility in their scheduling, will usually try to time their trips to avoid peak-period congestion in urbanized areas, allowing them to use existing highway capacity most efficiently. However, many truckers – port draymen making multiple local deliveries per day, delivery trucks moving goods from warehouses to retailers, etc. – can only operate when the businesses at both ends of the trip are open. Some bulk industries and larger wholesalers are open for delivery 24 hours a day, but most are open only during regular business hours. But even these trucks usually try to avoid peak traffic if possible – for example, the standard truck volume pattern for U.S. ports looks like a two-hump camel, with a morning peak occurring after the a.m. commuter peak and an afternoon peak occurring before the p.m. commuter peak. Recognizing that deliveries to end-users that operate normal business hours can never be shifted, how can time shifting be encouraged for truck trips that may be flexible?

It may be that toll road facilities with differential pricing could discourage a small share of peak-period trucking, but pricing is far more likely to be effective in shifting auto trips, many of which are discretionary in nature. Offpeak incentive programs, such as Southern California's PierPass program, could be implemented. PierPass imposes a surcharge on peak hour port gate transactions and uses the proceeds to subsidize the additional labor costs of operating after normal hours. However, PierPass depends on conditions that are highly specialized to Los Angeles/Long Beach – a 14 million TEU base of traffic, major railyards and warehouse centers operating 24 hours a day, and two main interstates where the majority (or near-majority) of trips are directly port-related, and extreme and sustained daylight congestion. None of these conditions currently apply to port facilities, or to other freight generating industries in the Commonwealth. Still, the Commonwealth may wish to explore the feasibility, conditions, and required incentives for businesses and facilities to encourage offpeak utilization of the highway network.

Land-use based strategies could be explored. If truck facilities and truck using industries are densely clustered, in areas where offpeak activity does not conflict with other land uses, they could be magnets for after-hours truck service. These could even be developed as inland ports, logistics centers, etc. – and service between these inland ports and centers could be accommodated by contracted, managed, offpeak trucking. Inland ports and logistics centers could be located so that the truck move to and from a congested urban region takes place in the offpeak, and then the move to/from the end user takes place according to their particular needs.

- **Truck parking**. A coordinated Commonwealth-wide approach to truck parking could be explored, in partnership with the private sector. The goals should be to increase the supply of well-located spaces and services, increase the availability of information about these spaces and services to the trucker, and reduce the utilization of unsafe roadside parking that is seen today.

- **Truck information**. The Commonwealth could, if the trucking industry is supportive, explore the feasibility of a limited pilot program to evaluate the effectiveness of collecting Virginia truck movement data using GPS tracking systems. Ultimately, this would be an ideal basis for system performance reporting and monitoring.

- **Larger vehicles**. Recognizing that this issue is one of the most hotly debated issues in freight planning, it still has to be mentioned. Larger vehicles allow more freight to be moved with less labor, making the operation more efficient and reducing the total amount of space that trucks require on the highway. They may also have significant safety, operational, and pavement impacts that negate their advantages.

- **Modal diversion.** One of the biggest opportunities for the Commonwealth is rail corridor improvements that would allow the railroads to handle a significant share of long-haul pass-through traffic, taking some of the burden off congested highway corridors. Plans to upgrade rail in the I-81 corridor are being advanced in partnership with the Norfolk Southern railroad, while plans to upgrade rail in the I-95 corridor are being advanced through the multistate I-95 Corridor Coalition.

Also, a variety of passenger rail initiatives are underway that would help reduce the need for auto travel on the highways, potentially freeing highway capacity for trucks. These initiatives are addressed in more detail in the following section.

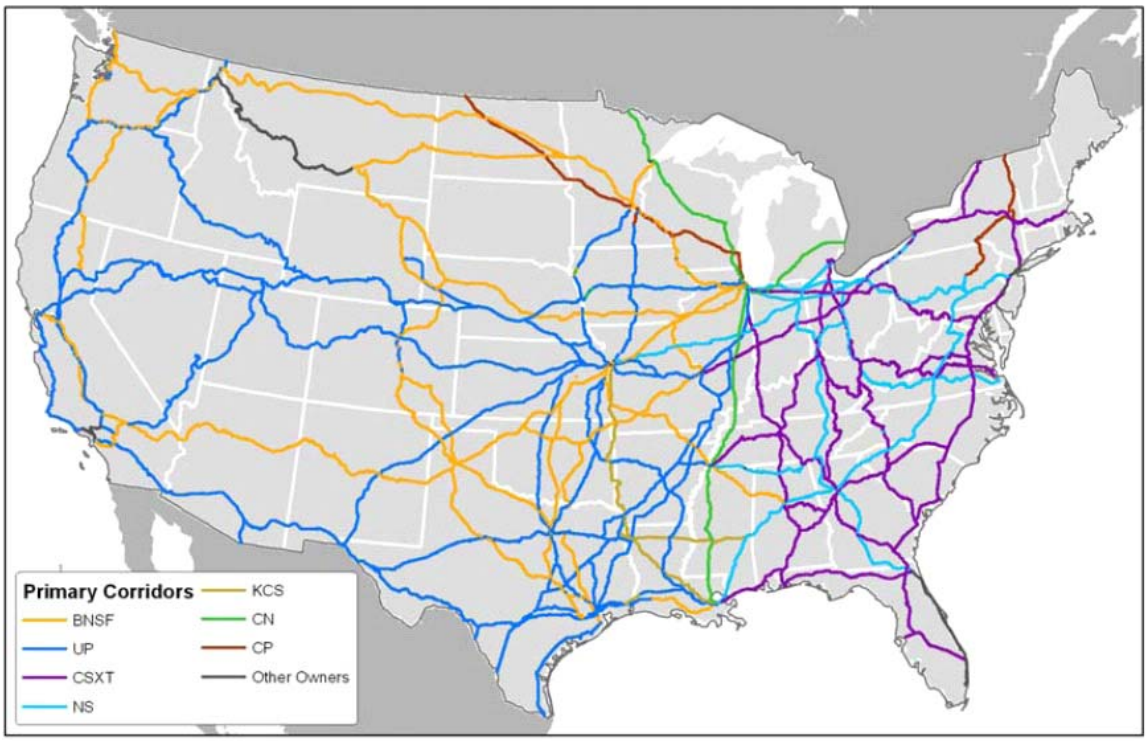
6.3.2 Rail

National Bottleneck Assessments

Until recently, there was nothing resembling a national "level of service" map for the freight rail system. Recently, however, the Association of American Railroads released a study (the *National Rail Freight Infrastructure Capacity and Investment Study*) that attempted to describe the U.S. freight rail system in terms of levels of service, generally analogous to highway performance measurement. Recognizing that this is just the first step in a longer process, the measures do represent the "cutting edge" of freight rail analysis.

Figure 6.10 shows the primary corridors of the national freight rail network. Note that Virginia's primary corridors are: 1) the NS east-west line from Ohio to Hampton Roads (the "Heartland Corridor" route); 2) the NS north-south line from Atlanta to Harrisburg generally paralleling the I-81 corridor (the "Piedmont Line," easily identified by the sharp angle turn at Manassas); 3) the CSX east-west lines between West Virginia and Richmond and Hampton Roads; and 4) the CSX north-south line from Jacksonville to Albany generally paralleling the I-95 corridor.

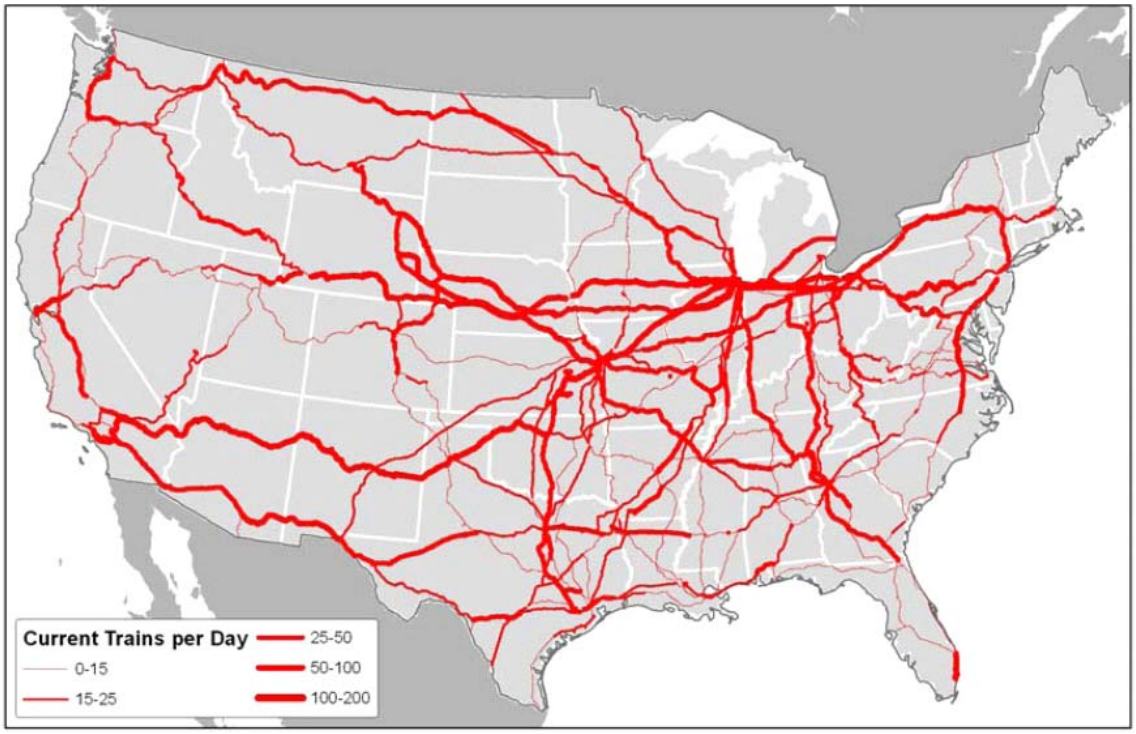
Figure 6.10 Primary U.S. and Virginia Freight Rail Corridors



Source: AAR.

Current traffic over these routes has been estimated in train moves per day. According to the AAR study, in which all U.S. Class I railroads (including NS and CSX) participated, the most heavily used rail line in Virginia is actually the CSX north-south line, which combines significant freight and passenger movements. Other lines carry substantially fewer trains per day, although many of the moves are unit trains of heavy commodities such as coal, so that east-west and north-south tonnages are actually closer than this map would suggest. Also, note that this reflects current conditions, not planned future conditions with implementation of the Heartland Corridor and other improvements.

Figure 6.11 Trains per Day over Primary Freight Rail Corridors
Freight and Passenger



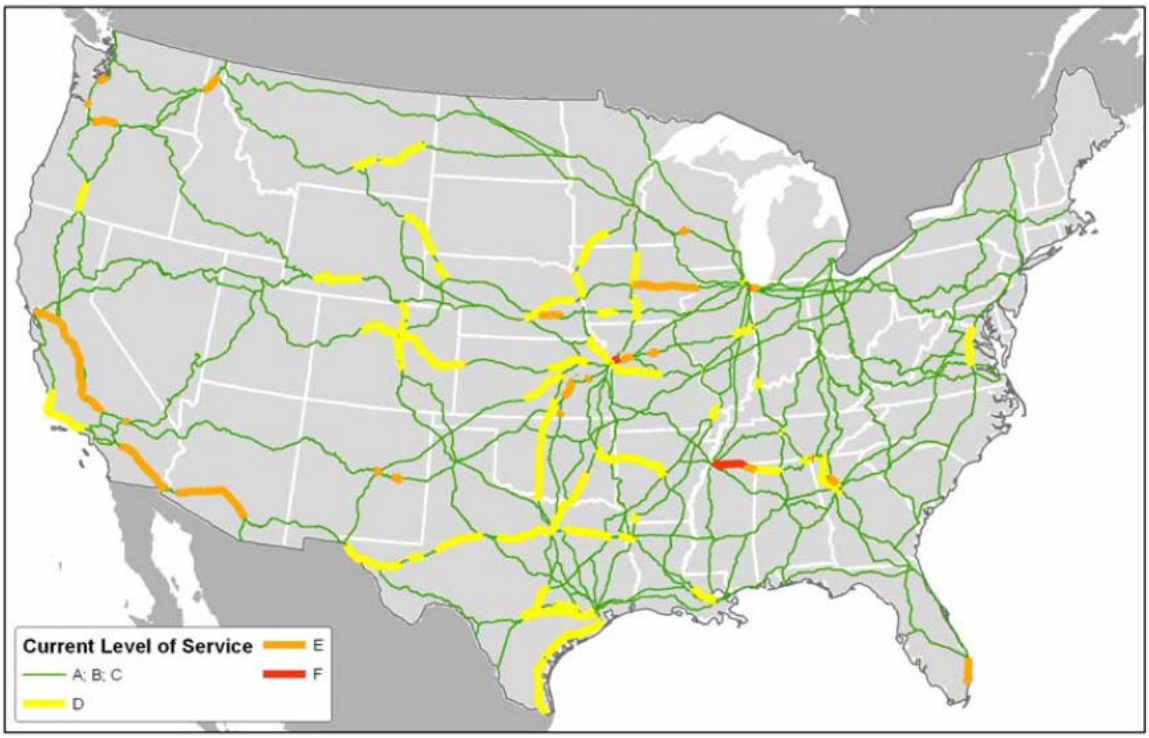
Source: AAR.

Looking at level of service on a scale of "A" through "C" (below capacity) to "D" (near capacity, "E" (at capacity) and "F" (over capacity), we see that all of Virginia's freight railroad system is considered to be operating at LOS A, B, or C, except for the CSX north-south line (see Figure 6.12 following).

This result can be interpreted two ways. The wrong interpretation is that the railroad system is mostly fine. The right interpretation is that there are significant limitations throughout the system, in Virginia as well as in other states traversed by these lines, and these limitations prevent the railroads from routing traffic over these lines. In other words, many of these lines have significant unused or "latent" capacity, which could be utilized if certain improvements – height and weight clearances, passing sidings, etc. –

were made. So Figure 6.12 is really telling two stories – the story of the CSX north-south mainline, which needs improvements today, and the story of the other lines, which offer latent freight transportation capacity.

Figure 6.12 Current Train Volumes Compared to Current Train Capacity
Passenger and Freight Trains



Source: AAR.

Virginia Bottleneck Assessments

The identification of critical freight rail chokepoints that prevent the utilization of latent rail capacity was begun several years ago as part of a cooperative effort between Virginia and four other Mid-Atlantic states. The joint study, known as the Mid-Atlantic Rail Operations Study (or MAROps), identified more than $6 billion in public-private rail investment opportunities over the five-state area.

Because the Mid-Atlantic rail freight system accommodates significant passenger traffic, and because projected growth in passenger traffic will further constrain freight capacity and operations, the study considered both passenger and freight-serving projects.

Many of these projects are being advanced by the Commonwealth, through programs administered by the Virginia Department of Rail and Public Transportation (DRPT). DRPT has also identified multiple chokepoints throughout the Commonwealth, which it is

addressing through the Virginia Statewide Rail Plan and the Virginia Rail Enhancement Fund. The Commonwealth is also funding certain rail improvements through public-private partnership agreements.

Synthesis of Rail Chokepoints

At the system level, typical causes of rail chokepoints include: insufficient line capacity or connectivity; restrictive dimensional (height or weight) standards or geometric design; presence of at-grade crossings; coordination of passenger and freight rail traffic on a common line (in which passenger traffic usually has priority); and yard capacity.

In 2004, the Virginia State Rail Plan (VSRP) identified these as the most critical freight chokepoints:

- Insufficient mainline capacity, restricted geometric design, passenger-freight conflicts, etc. – on the CSX line paralleling I-95 between Richmond and Washington, D.C. These chokepoints severely limit the growth of both passenger and freight traffic in this critical corridor.

- Insufficient capacity and operability along the NS corridors paralleling I-81. Improvements to this corridor could potentially help reduce or delay the need for highway improvements to I-81 itself.

- Inadequate capacity and clearances on the Heartland Corridor. There is an existing rail line between Hampton Roads and Columbus, Ohio, continuing to Chicago, that was designed for dimensions suitable for hauling coal. With growing international container traffic through the Virginia Port Authority facilities at Hampton Roads, there is an opportunity to move containers inland via rail, provided that restricted tunnel dimensions are improved and intermodal yards are developed.

- I-664/SR 164 Median Rail. In the Hampton Roads area, major port development is planned for Craney Island, but the site lacks direct rail access, which is considered a substantial chokepoint.

Stakeholder interviews also cited a desire for more rail capacity, and enthusiasm for the concept of diverting some share of I-81 truck traffic to rail. The Virginia Freight Advisory Committee identified the need for, and value of, cross-modal investment strategies such as the I-81 corridor project, and debated the pros and cons of competitive Class I access to major freight generators such as port facilities.

Based on available information, some of the Commonwealth's major freight rail chokepoints are summarized in Table 6.6 following.

Table 6.6 Current Freight Rail Chokepoints

Region	Location
Southwestern Virginia	• CSX east of Clinchport
	• NS west of Blacksburg
Southeastern Virginia	• NS west from Virginia Port Authority
Western Virginia	• NS west from Roanoke
	• NS and CSX east from Lynchburg
	• CSX east of Clifton Forge
	• CSX east of Scottsville
Central Virginia	• CSX west from Richmond
	• Buckingham Branch north from Richmond
Northern Virginia	• NS Piedmont Line through Manassas
	• Other Mid-Atlantic Rail Operations Study chokepoints (CSX from Washington DC to Richmond, NS Piedmont Line)

Impacts of Projected Growth in Rail Traffic

Like trucking, Virginia rail tonnage is projected to double through the year 2035. The largest growth is projected for inbound tonnage, the least for through tonnage. These projections are based on the current rail system and the current services offered by the railroads – with appropriate improvements, these tonnage forecasts could and should be exceeded, particularly with respect to through tonnage.

Table 6.7 Virginia Rail Tonnage Estimates
2004 and 2035

Year	Inbound	Outbound	Internal	Through	Mode Total
Rail Tons, Year 2004	47,118,374	30,549,739	21,526,944	83,254,468	**182,449,525**
Rail Tons, Year 2035	112,142,749	61,758,374	43,797,725	150,460,752	**368,159,600**
Absolute Increase	65,024,375	31,208,635	22,270,781	67,206,284	**185,710,075**
Ratio of 2035 to 2004	2.4	2.0	2.0	1.8	**2.0**
Compound Annual Growth	2.8%	2.3%	2.3%	1.9%	**2.3%**

Source: TRANSEARCH database.

Figures 6.13 and 6.14 offer hypothetical "what if" network assignments of future rail freight traffic to the existing system (assuming no physical or operating improvements) through the year 2035. Implementation of projects such as the APM and Craney Island terminals at Hampton Roads, development of the Heartland Corridor project, improvement of the I-81 and I-95 corridors, and other initiatives (see discussion following) will likely produce different flow volumes and patterns.

Figure 6.13 Virginia Rail Tonnage (Inbound, Outbound, and Internal)
2035, 2004 Volumes Inset; Assumes No System or Routing Changes from 2004

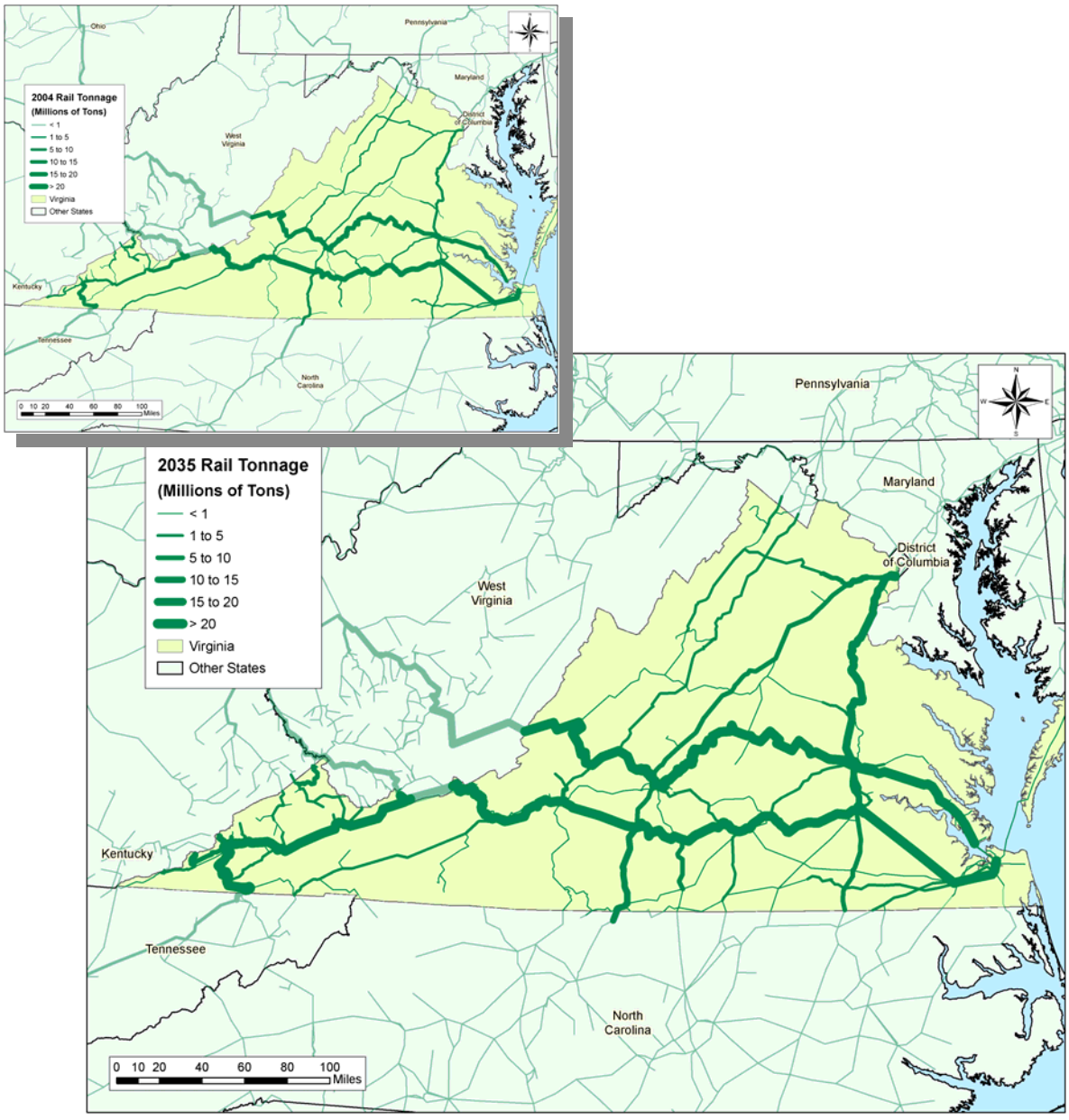
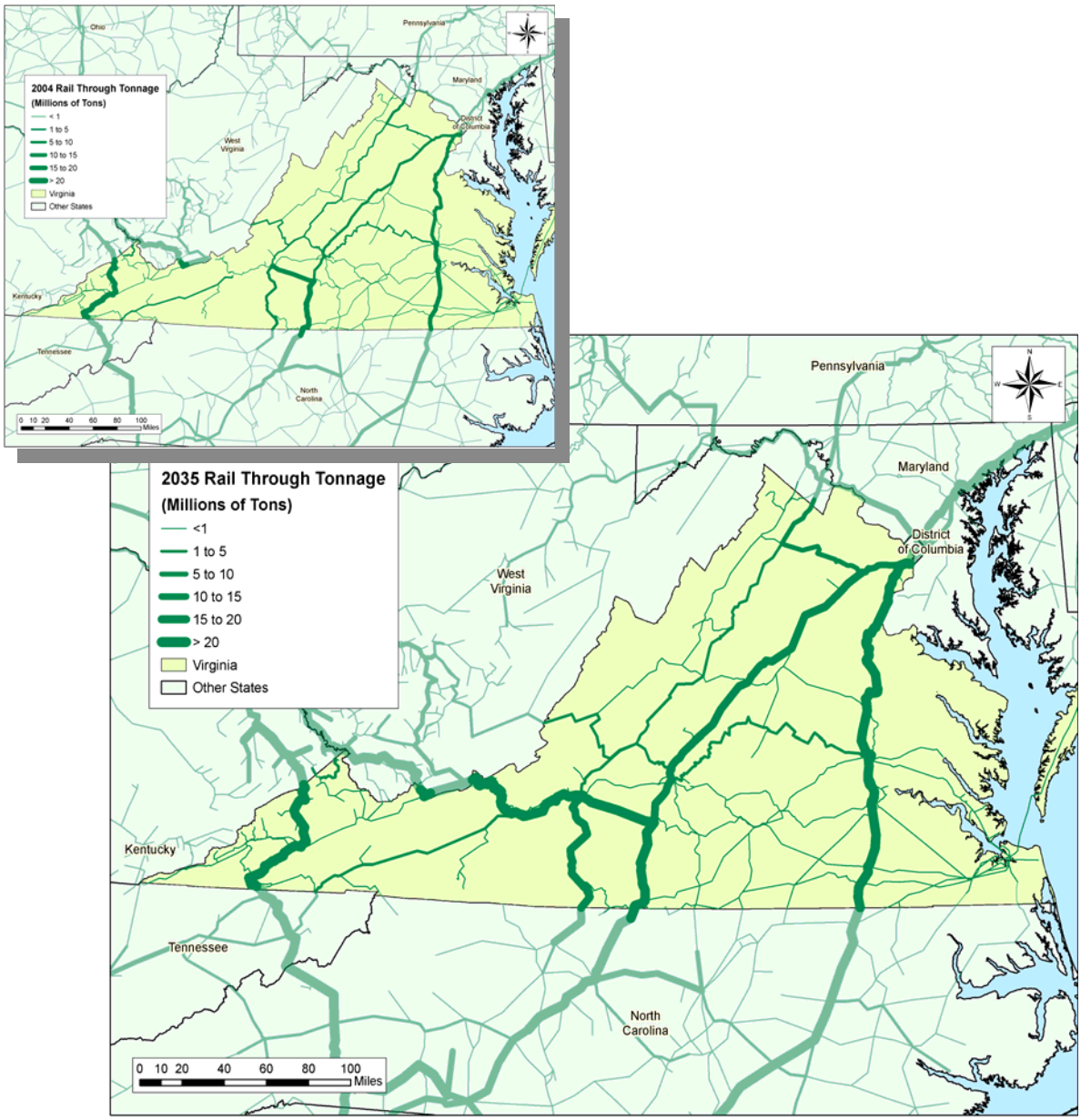


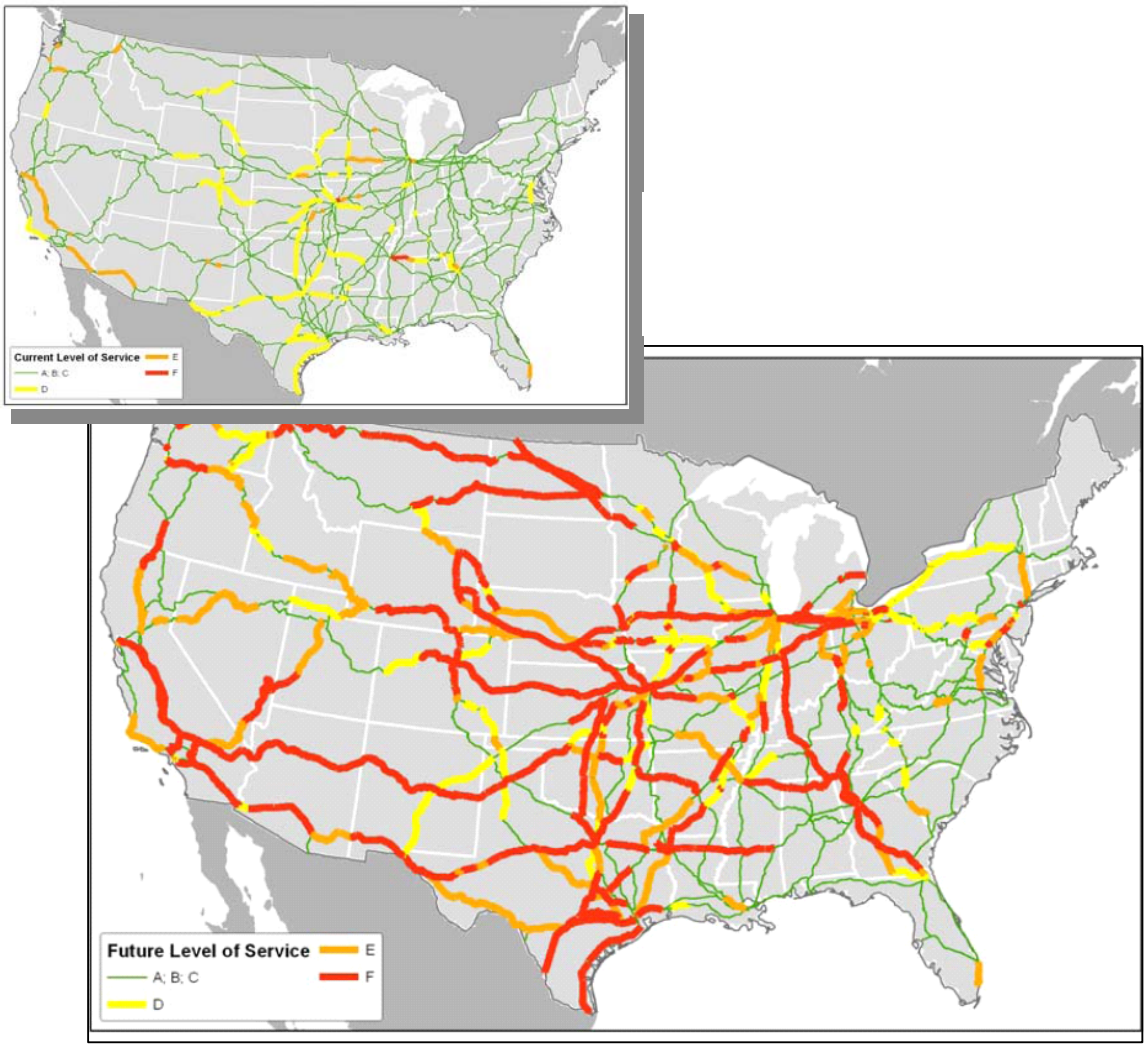
Figure 6.14 Through Rail Tonnage
2035, 2004 Volumes Inset; Assumes No System or Routing Changes from 2004



As shown in Figure 6.15 below, according to the AAR projections, much of the U.S. rail system would "go to red" by the year 2035, assuming no improvements due to growth in both freight and passenger services. The railroads are, of course, constantly maintaining and improving their systems, and most of the states that host rail services are also investing in improvements to varying degrees, so we do not expect this scenario to materialize. However, it is interesting to note that, even in a worst-case scenario, most of

Virginia's rail system continues to operate acceptably, other than the CSX north-south line and the NS west of the Shenandoah. (Again, this is in part because the AAR work assumes Virginia's rail lines would not be improved to serve new markets.)

Figure 6.15 Current Train Volumes Compared to Current Train Capacity Passenger and Freight Trains
2004, Volumes Inset; Assumes No System or Routing Changes from 2004



Source: AAR.

Critical Issues, Current and Future

Today, critical issues for Virginia's freight rail system include:

- **Safety and security, particularly for at-grade road-rail crossings.**

- **System preservation.** Without railroads, Virginia's truck tonnage would increase dramatically, and businesses that depend on rail would close their doors – so even though it is almost entirely in private hands, the Commonwealth's rail system is one of its primary transportation and economic assets.

- **System modernization and capacity improvements.** Over the past two decades, the nation's rail system has transformed much of its 19th century infrastructure to serve 21st century markets, with tracks and bridges that accommodate heavier railcars, and with improved double-stack intermodal corridors and railyards. Most of these investments have come from the rail companies themselves.

- **Public-private partnership opportunities.** There are some types of railroad improvement projects where public partnership may be appropriate. Generally, these are cases where the cost exceeds the investment ability of the railroad, and where the project generates a positive return to the public in the form of transportation, economic, and/or environmental benefits. Virginia is currently partnering with Norfolk Southern to develop the Heartland Corridor, which will upgrade an historic coal line between Hampton Roads and Columbus, Ohio to enable double-stack intermodal service. Other opportunities to upgrade rail lines paralleling I-81 and I-95 are under discussion.

- **Shortline assistance.** As the nation's rail system has evolved, many of its "last mile" connections to end users have moved from the Class I railroads to the shortlines, and in some cases these shortlines require public support for needed improvements. Virginia is meeting some of these needs through its Rail Enhancement Fund.

- **Port accessibility and service.** With strong anticipated growth in the movement of international shipping containers and other commodities through Virginia's ports, maintaining and improving rail service for marine terminals is critical. There are several projects advancing in this area.

- **Passenger operations.** In Virginia, passenger and freight rail service operate over the same tracks, potentially restricting the capacity of both. Virginia's freight rail system must accommodate growing levels of utilization by passenger rail service, safely and reliably.

- **Multistate coordination.** Most rail freight travels long distances (e.g., greater than 500 miles), usually traversing multiple state lines. The success or failure of rail investments in Virginia may depend on corresponding investments in other states.

By 2035, the critical issue is: how can Virginia's rail system be preserved and upgraded to handle a projected doubling of tonnage, while also potentially relieving pressure on the highway system by diverting truck traffic to rail?

Rail Improvements Being Implemented or Planned

The 2004 Virginia State Rail Plan (VSRP) defines and conveys the magnitude of rail needs in the Commonwealth, and sets forth a policy framework for strategic actions to realize the full potential of Virginia's passenger and freight rail systems. The VSRP presented a number of key initiatives, which should be implemented as soon as practical; these are listed below.

- **I-81 Freight Rail Improvements.** The Virginia Department of Rail and Public Transportation has signed an agreement with Norfolk Southern Corporation for improvements along the I-81 rail corridor. Improvements will enhance rail operations in the congested Manassas-Front Royal rail corridor, and permit an expansion of Virginia Railway Express service in the Gainesville/Haymarket area. The project is expected to be complete by late 2008.

- **The Mid-Atlantic Rail Operations Study (MAROps).** As previously noted, Virginia is partnering with the Maryland, Delaware, Pennsylvania, and New Jersey, along with the I-95 Corridor Coalition and three railroads (Amtrak, NS, and CSX) to conduct the Mid-Atlantic Rail Operations Study. For the past four years, MAROps has examined the operational efficiency and capacity of the rail lines parallel to I-95 and I-81, with the goal of identifying strategies to increase the efficiency and attractiveness of rail (for both passengers and freight) and reduce pressure on I-95, I-81, and other major multi-state highway corridors. MAROps has recommended a 20-year, $6.2 billion ($1.8 billion in Virginia) public-private investment program to implement 71 chokepoint elimination projects across the five states.

- **Heartland Corridor Double-Stack Initiative.** Following completion of the VSRP, this project has received approvals and funding, including a $100 million Federal earmark. The work involves upgrading an existing coal line with restricted dimensions to handle double-stack container traffic moving from the Virginia Port Authority west through Virginia, West Virginia, and Ohio, continuing to Chicago and its interchanges with the western Class I railroads. The project affords a significant competitive advantage to Virginia's ports by providing a shorter (by several hundred miles) and faster route to the Midwest along with high-speed double-stack capacities. It also benefits communities along the route by providing economic development and transportation opportunities. Project funding is coming from both public sources (Virginia Rail Enhancement Grant and Ohio Rail Development Commission Grant) and the private sector (Norfolk Southern Corporation). Compared to other rail improvement projects across the U.S., this project is on a very accelerated schedule, with completion estimated in 2009 or 2010.

- **CSX I-95 Rail Corridor of the Future Proposal.** CSX has submitted a proposal to U.S. DOT that sets a vision for the I-95 rail corridor of the future between Washington,

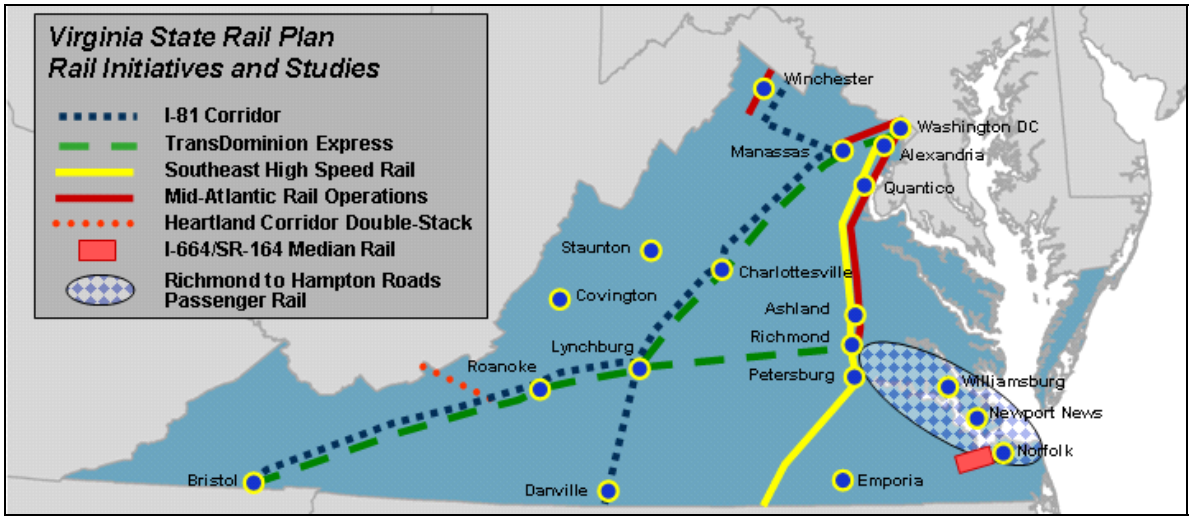
D.C., and Miami that includes substantial growth of both passenger and freight services with a sealed high-speed passenger route. The 1,200-mile corridor will be an example of how well-planned comprehensive investment in rail infrastructure can support economic development and further national transportation goals. With the exception of Florida, most of the near-term projects in the corridor are between Washington, D.C. and Richmond. Investments in the Commonwealth will include the modification of five bridges that serve as clearance obstacles for potential CSX double-stack service through Virginia to points south and west.

- **I-664/Route 164 Median Rail.** In the Tidewater area, the Commonwealth has set aside right-of-way and is planning a seven-mile rail link to provide rail service to the future port developments lying between Craney Island and Route 164. The line would be constructed in portions of the highway median of I-664 and SR 164. By providing port development with rail freight access, the project offers an alternative to truck-only service, benefiting port users (in the form of greater transportation choices and lower costs) and the surrounding transportation system (by reducing reliance on truck).

- **Virginia Railway Express Strategic Plan.** The VRE strategic plan calls for a continued expansion of service to accommodate strong ridership growth in the Washington, D.C. suburbs of Northern Virginia. Many of the improvements affecting VRE are encompassed in the MAROps report for the NS line extending west from Alexandria, Virginia, to Manassas and for the CSX line extending south from Washington, D.C., to Richmond. This would support an increase in VRE ridership, from a current average of 14,000 trips per day to a target of 18,000 trips per day by 2010.

Figure 6.16 Virginia State Rail Plan

Major Freight and Passenger Initiatives



Source: Virginia State Rail Plan, 2004.

Table 6.8 Potential MAROps Improvements in Virginia

Railroad	Project Location	Description	Total Cost (Thousands)	Timeframe
CSX	Rose and South Anna	Crossovers between main tracks	$4,957	0-5 years
CSX	RO to SRO, Franconia Hill, Fredericksburg-Crossroads, Aquia, Quantico, Pedestrian bridge Featherstone	Selected Virginia Capacity Projects	$67,590	0-5 years
CSX	North RO (Alexandria) to Cross Roads	Virginia third main track	$216,174	0-5 years
NS	Berryville to Riverton Jct.	25.1 miles second main track	$173,705	0-5 years
NS	"B" line between Manassas and Riverton Jct.	Improve track, signals, relocate fiber optic cable	$221,468	0-5 years
NS	Riverton Interlocking Redesign	Upgrade of interlocking, including five miles of new track	$54,635	0-5 years
CSX	Greendale to Main Street	Grade crossing elimination and track improvements	$57,460	5-10 years
CSX	Between Airport Road and Emporia, Virginia	Virginia Clearance Projects (11 projects for double-stack trains)	$8,488	5-10 years
CSX	Fredericksburg to Washington	Freight and passenger capacity projects	$83,970	5-10 years
CSX	Main Street to Centralia	Grade crossing elimination and track improvements	$32,689	10-20 years
CSX	Crossroads-Greendale	Virginia third main track, grade separate Milford crossing, improve Doswell Crossing	$435,261	10-20 years
CSX	CP Virginia to Long Bridge (A cooperative effort with the District of Columbia)	Construct third and fourth main tracks; add TCS	$449,481	10-20 years
CSX	Long Bridge	Construction of a second two-track bridge across the Potomac River	$475,620	10-20 years

The VSRP also identifies several other passenger rail initiatives – the Southeast High-Speed Rail Corridor, Richmond to Hampton Roads Passenger Rail, Bristol to Richmond and Washington, D.C. (TransDominion Express), and Richmond Main Street Station project – whose benefits to freight would most likely be limited.

The Virginia Rail Enhancement Fund (REF) is administered by the Virginia Department of Rail and Public Transportation. It provides annual program support for public investments in Virginia's freight and passenger rail system, and can be used to leverage private rail funds to achieve quantifiable public benefits. Freight-oriented REF projects are all candidates for accelerated implementation. Freight-oriented REF projects include the following:

- **Heartland Corridor, Virginia Contribution.** Total project cost is $186 million, and the REF contribution was recommended at over $22 million.

- **Commonwealth Railway Line Purchase.** This project will acquire 10.5 miles of existing rail line from Norfolk Southern Railway between Chesapeake and Suffolk to ensure dual, unimpeded, and equitable access. The acquisition will relocate the Commonwealth Railway (CWRY) main line away from densely populated areas to the secure 164 – I-664 corridor median. The CWRY would make an in-kind contribution of its existing main line between Coast Guard Boulevard and I-664 through Portsmouth, Churchland, and Chesapeake. This median route was previously designed to accommodate a dual-track rail line serving the planned APM/Maersk and Craney Island marine terminals and has clearances and interstate bridge work in place.

- **APM/Maersk Terminals Rail Yard Expansion.** This project would allow the APM/Maersk facility to double their rail yard capacity and provide the Hampton Roads region with an alternative to truck-induced congestion while allowing growth at the Port of Hampton Roads.

- **Suffolk Connection from CSX to Commonwealth Railway.** This project involves constructing a track connecting the CSX Portsmouth Subdivision to the Commonwealth Railway in Suffolk to ensure dual, unimpeded, and equitable access.

- **Portsmouth Subdivision Height Clearances.** This project would clear overhead impediments on the VA portion of the Portsmouth Subdivision (rail line that runs between Portsmouth and Weldon, NC) to provide double-stack freight service over a 560-mile market, connecting Portsmouth with Atlanta and the Southeast. These improvements would allow double-stack movement to the VA/NC state line. CSX will fund improvements between the VA/NC line and Atlanta.

- **North Acca Yard Switches.** This project would replace 13 pneumatic switches at North Acca Yard (City of Richmond) with more reliable electric dual control (remote or manual operation) switches. Dual control allows either passenger or freight trains to manually operate the switch without the presence of a Signal Maintainer. Associated signals and communication systems also would be upgraded. Project would include installation of switch heaters.

- **Richmond Port Passenger/Freight Improvements**. This project would provide dual, unimpeded, and equitable access to the Port of Richmond, a TDX connection to Main Street Station, four additional daily passenger stops at Main Street Station, and turning and storage facilities for passenger trains.

- **Intermodal Improvements, Crewe to Suffolk**. This project would improve the connection with Commonwealth Railway in Suffolk for daily train load movements of up to 120,000 containers annually in 2010, establish a block swap yard in Crewe (Nottoway Co.), add two tracks at the auto loading/unloading facility in Poe

(Petersburg), and add an additional track and carload switching facility in Broadway Yard in Petersburg.

Additionally, the REF includes several passenger-oriented projects, including:

- Charlottesville Connecting Track Upgrade;
- VRE Gainesville-Haymarket Extension Feasibility Study;
- VRE Cherry Hill Station and Third Track project; and
- VA/NC Passenger Rail EIS (for a segment of the Southeast High Speed Rail corridor, or SESHR).

The benefits of these projects would not primarily accrue to freight. The Commonwealth is also currently evaluating applications for 15 additional projects for the 2008 to 2009 time period.

Innovative Rail Strategies

Virginia is already emerging as a national leader in innovative rail strategies, with its participation in the Heartland Corridor, I-81 Corridor, MAROps program, and Rail Enhancement Fund. Successfully following through on these identified initiatives should be the first priority. Beyond that, there are some further possibilities for innovative approaches.

- **Multistate rail funding compacts**. The I-81 corridor is part of a travel route whose core runs between Atlanta and Harrisburg, but which reaches markets in New York/New Jersey to the north and Louisiana, Texas, and even Mexico to the south. The core study area for MAROps was the I-95 corridor between northern New Jersey and the Virginia/North Carolina state line, but it serves a market from New England to Florida. Finding ways to partner with other states that benefit from rail system improvements in Virginia – and vice versa – will be a critical institutional challenge. This is also an obvious opportunity for Federal leadership, and Virginia should facilitate this to the extent practical.

- **Advanced rail technologies**. It is anticipated that the introduction of new rail technologies and equipment (positive train control, "open technology" accommodating roll-on/roll-off loading, etc.) will allow Virginia's railroads to handle a wider variety of commodities via intermodal services. Virginia may partner in the introduction of these technologies in the I-81 corridor or elsewhere.

- **Intermodal Logistics Centers**. An emerging service strategy for the railroads is the development of intermodal logistics centers, or ILCs. An ILC is essentially a large rail served parcel, on or near a major highway, with extensive warehouse/distribution capability and a base of core rail-using industrial tenants. Attracting business to ILCs is good for railroads, as it builds their customer base and affords a critical mass of

traffic that in turn allows them to offer frequent and attractive service. It can also be good for the public, because it makes it easier for freight shippers to use rail in lieu of congested highways. The Virginia Inland Port is one an example an ILC; opportunities to develop ILCs along the Heartland Corridor, I-95, and elsewhere can and should be explored.

- **Short-haul rail**. Bulk rail can be effective at either short or long distances, but intermodal services generally become competitive with trucking only for hauls longer than 400 to 600 miles. Some states are exploring ways to make intermodal service more competitive at shorter distances. Most analysts believe there are good reasons why it is not competitive today at short distances, and believe that such services would require considerable public subsidies. In some places – New York/New Jersey, Los Angeles/Long Beach, etc. – where the cost of providing new highway capacity is astronomical, such subsidies might well be warranted. However, the Commonwealth is not yet experiencing such dire freight movement conditions, so short-haul rail is probably more of a far-term option. The nearer-term exception might be service to ILCs – because ILCs generate their own critical mass of demand, they might support shorter haul rail service in lieu of trucking.

- **North-south landbridge**. Broadly speaking, a "landbridge" is a rail service that substitutes for water service. Historically, most of the Asian containerized goods moving to the U.S. east coast were received through west coast ports, and then moved by rail through railroad interchange hubs in Chicago and other midwest cities. With growing trade volumes and growing congestion for west coast ports and western railroads, and with the prospect of significant expansion of the Panama Canal by 2015, shippers have increasingly moved Asian cargo directly through Atlantic Coast and Gulf Coast ports. This is a huge opportunity for Virginia's ports, which offer the only U.S. facilities on the Atlantic coast capable of handling the large vessels that are preferred in Asian trades. The Heartland Corridor will basically provide an intermodal link from Hampton Roads to West Virginia, Ohio, and the midwest, allowing these regions to receive their cargo via Virginia rather than west coast ports – and Virginia will be a new hub for the nation's east-west rail landbridge system. But another possibility is being part of a north-south rail landbridge system, for containers arriving in the Gulf that are destined for Northeastern U.S. markets, or for containers landing in Virginia and heading to other Atlantic coast markets. The MAROps program would accomplish some of the required infrastructure improvements.

- **Competitive Class I rail access to ports**. This is a much-discussed and as yet unresolved question. In its favor, it offers the possibility of rate and service competition between multiple railroads, which could benefit shippers and make the facilities more attractive places for them to do business. In its disfavor, it means introducing duplicative infrastructure and/or potentially burdensome interoperability agreements between the railroads, as well as decreases in each railroad's established market that could affect their ability to maintain present levels of service.

Virginia's innovative efforts are similar in many respects to groundbreaking partnership efforts in Southern California and Chicago (see Tables 6.9 and 6.10 following).

Table 6.9 Rail Freight Partnerships in Other States
California's Alameda Corridor and Alameda Corridor East

The ports of Long Beach and Los Angeles handle more than 64 percent of Asian container imports and nearly 25 percent of all U.S. imports. Much of this cargo moves by rail to the U.S. midwest and east coasts. The Alameda Corridor project built a state-of-the-art rail access network to the ports. It consists of a 20-mile-long rail expressway – basically a large-grade separation project – linking the Ports of Long Beach and Los Angeles to the nation's rail network near downtown Los Angeles. It consolidated four branch line railroads and eliminated more than 200 at-grade crossings thus improving safety and productivity while reducing emissions and community disruption. Trains speeds have been raised from 10-15 mph to nearly 40 mph. Trains moving through Corridor in 2006 hauled about five million TEUs, up by 32 percent from 2005.

The success of the Alameda Corridor means that train traffic will increase as much as 160 percent to the East through the San Gabriel Valley by the year 2020. To deal with that growth the $1.4 billion Alameda Corridor East Project (a separate effort) is under development. It will improve safety and mobility at 39 crossings, construct grade separations at 20 crossings, and eliminate several others. The result will be time savings for highway and rail traffic, improved safety and reduced air emissions.

Table 6.10 Rail Freight Partnerships in Other States
Chicago's CREATE Project

The Chicago Region Environmental and Transportation Efficiency Project (CREATE) can be classified as achieving *operational improvement* with respect to freight rail, and *augmenting capacity* with respect to passenger rail (an explicit METRA objective). These improvements would be made possible by removing bottlenecks, improving the fluidity over the system (i.e., fewer delays, better speeds, added reliability) and more prompt recovery of operations after bad weather or accidents. Operational benefits for the six railroad operators would follow from the investment to improve rail network efficiencies. The public-benefits focus was on the local rail serving market of Chicago-Kenosha-Gary CMSA and on the nation as well. These benefits, which were monetized and expressed in net present value over the period 2003 to 2042, estimated that CREATE will provide the Chicago region with at least $595 million in benefits related to rail passengers, motorists, and safety, plus air quality improvements valued at $1.1 billion.

6.3.3 Ports and Warehouse/Distribution

Bottleneck Assessments

Virginia's ports – both public and private – operate as entrepreneurial business enterprises. They identify market opportunities, investments needed to meet those opportunities, and likely returns on investments, on an ongoing basis. Identifying and addressing bottlenecks at private marine terminals is mostly a matter of private business activity, except when it involves improvements to public assets serving those facilities, such as navigation channels, highways, and/or public railroads. Identifying and addressing on-terminal bottlenecks at public marine terminals is the business responsibility of the Virginia Port Authority, and addressing offterminal bottlenecks (navigation channels, highways, railroads) is accomplished in cooperation with the responsible local, regional, state and Federal agencies. Similarly, warehouse and distribution activities are largely a function of the private sector, which identifies and meets need, although their development can be substantially affected (positively or negatively) by public regulation and land use/transportation investment decisions.

Because of the dynamic nature of their business operations, ports tend to respond quickly to on-terminal bottlenecks. The more significant issues for most ports usually relate to significant land expansion (through acquisition and/or landfill), and the development and maintenance of adequate marine channels, highway access, and rail service – these efforts can require significantly longer timeframes.

Impacts of Projected Growth in Marine Traffic

As discussed in Section 3.0 of this report, international marine container traffic is expected to grow faster than any other freight mode or service through the year 2025. National forecasts, despite some downturn in the past year, remain robust. Growth in international trade in noncontainerized commodities, and in the movement of domestic commodities, will be slower but steady. VPA anticipates that this will create a significant market opportunity for the development and absorption of new container terminal capacity at least through the year 2035, taking the port from a capacity of 3.5 million TEUs annually to a capacity of eight million TEUs annually.

Current estimates based on the container forecast suggest that by 2030, another 60 million square feet of distribution space will be needed. There are several forces at work, and building momentum, that might actually double the needed square footage. First, the Heartland Corridor will provide services to Chicago and the Midwest that will make Virginia a much more attractive point for landing international marine cargo. Second, as congestion grows on highway and rail systems, the utilization of "transloading" facilities, where 20-foot and 40-foot containers are unpacked ("stripped") and repacked into 53-foot containers ("stuffed") will probably increase. Third, as ports and their urban areas on the West Coast reach saturation, and with the widening of the Panama Canal, more "discretionary" containerized cargo (cargo that has a choice of ports) from Asia is likely to

land in Virginia, further increasing transload activity. The 50-foot channel at Hampton Roads should provide a significant competitive advantage for this traffic.

Table 6.11 Virginia Port Tonnage Estimates
2004 and 2035

	International Container	International Noncontainer	Domestic	Mode Total
2004 Tons	11,094,450	22,627,103	19,644,329	**53,365,882**
2035 Tons	36,213,917	45,254,206	39,771,628	**121,239,751**
Absolute Increase	25,119,467	22,627,103	20,127,299	**67,873,869**
Ratio of 2035 to 2004	3.3	2.0	2.0	**2.3**
Compound Annual Growth	3.9%	2.3%	2.3%	**2.7%**

Sources: Global Insight, Inc., www.usatradeonline.gov; and Cambridge Systematics.

Critical Issues, Current and Future

Today, the most significant port issues are:

- **Safety and security.** Virginia and other U.S. ports are operating under heightened security procedures to ensure the safety and security of containers and other cargo.
- **Improving facilities to accommodate anticipated growth.** Port improvements tend to have very long lead times, especially if they involve channel deepening or landfill. Growth in international containers is conservatively forecast to triple over the next 30 years, and more aggressive forecasts envision Virginia's container traffic quadrupling. At the same time, international noncontainer traffic and domestic waterborne traffic is forecast to grow at a pace similar to truck and rail.
- **Preserving and upgrading the quality of landside access**, by truck and rail, to existing and planned future marine terminals.
- Planning for the additional warehouse and distribution facilities that will be needed to support container growth.
- **"Marine Highway" initiatives** that could potentially shift truck traffic to barges.

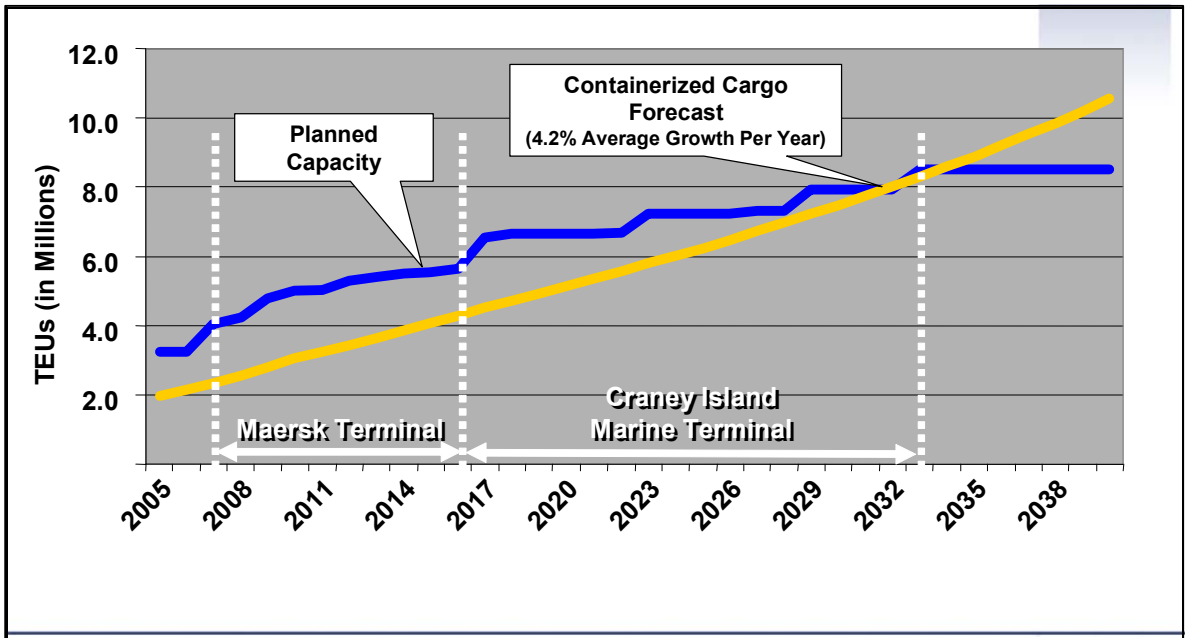
Through 2035, the critical issue is: how can Virginia best handle a tripling (or quadrupling) of container traffic, and a doubling of other tonnage, by improving port

facilities and operations, while ensuring adequate landside access, safety and security, and environmental quality?

Port and Port-Serving Improvements Being Implemented or Planned

VPA is undertaking a very aggressive expansion plan under its VPA 2040 Master Plan. The three existing VPA terminals (Norfolk, Portsmouth, and Newport News) are increasing capacity through strategic capital projects; when completed the existing terminal will provide capacity for over 3.5 million TEUs. Additional capacity will be provided by planned development of Craney Island, and by the privately owned APM (Maersk) terminal currently under construction, which would take the port to a capacity of eight million TEUs, sufficient to meet projected demand through 2035.

Figure 6.17 Container Demand and Capacity With Planned Improvements
With Virginia's Public and Private Terminals



Source: VPA Master Plan. Forecast numbers prepared in 2005 and represent average increase over the forecast period.

Beyond ensuring that the marine terminals themselves are capable of accommodating future volumes are issues related to highway and rail access to the terminals. Over the road access to and from the terminals is facilitated through three primary routes:

- I-64 and its spurs – I-264 and I-664 with connections to I-95 and I-81;
- U.S. 460, an east-west route; and
- U.S. 58, an east-west route on the southern edge of Virginia with access to I-95 and I-85 for cargo movements south of Virginia.

Truck traffic on Hampton Boulevard, south of the NIT gate, was recently restricted. The port has responded with extended Saturday operations and is working with the City of Norfolk to reach a permanent solution.

Rail access for international cargo travels via:

- The Virginia Inland Port (VIP) at Front Royal, served via NS;
- Lamberts Point;
- CSX Rail Yard; and
- Norfolk Southern Rail Yard.

Virginia's ports should benefit from many of the highway and rail improvement strategies described previously in Sections 6.2 and 6.3 – particularly the Heartland Corridor and I-664/Route 164 Median Rail projects, and the U.S. 460 and potential Hampton Roads Third Tunnel.

Innovative Port Strategies

- **Upgraded on-dock rail capacity**. In the year ending June 30, 2006, nearly 250,000 containers moved by rail to/from Virginia's ports, while 925,000 containers moved by over the road truck. Because of limited on-dock rail service at Hampton Roads marine terminals, 145,000 of these rail moves – more than one-half – required truck drayage between the terminals and the rail yards. For the 12 months ended September 2006 there were an estimated 1.6 million vehicle miles of travel associated with these rail drayage moves. These volumes could grow by around 400 percent over the next 30 years. This will increase the stress placed on the intermodal connection points and transportation infrastructure that handles port-related cargo. Many of these intermodal connectors already are strained with a combination of general and truck traffic. Providing upgraded on-dock rail capacity for these terminals could reduce or eliminate these drayage moves, and potentially increase the attractiveness and mode share of rail compared to trucking. The possibility of joint access by CSX and NS has been discussed and awaits resolution.

- **Port-related intermodal park and distribution center growth**. Forecasted growth in containerized cargo and the way in which such cargo is handled leads to the finding that over 60 million square feet of additional distribution center space will be needed in the next 20 years. This space will be built along existing freight corridors and the impacts of increased truck traffic along routes such as U.S. 460 and U.S. 58 will need to be addressed, in a manner coordinated with land use and development. A

coordinated land use and transportation strategy could help focus this development in strategic planning corridors. This could be part of a larger statewide ILC and inland port strategy as well.

- **Barges and "marine highway" initiatives**. The U.S. Maritime Administration is actively promoting the use of barges as an alternative to truck service along congested coastal and inland corridors. (Formerly known as "short sea shipping," various high officials through the years have found the term difficult to speak aloud, and the initiative has been rebranded as the "marine highway.") Virginia already has a successful barge service to the Port of Baltimore, and the possibility of a new barge service to the Port of Richmond has been discussed. There are many successful barge services in the U.S., but most are oriented to bulk commodities. There are significant impediments to container and trailer barge services, including vessel and labor costs; the American Association of Port Authorities and others have recommended exempting short sea shipping from the "Jones Act," which mandates U.S. flag vessels and labor rules on domestic waterborne services. As highways become more congested, and as national policy addresses current impediments, barge services should become more viable and attractive.

- **Electronic seals**. Private marine terminal operators have expressed an interest in working with the Commonwealth to promote the standardization and use of electronic customs data "seals" for international containerized cargo.

6.3.4 Air Cargo

Bottleneck Assessments

Freight stakeholders, the Virginia Freight Advisory Committee, and study team members have identified no current critical capacity or performance issues related to Virginia's air cargo system. Air freight through Virginia does not suffer from bottlenecks at the airports. While some airports are experiencing significant rates of growth, airport capacity and on-time arrival statistics indicate no undue stress on the air cargo network.

One issue that has been discussed previously in this report is the fact that many air cargo users will truck long distances to out-of-state airports for international travel, taking advantage of the high numbers of wide-body flights available from JFK and other airports. Short of providing as many wide-body flights to as many places as JFK, there is no means of accommodating this type of activity within Virginia's system. However, there may be opportunities for improvements in specialized and domestic air cargo functions.

Impacts of Projected Growth in Air Cargo

On a percentage basis, air cargo is projected to be the second fastest growing component of Virginia's freight transportation system, after international container trade. Air tonnage is expected to triple by the year 2035. It is expected that these levels of growth can be accommodated by capital improvements programs at existing facilities.

Table 6.12 Virginia Air Cargo Tonnage Estimates
2004 and 2035

	International	Domestic	Mode Total
2004 Tons	102,590	469,558	**572,148**
2035 Tons	214,980	986,072	**1,201,051**
Absolute Increase	112,390	516,514	**628,903**
Ratio of 2035 to 2004	2.1	2.1	**2.1**
Compound Annual Growth	2.4%	2.4%	**2.4%**

Sources: Global Insight, Inc., www.usatradeonline.gov; and Cambridge Systematics, Inc.

Critical Issues – Current and Future

Currently, Virginia's airports do not suffer from significant freight movement bottlenecks. Airport capacity and on-time arrival statistics indicate no undue stress on the air cargo network. Given that air cargo tonnage is projected to triple, opportunities to improve the quality of international and domestic services through Virginia's air cargo gateways will need to be explored. One possible opportunity is to capture more of the current "truck-air" market, which is Virginia traffic that is trucked to and from out-of-state airports like JFK that offer more frequent wide-body passenger flights to more destinations. To compete effectively, Virginia would need to offer services more comparable to those available at JFK. In the future, growing passenger volumes will generate significant air-port improvements on both the airside and ground access systems, and freight will benefit from them.

Through 2035, the critical issue is: how can Virginia best handle a tripling of air cargo traffic, within the context of growing passenger demand through Virginia's airports?

Airport Improvements

Like marine terminals, each of Virginia's cargo airports makes significant investments according to its own capital improvements plan. Airside improvements such as runways, as well as landside access improvements, benefit freight as well as passengers.

This study did not identify significant air cargo bottlenecks. However, positive opportunities for Virginia airports to be more competitive with out-of-state airports for international services, as well as the potential for increased domestic cargo service from existing and additional airports, should continue to be explored.

Innovative Air Cargo Strategies

- **Extension of MetroRail to Dulles Airport.** Extension of Metro to the airport will free up capacity on the existing two-lane toll road for use by autos (primarily) and trucks (secondarily). Currently, truck traffic on this road is relatively light, but could be expected to intensify with continued growth in air cargo demand.

6.4 Challenges and Opportunities – A Multimodal View

6.4.1 Statewide and Regional Synthesis

Taking the preceding material as a whole, it is clear that Virginia's freight transportation system contains segments that are stressed or over subscribed to the point that they are defined as bottlenecks. Bottlenecks – whether existing or emerging – prohibit the efficient flow of freight through the system and across the Commonwealth. Bottlenecks are created by a combination of demand to utilize a transportation asset (both freight and passenger), the capacity of the asset, and fluctuations in the demand at different points in time. A bottleneck slows down the system regardless of its mix of passenger and commercial vehicle traffic.

Based on a scan and synthesis of available data, the most pressing freight bottlenecks and chokepoints generally correspond to:

- Major urbanized regions (Northern Virginia, Hampton Roads, Richmond);
- Intersections of major highway arteries (I-495/I-95, I-77/I-81, I-64/I-295/I95);
- Major national through-travel corridors (I-95, I-81);
- Routes with few or no alternatives (Hampton Roads Bay Tunnel, Monitor Merrimac);
- Rail system points where infrastructure provides inadequate freight capacity or dimension, especially where growing freight and passenger needs must be accommodated over shared infrastructure; and
- Access into and out of heavily used marine terminal facilities, and links between marine terminals and related inland facilities and warehouse/distribution centers.

The following pages presents a series of synthesis maps summarizing current freight bottlenecks and chokepoints in Virginia from a multimodal perspective.

Figure 6.18 Current Virginia Freight Bottlenecks
Statewide

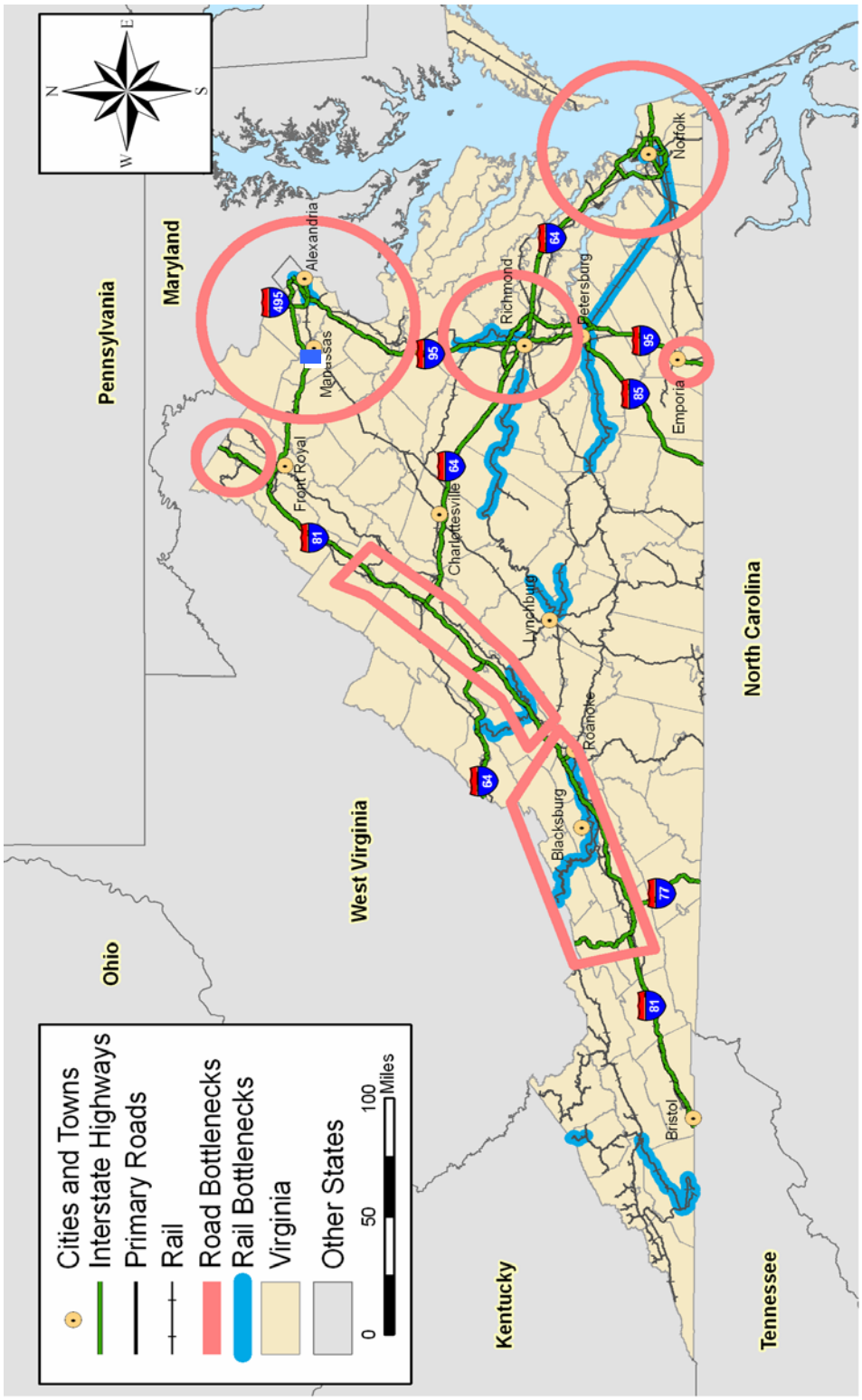


Figure 6.19 Current Virginia Freight Bottlenecks
Southwestern Virginia

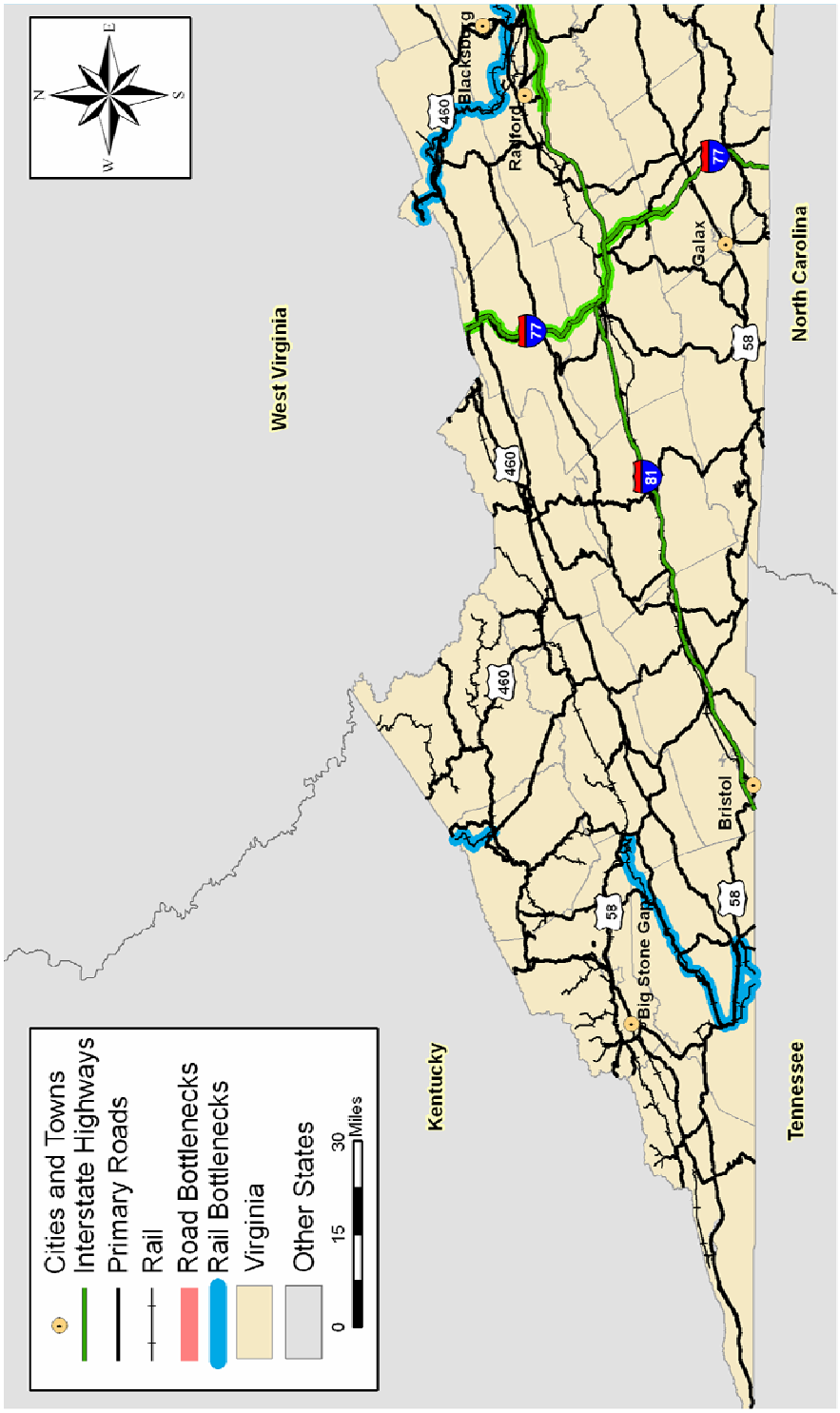


Figure 6.20 Current Virginia Freight Bottlenecks
Southeastern Virginia

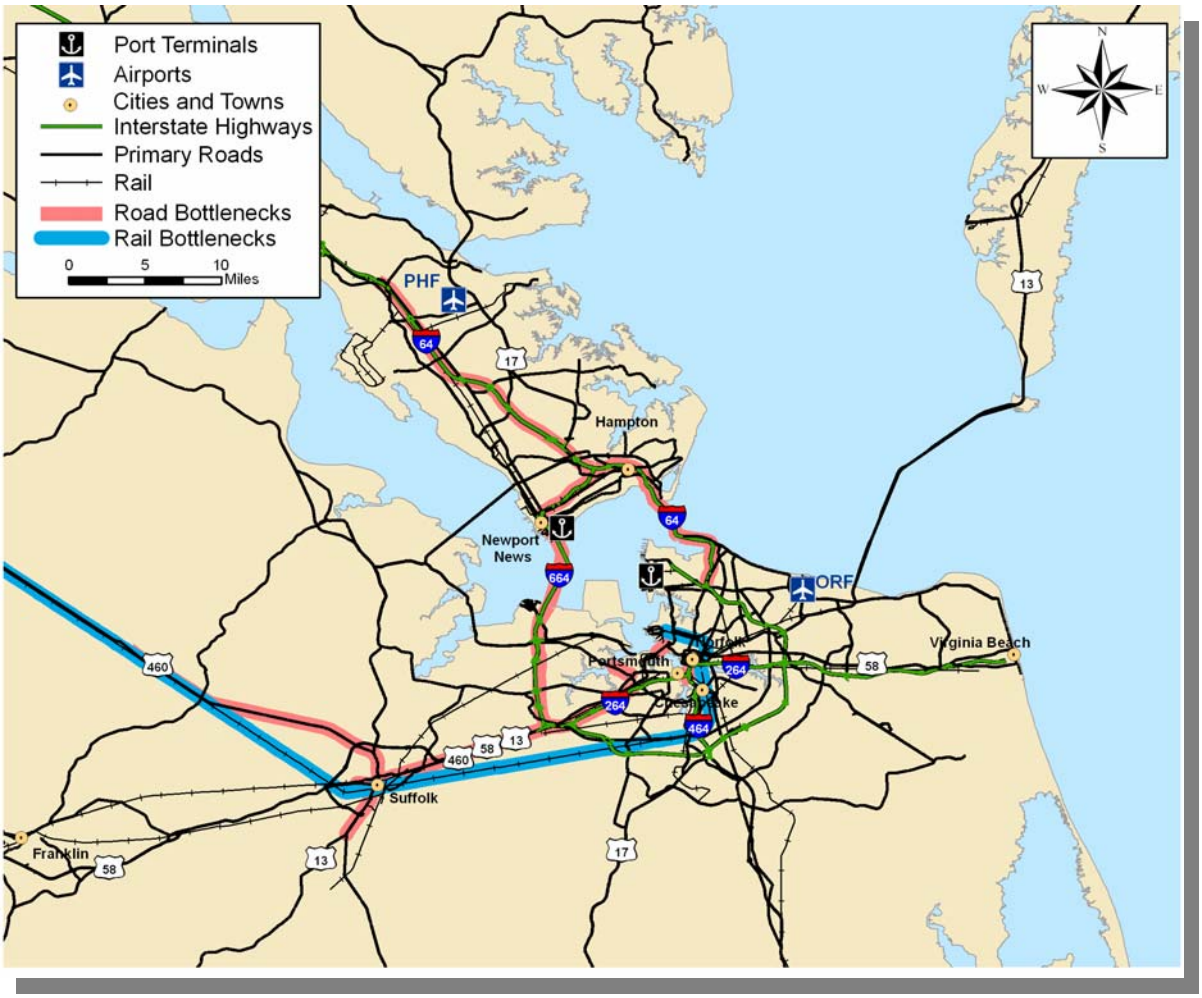


Figure 6.21 Current Virginia Freight Bottlenecks
Western Virginia

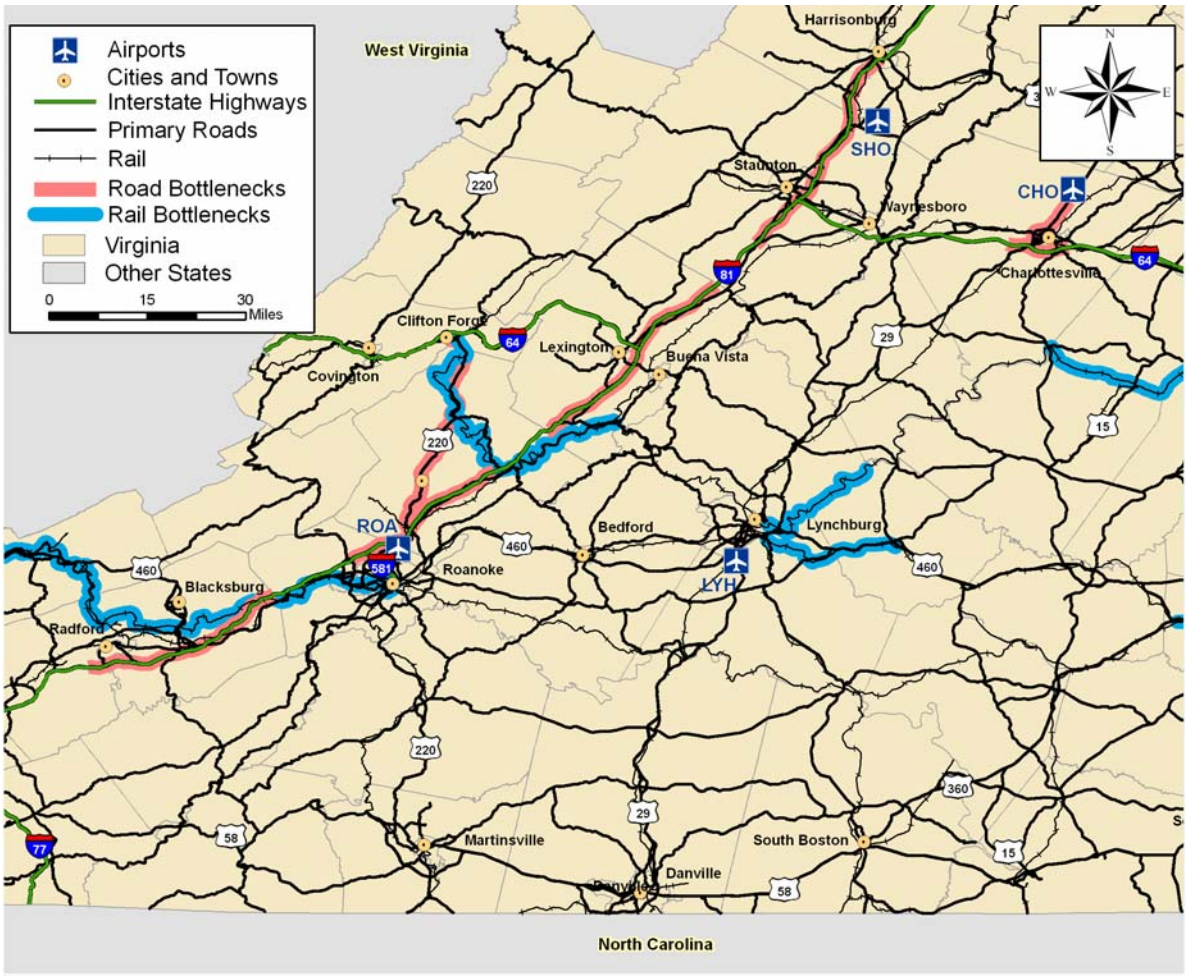


Figure 6.22 Current Virginia Freight Bottlenecks
Central Virginia

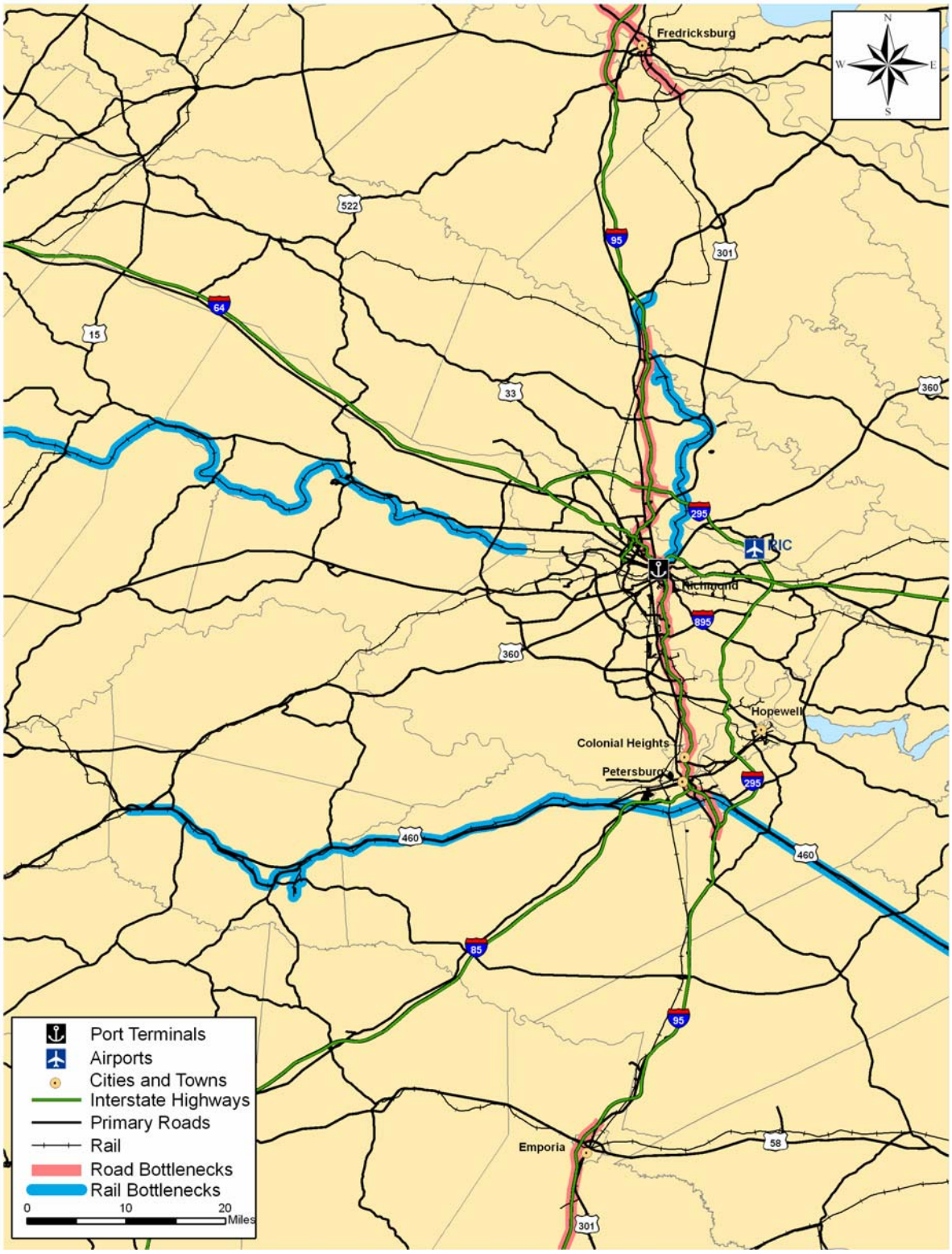
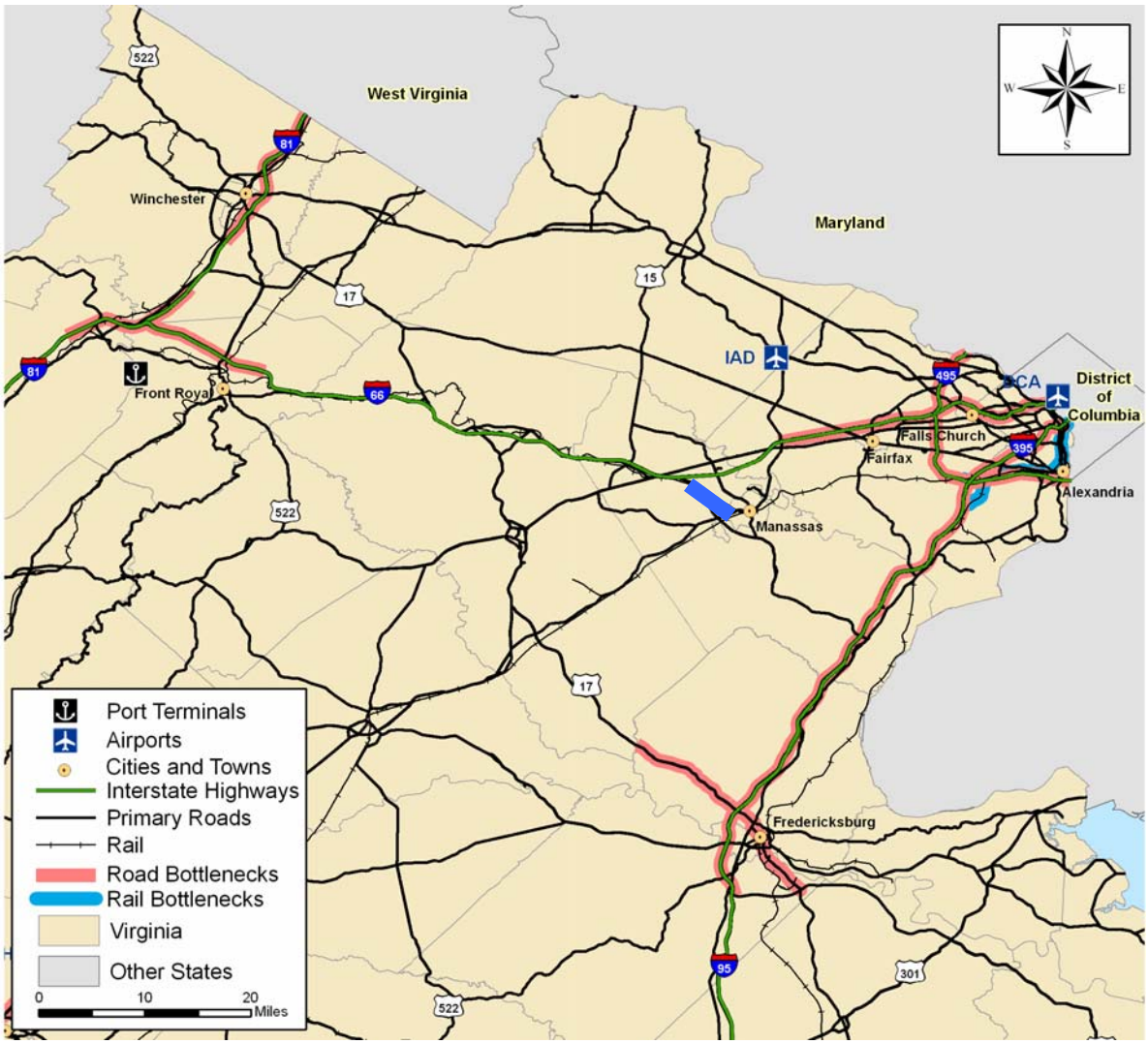


Figure 6.23 Current Virginia Freight Bottlenecks
Northern Virginia



6.4.2 Multimodal Issues and Strategies

Virginia's public transportation agencies, communities, and private stakeholders already have done extensive work in identifying and advancing freight-supporting infrastructure projects. While the Statewide Multimodal Freight Study aims to identify additional project opportunities, many of the most important opportunities already are known and under discussion.

One of the negative findings from this exercise is the need to confront today's fiscal reality – namely, that Virginia's ability to implement these improvements is severely

constrained by the availability of transportation funding. Much of the State's transportation budget is formula-allocated and maintenance-oriented, and funding to develop new capacity is far below identified needs to serve freight and passenger movement throughout the Commonwealth. Virginia is a national leader in pursuing innovative strategies such as public-private partnerships and tolling, and while these can help fill some of the gaps and provide greater implementation flexibility, they cannot substitute for adequate levels of total program funding.

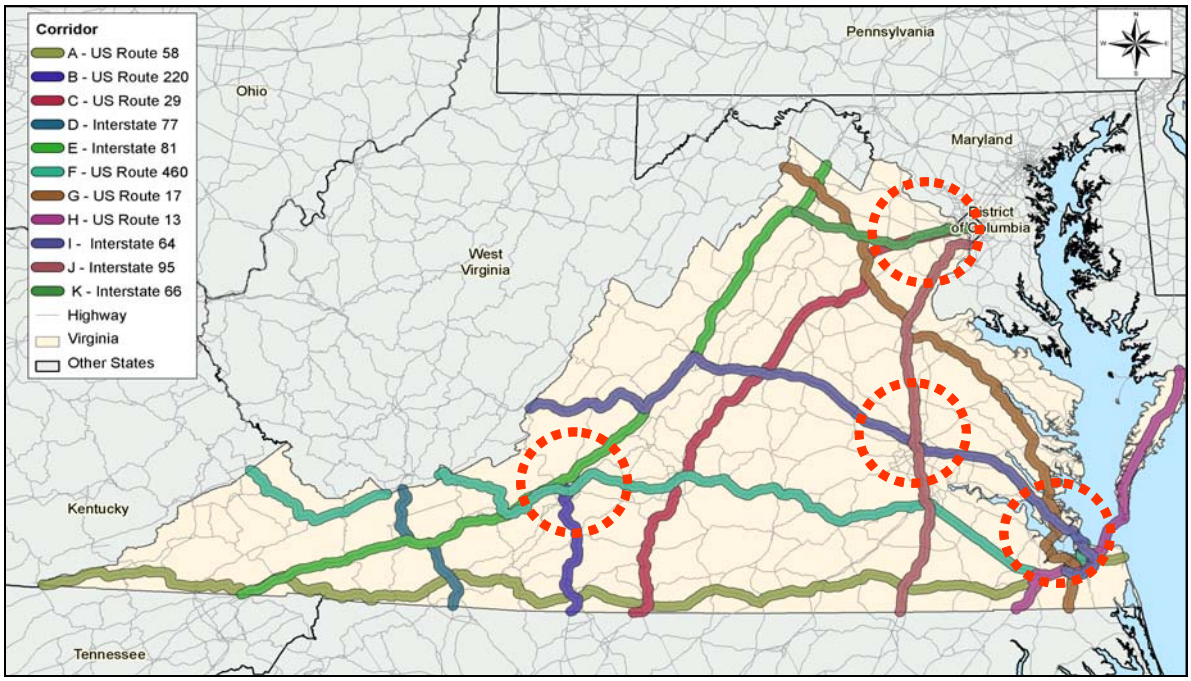
Freight analysts, as well as advocates, would like to see all of these projects advanced as soon as practical, but it must be recognized that progress on many – if not most – will depend on the identification of new revenues, and the timetable for accomplishing this is far from certain. In the meantime, due to funding limitations, project opportunities will need to be carefully prioritized and traded-off, to obtain the greatest public benefit for the least public cost.

This cannot be accomplished without a multimodal approach to transportation planning that considers both **critical corridors** and **subregions**. Traditionally, transportation projects are classed according to their mode – highway, rail, port, airport, etc. – and planned and implemented by different sets of public and/or private stakeholders at a fixed level of geographic interest. This is true for virtually every state as well as the Federal government. It derives more or less directly from the fact that funding sources for different types of projects come from distinct "pots" with mode-specific obligations relating to their use. Modally oriented planning has succeeded in building the transportation system we enjoy today, but it works best when all modes are appropriately funded. As funding becomes more limited, cross-modal cooperation and investment tradeoffs among and between modes become more critical.

The VTrans 2025 effort aimed to promote a planning approach that emphasized the consideration of all transportation modes along extended corridor-level geographies. This approach is particularly well-suited for freight planning, because freight trips (by truck, rail, water, or air) often involve hundreds (or thousands) of miles of travel, across local and state and (often) international borders, using combinations of different transportation modes (truck, truck and rail, water and rail or truck, air and truck, etc.).

A major opportunity for future phase work of the Virginia Statewide Multimodal Freight Study is to expand on the VTrans 2025 philosophy and apply multimodal corridor-based planning to critical freight corridors. This is a value-added overlay to the modally oriented planning performed by Virginia's Department of Transportation, Department of Rail and Public Transit, Virginia Port Authority, and Department of Aviation. There is substantial overlap between the VTrans corridors and the freight bottlenecks identified in the previous section of this report.

Figure 6.24 Critical Corridors and Subregions for Multimodal Freight Planning



7.0 Conclusions and Next Steps

Phase I of the Virginia Statewide Multimodal Freight Study was designed primarily to collect data, inventory conditions and needs, and draw general conclusions. These conclusions include the following:

- Maintaining and improving freight system performance – in terms of travel time, cost, reliability, capacity, safety, and security – will enhance Virginia's competitiveness and attractiveness as a business economic location, as a preferred gateway for global trade, and as one of the nation's most attractive places to live and work.

- Currently, Virginia's freight system is generally performing at a high level, but it faces increasing pressure to maintain performance and keep pace with growing demand.

- Virginia has significant freight needs, with significant costs, and very constrained funding for improvements. It is critical to make the most efficient use of Commonwealth resources, public-private partnership opportunities, and innovation. This requires a multimodal approach to freight transportation planning and programming, supported by the best available data and analytical tools, and informed by meaningful input from public and private interests.

- The next step is to develop freight policy and infrastructure recommendations, along with the transportation and economic analyses necessary to support them.

Phase II of the Virginia Statewide Multimodal Freight Study is envisioned to have five major components:

- Data and analytical tools development, addressing both freight transportation system modeling and economic cost-benefit analysis;

- Freight project planning for critical corridors and subregions, including freight planning analyses, including identification and analysis of recommended multimodal projects;

- Statewide policy analysis, addressing program-level impacts, regulation, funding, and other priority issues, with identification of recommended approaches;

- Expanded public and stakeholder outreach, to obtain input and feedback on potential strategies and recommendations; and

- Institutional and organizational recommendations to help the Commonwealth best approach freight challenges in the coming years, through performance-based freight planning.

Finally, Phase II should address a series of difficult but important questions:

- Given Virginia's projected freight needs, and given the improvements that are already in the planning stages, is it enough? Or will there still be critical deficiencies?

- What are the economic and transportation infrastructure costs to Virginia of these deficiencies? Conversely, what are the economic benefits of addressing them?

- What additional improvements – whether infrastructure, policy, or institutional – will be needed to meet Virginia's emerging and future needs? How will critical corridors and regions be affected? What are the key scenarios and variables for growth, the environment, and other critical factors?

- How will needed improvements be funded? What are the fair and appropriate contributions of governments, and of the private sector?

- How should the Commonwealth approach freight planning on a consistent institutional basis, with its public and private sector partners, in Virginia and other states?