Virginia's Long-Range Multimodal Transportation Plan 2007-2035

CONGESTION

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TACKLING CONGESTION IN VIRGINIA

The Commonwealth of Virginia faces a future where traffic congestion continues to impose added costs for businesses and individuals, particularly in Northern Virginia, the Hampton Roads region, and the Richmond metropolitan area. In some respects, traffic congestion is a natural consequence of economic activity, and can be tolerated in small doses. However, excessive congestion is a drag on the economy, and inflicts stress and strain on travelers. As population and economic activity increase, traffic congestion will also grow unless aggressive steps are taken to manage the forecast surge in demand.

The major drivers of increases in demand are population and employment increases. Forecasts of population growth range from 28 to 35 percent from 2010 to 2035, while employment is expected to rise by as much as 50 percent. Vehicular traffic, measured in daily vehicle miles traveled (DVMT), may continue to increase as fast as or faster than population through 2035. Meanwhile, transit ridership (192 million unlinked passenger trips per year in 2007) could increase by as much as 4 percent per year, yielding a high forecast of 586.6 million passenger trips per year in 2035.

There will never be enough resources available to eliminate congestion entirely. However, Virginia has several options available in the effort to manage congestion, to keep it from crippling commerce and imposing unreasonable burdens on citizens of the Commonwealth. These options fall into the categories of mobility strategies, proximity strategies, and demand management strategies.

On the supply side, there are improvements that can be made to the roadway network and to transit facilities that will make the system operate better and carry more people. Examples of some of the "megaprojects" that will be completed over the next decade or so are the Dulles Metrorail extension and the construction of high occupancy toll (HOT) lanes on the Capital Beltway and on I-95/I-395 in Northern Virginia. These projects will bring congestion relief by expanding capacity in critical congested corridors. The rail extension to Dulles will get people out of their cars in the congested Tysons Corner area and out toward Loudon County, while HOT lanes will keep traffic flowing through dynamic pricing.

This kind of major capacity expansion is likely to be the exception, rather than the rule, however. More typical of capacity increases will be investments in Intelligent Transportation Systems (ITS) technology and other transportation system management and operations measures that will help to squeeze more capacity out of the existing network. Examples of this approach include managed lanes, which maximize capacity through value pricing, vehicle eligibility, and access control; improved traveler information, using dynamic message signs (DMS), 511 Virginia Systems, VA Traffic and pre-trip planning assistance; improved incident management, using vehicle detection technology, closed circuit television (CCTV), Safety service patrols (SSP) and Ramp Metering; and improved transit technology using transit signal priority, automated vehicle location (AVL), Collision-Prevention Technology and other advanced public transportation systems technology. Low-tech solutions such as Safety Service Patrols can reduce the impact of breakdowns and minor incidents, and improved coordination and information sharing among agencies can reduce the impacts of crashes and other serious incidents on traffic flow.

Travel demand management (TDM) strategies range from transportation-land use coordination, to community programs, to workplace-oriented techniques such as compressed

work weeks and telework programs. Through the Department of Rail and Public Transportation (DRPT), the Commonwealth partners with local commuter assistance programs, Metropolitan Planning Organizations, various Transportation Management Associations, and others to provide TDM programs throughout the Commonwealth. TDM programs help manage travel demand to make our systems more efficient by moving more people in fewer vehicles, moving trips out of the peak period, or eliminating trips altogether.

Effective coordination of transportation and land use can be measured in many ways and is generally best addressed at the regional rather than at the state level. State initiatives and incentives can play a strong and positive role. Decisions about land use and development determine the transportation needs of an area – in terms of the number of trips and the modes that can be used to make those trips. The availability of transportation facilities also has an impact on land use, since accessibility affects the ability to develop property to its highest and best use. Thus, both land use decisions and transportation investments affect the level of mobility and accessibility in the region, the viability of each mode, and the overall efficiency of transportation facilities and services.

One policy approach to address concerns about increasing congestion due to VMT increases is to encourage higher density residential development and transit oriented development. Higher population density can facilitate the use of transit, walking and biking because it makes such services and infrastructure cost-effective. This class of actions can be referred to as "proximity strategies," since the clustering of origins and destinations reduces the need to expand transportation services to provide mobility. Striving for jobs-housing balance is another way to limit the impacts of inter-regional work travel and congestion.

Major opportunities for future initiatives include targeted capacity expansion; expanded high occupancy vehicle (HOV) and high occupancy toll (HOT) lane expansion; expanded travel options, including transit and non-motorized modes; expanded travel demand management programs; and promotion of transit oriented development (TOD). Virginia should also be looking for innovative ways to finance transportation improvements, including public-private partnerships, and road user fees.

Public-private partnerships, implemented through the Public-Private Transportation Act (PPTA), have been working well for the Commonwealth of Virginia since 1995. Examples of successful projects include:

- Route 895 Pocahontas Parkway, an 8.8-mile-long tollway built 1998-2002; 92% private funding, the project was awarded at $324 million, to be completed in 44 months; completed at $314 million, $10 million under budget, and in 49 months.
- Western Route 288 Richmond beltway, a 17.5-mile-long freeway built 1999-2004; 100% public funding; the largest section of the project was awarded under PPTA in May 2001 at $236 million, to be completed in 29 months; completed at $236 million, on budget, and in 41 months.
- Jamestown 2007 or Route 199, a five-phase $31.8 million PPP converted from a federal project in order to build the project well before the traffic anticipated for the 400th Celebration of the Jamestown Settlement.
- I-495 Capital Beltway Project, an unsolicited project from Fluor-Transurban; a 14-mile project from the Springfield Interchange to just south of the Georgetown

Pike exit; 7 entry/exits, as well as 5 intermediate entry/exit points, and direct HOV to HOV access at the Dulles Access Road and I-66; comprehensive agreement signed in April 2005, completion estimated end of 2012.

- I-95/395 BRT/HOT Lane project, unsolicited project from Fluor-Transurban, approximately 56 miles from Fredericksburg to Washington; with electronic toll collection and variable pricing of tolls.

Notably, several of the above projects involve some form of user fees to back construction bonds. For instance, the Pocahontas Parkway is a major project valued in excess of $318 million, of which $300 million was funded by a revenue bond issue that will be repaid from tolls. Road user fees are likely to become more important as several trends converge to make current transportation financing arrangements untenable. Some states, including the States of Oregon and Washington, have undertaken pilot tests that are assessing the challenges involved in implementing VMT fees rather than fuel taxes.

WHAT IS CONGESTION, AND WHY DOES IT MATTER?

Congestion, simply put, is a condition caused when the demand for use of a given transportation facility is greater than the available capacity. Congestion can affect all modes of travel, including highway passenger and freight vehicles, freight rail, commuter rail, Metrorail, bus, air traffic and airport ground traffic, ports, and waterways. Traffic demands can vary significantly depending on the season of the year, the day of the week, and even the time of day. Furthermore, traffic congestion can be highly subjective; one person's teeth-grinding wait at a traffic signal may seem inconsequential to someone accustomed to city streets that routinely suffer near-gridlock conditions.

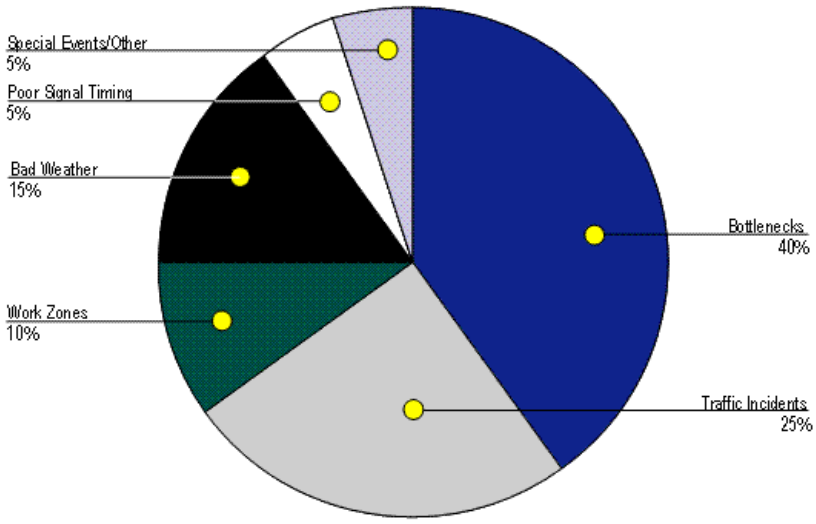
Congested conditions are characterized by the breakdown in the flow of vehicles, leading to slower speeds and lower vehicle throughput. Congested conditions are also highly sensitive to disruption, such that a minor incident or adverse weather conditions can exacerbate the underlying capacity problem and lead to more extreme delays.

More important than the severity, magnitude, or quantity of congestion is the reliability of service on a transportation network. Travelers in a large metropolitan area may be able to live with the fact that a 20 mile freeway trip takes 40 minutes during peak periods, so long as this predicted travel time is reliable and is not 25 minutes one day and 2 hours the next. Reliability is particularly important to the freight community, where the value of time under certain just-in-time delivery circumstances may exceed $5 per minute. However, delay can also adversely affect worker productivity if employees are late to work due to traffic congestion.

A number of problems contribute to traffic congestion, beyond the fundamental of too many vehicles competing for too little space. These problems include:

- **Bottlenecks**—points where the roadway narrows or where regular traffic demands cause traffic to backup due to a lack of needed capacity are the largest source of congestion.
- **Traffic incidents**—crashes, stalled vehicles, and debris on the road cause about 1/4 of congestion problems.
- **Work zones**— the work zones for new road building and maintenance activities like filling potholes are caused by necessary activities.
- **Bad weather** cannot be controlled, but travelers can be notified of the potential for increased congestion.
- **Poor traffic signal timing**—the faulty operation of traffic signals or green/red lights where the time allocation for a road does not match the volume on that road are a source of congestion on major and minor streets.

Figure 1 Causes of Congestion



- **Special events** cause "spikes" in traffic volumes and changes in traffic patterns, and either cause delay on days, times or locations where there usually is none, or add to regular congestion problems. [1]

The congestion caused by these actions can be reduced by a variety of strategies, which will be dependent on the cause or causes.

Urban Congestion

Traffic congestion is more than just an irritant. Congestion increases the cost of mobility for everyone and reduces the efficiency and effectiveness of the transportation network. The ability to move goods and people at relatively low cost contributes directly to the well-being of citizens. These lower costs result in savings to consumers and higher profits for businesses. In some respects, answers to urban traffic congestion will require new thinking about mobility and accessibility; future solutions will include not just expanded capacity or improved system management, but attention to land use and proximity strategies.

The costs of congestion have risen over the past decades -- lost wages, eroded productivity, and the increased cost of freight transport. As noted in **"Virginia Performs,"** a combination of factors contributes to congestion, including road capacity and conditions, commuting demands, and the costs of using the road. If population in the area around a roadway increases, the likelihood of congestion increases. A road in disrepair has a lower capacity than a new road or a road in good condition and is more likely to experience congestion.

In recent years, transportation agencies have focused on factors contributing to congestion, including both capacity problems and operational issues. More than half of all congestion is non-recurring – caused by crashes, disabled vehicles, adverse weather, work zones, special events, and other temporary disruptions to the transportation system.

The impact of work zones on congestion is expected to increase. VDOT hopes to move forward with "shovel-ready" projects statewide, enabled by the "Stimulus package" (the American Recovery and Reinvestment Act, or ARRA). At the same time, Northern Virginia is on the brink of not one, but several simultaneous large-scale projects in Northern Virginia, which will each have very significant benefits for congestion reduction, including:

- I-495 HOT lanes;
- I-95/I-395 HOT lanes; and
- Dulles Metrorail Extension.

As **"Virginia Performs"** points out, "The ability to move goods and people around the Commonwealth at relatively low cost is a substantial benefit for residents, and also reduces the total cost of the goods and services they receive. But congestion increases these costs; strained and congested roads eat up time and fuel, exacerbate road and vehicle wear-and-tear, and increase driver stress." Traffic congestion also contributes to increased vehicle emissions. However, since 1990, volatile organic compounds (VOC) and nitrogen oxides (NOx) emitted into the air from highway vehicles have continued to decrease, due to cleaner vehicles entering

[1] FHWA - http://www.fhwa.dot.gov/congestion/index.htm; Figure: http://ops.fhwa.dot.gov/congestion_report/

the fleet each year as mandated by the Environmental Protection Agency (EPA), increased transit use, increased teleworking, and better land use planning.

On the other hand, fuel usage per capita had increased through 2007 at an average annual rate of 1.3 percent per year over the previous five years. From an environmental perspective, a decrease in fuel consumption is associated with improved air quality, lower GHG emissions and more efficient use of resources. Transportation is the largest energy-using sector, accounting for approximately 42 percent of the total energy used in Virginia (2007). Transportation sources emitted 55.9 million metric tons of greenhouse gases (GHG) in 2007, roughly 1/3 of overall GHG emissions in the Commonwealth. Levels of GHG emissions from transportation sources are affected by fuel efficiency of the vehicle fleet, the types of fuel used, the number of vehicle miles traveled and traffic operations. According to the Department of Environment Quality's latest estimates, GHG emissions from transportation sources will increase 12 percent to over 61.3 metric tons by 2025 (inclusive of the 2007 CAFÉ standards).

Rural Congestion

Congestion is not just an urban problem. Traffic congestion can affect goods movement along congested corridors like I-81 and I-95; seasonal congestion can also have an impact on tourist and holiday traffic. Although it is more sporadic, delay often occurs in rural areas and heavily traveled intercity corridors, such as I-95 on the East Coast. Particularly hard hit are the arteries around popular tourist destinations, such as beach and ski resorts, in peak season. This kind of traffic congestion can be seen on routes headed for summer beach destinations on the Delmarva Peninsula. Work zones, poor weather, and special events are all causes that can create major backups in rural areas just as they can in urban areas.

Some rural corridors experience congestion in part due to heavy freight traffic. I-81 includes 855 miles in six states, including 325 miles in Virginia. The route, which serves both as a local and regional connector and as a national and international freight corridor, carries an outsize share of freight traffic. Compared to other routes, I-81 carries less total traffic (44,185 vehicles/day, 16.1 mil/yr) but carries the highest volume and percent of truck traffic (27%). Freight traffic includes a large percentage of through movements (trips originating and ending outside of Virginia.

CURRENT CONGESTION CONDITIONS AND PERFORMANCE IN VIRGINIA

Road usage, as measured by vehicle miles traveled (VMT), has increased significantly over the past few decades as rising incomes have led to increased car ownership, increased desire for lower density living arrangements, policies that encourage more dispersed patterns of residential development, new road capacity, and a long-term trend toward lower real costs of personal transportation. In the last two decades, increases have occurred in the number of road miles that experience congestion, the frequency of serious congestion incidents, and the number of localities that experience chronic congestion, especially during prime commuting hours. Travel delays on Northern Virginia's roadways are nearly twice the national average.

In 2006, according to VDOT's **"Congestion At A Glance"** report, Virginia had the 6th highest average commute time in the nation (26.9 minutes). While higher than North Carolina (23.4 minutes) and Tennessee (23.5 minutes), the average time is lower than Maryland's 30.6 minutes. The national average was 25 minutes.

Congestion problems are most serious in the heavily populated Northern Virginia and Hampton Roads regions. Locally, the U.S. Census measured the average commute time for 27 of Virginia's larger counties and cities in 2006. The highest average commute times were all in the Northern region with Prince William County (39.5 minutes) and Stafford County (39.2 minutes) leading the way. Lynchburg City (16.3 minutes) in the West Central region had the lowest commute time in the Census study.

The Virginia Department of Transportation (VDOT) collects congestion data from continuous count stations and other devices on key corridors. VDOT tracks congestion on a rolling 13 months basis; congestion statistics are updated quarterly, and reported as part of the VDOT Dashboard. Targets for the 2008 - 2010 Biennial strategic plan measures were established in 2007. The target is defined as: "At interstate locations, by 2010, 85% of the interstate system will be congestion free over a rolling 13 month period."

When these targets were set, about 88% of Virginia interstate highways were considered "congestion-free." **Virginia Performs** notes that "At the time all indicators showed that congestion would increase (and the percent of congestion free interstates would decrease), especially in traffic heavy Northern Virginia and Hampton Roads. The Department thought that, given trends and available resources, a decline in the percent of congestion free interstates was inevitable, and any congestion mitigation strategies the department could employ would only slow the rate of decrease."

In fact, events have played out quite differently in the very recent short term. Changes in petroleum retail prices, the economic slowdown, and other factors have led to unprecedented changes in travel demand. Efforts to save at the pump and reduced work trips due to rising unemployment numbers have reversed the upward trends in vehicle miles traveled, which has caused 2007 congestion figures to hold steady at 2006 levels. In fact, according to some reports, traffic congestion in Virginia's largest metropolitan areas has significantly declined for 2008. Given the unfortunate causes, the recent drop in congestion has been a mixed blessing.

TTI Urban Mobility Report Travel Delay Data

Travel delay is measured as the extra time required to travel over and above what would be experienced during free flow traffic conditions, and illustrates the effect of congestion. The Texas Transportation Institute (TTI) publishes congestion data for 85 urban areas across the country. TTI reported in the 2007 Urban Mobility Report that in 2005, 49% of the Washington DC area daily travel was congested, costing the region over $2 billion in lost productivity and wasted fuel. Annually, each traveler in the DC area wasted 60 hours sitting in traffic, 22 hours more than the national annual delay, and used an additional 43 gallons of gasoline. In the Washington region, delay peaked in 2003, dropped in 2004, and remained stable in 2005. Similarly, in Virginia Beach and Richmond, delay remained flat in 2004 and 2005.

The metro area around Washington, DC was tied with San Francisco, CA and Atlanta, GA as second in the nation for average hours of delay per traveler. This ranking is considerably higher than any other region in Virginia but also much higher than for urban areas in neighboring states. The Washington DC area was eighth overall in total delay in person hours and total cost attributable to congestion, including both fuel wasted in congested traffic, the

cost of delay to individual travelers, and economic losses to the trucking industry.[2] Although TTI rankings roughly correlate with area size, Richmond, VA has less congestion compared to other cities in its size class.

INRIX National Traffic Scorecard

According to the INRIX *National Traffic Scorecard*, Virginia's three largest metropolitan areas were among the nation's top 100 congested regions.

For the past two years, traffic information provider INRIX has published a "*National Traffic Scorecard*" that uses methods similar to the TTI Urban Mobility Report to track congestion. The INRIX Scorecard defines bottleneck congestion as times when the hourly speed is half or less of the uncongested speed for that road segment. For this estimate, 30,909 individual road segments (based on an industry convention known as "TMC location codes") were analyzed to determine the extent and amount of average congestion each had in 2007 and 2008. Nationwide, there were more than 9000 road segments that experienced five hours or more of congestion in 2007.

In 2008, more than 6000 segments registered at least one hour of the week when one can expect to travel at less than half the free flow or uncongested speed. Overall 28% fewer segments had at least one hour of congestion in 2008. Overall, the top 1000 bottlenecks in 2008 were congested an average of 26 hours each week (versus 31 hours in 2007), with an average speed while congested of 18 MPH (versus 16 MPH in 2007). Table 1, in an Appendix to this report, provides details on delay, bottleneck locations, and other information from the INRIX Scorecard for Virginia.

Northern Virginia

The Northern Virginia region is the most congested district in the Commonwealth. In **Virginia Performs**, VDOT has set a target of 59 average hours of delay per traveler in the Northern Virginia region, due to congestion on state highways, as measured by the Texas Transportation Institute. In 2005, travelers in the Northern Virginia area experienced 60 hours of delay each year due to traffic congestion. The impacts of the 2008 – 2010 Biennium strategies implemented with the period's start in FY2009 will be reviewable in the 2011 TTI publication, at the earliest.)

Hampton Roads

Cities in the Hampton Roads region tended toward average commutes of 22 to 24 minutes, though Suffolk City had an average commute time of almost 29 minutes. Relative to peer Metropolitan Statistical Areas (MSAs), the Virginia Beach-Norfolk-Newport News, VA-NC MSA (Hampton Roads MSA) had the second lowest commute time at 24 minutes. Only the Savannah, GA MSA had a lower average commute time at 23 minutes. Compared to the other MSAs in Virginia, however, Hampton Roads has one of the longer average commute times in the state, over 25 percent longer than the Harrisonburg MSA (the leading Virginia MSA) whose average commute time is just over 19 minutes. In the Hampton Roads region, congestion is most serious where traffic is forced into bottlenecks at the bridges and tunnels.

[2] TTI uses$14.60 per hour of person travel and $77.10 per hour of truck time.

In **Virginia Performs**, VDOT has set a target of 30 average hours of delay per traveler in the Virginia Beach metropolitan area, due to congestion on state highways, as measured by the Texas Transportation Institute. Community leaders have made progress on several initiatives to improve transportation system effectiveness and efficiency. High-density population and housing provide enough passengers for the efficient use of transportation systems. The Hampton Roads region is second only to the Northern region in Virginia in the number of people and houses per square mile.

Richmond

In **Virginia Performs**, VDOT has set a target of 18 average hours of delay per traveler in the Richmond metro area due to congestion on state highways, as measured by the Texas Transportation Institute. In the most recent year for which figures are available (2005), travelers in the Richmond area experienced 20 hours of delay each year due to traffic congestion. This value has increased by 233% since 1982 when TTI recorded six annual hours of delay per traveler in the Richmond region.

From 2000 to 2006, the region's average annual growth rate for vehicle registrations (2.9%) was more than double that of the area's average annual growth in population (1.4%). The Richmond area's vehicle registration is increasing at a faster rate than that of the state and nation. In 2006, there were 925,988 registered vehicles in the Richmond region, or .98 vehicles for every area resident. By comparison, Virginia had .87 vehicles per person and nationally there were .82 vehicles per person.

RECENT TRENDS AND FORECASTS OF CONGESTION

Statewide

Depending on the source, population growth is forecast to rise by 28 percent to 36 percent between 2010 and 2035. Employment is expected to rise from 5.21 million jobs in 2010 to 7.75 million jobs in 2035.

Forecasting travel growth is fraught with uncertainty. Forecasts in the high range, essentially tracking the rate of growth for the period 1982 through 2007, yields a total of 483.6 million vehicle miles traveled daily (DVMT). Moderate forecasts, based on the population and employment growth rates from the Virginia Employment Commission and NPA Data Services, reflect the period from 1991 – 2007, when the population/VMT ratio was relatively stable. These forecasts range from 345.4 million to 321.2 million DVMT. Another estimate, using assumptions about lower growth rates than those observed previously, yields 336.7 million.

Forecasts of transit use, based on the 1997 – 2007 annual percentage growth of 4.07 percent, yields a high forecast of 586.6 million unlinked trips per year by 2035. A more moderate rate of growth of 2.27 percent (based on the average annual percentage growth in transit use from 1991 – 2007) yields 360.3 million unlinked trips in 2035. Using the negative growth rate that was experienced in 1991 – 1997, a decrease of -0.65 percent, yields 159.9 million trips statewide in 2035. The moderate growth scenario represents a total increase almost double the 192 million trips taken in 2007. The price of fuel could have an impact on the level of ridership and on VMT, as could changes in assumptions about household income.

Multimodal and Modal

The Port of Virginia is the third largest port on the East Coast, trailing New York/New Jersey and Savannah, Georgia. The average annual growth rate in containerized cargo through the Port has increased 8 percent per year (inclusive of the new APM Terminal). (Twenty-foot equivalent units (TEUs) are used as the standard measurement for shipping containers of various lengths and for describing the capacities of terminals. For instance, one standard 40-foot container equals 2 TEUs.) In 2007, 2.13 million TEUs passed through the Port's four terminals, up from 2.05 million units in 2006. By 2010, the Port anticipates 2.3 million TEU's. The impact of current declines in global trade has not yet been factored in to these forecasts.

Previous forecasts for containerized cargo indicate an average long term growth rate of 5.0 percent per year. To accommodate future growth, the VPA plans to renovate and expand existing facilities, including construction of the new Craney Island Marine Terminal. This terminal is scheduled to open its first phase in 2020.

The majority of cargo moving in and out of the Port of Virginia is transported by trucks, though rail moves 31 percent, up from 24 percent in 2005, and is the fastest growing segment of the Port's business. To encourage intermodal activity, the VPA has established a rail target of 50 percent at Craney Island.

VIRGINIA'S CURRENT LEADERSHIP ROLES AND UNIQUENESS

The **Virginia Performs** report points out a number of strategies that can help manage road congestion. The state can

- expand capacity in congested areas;
- provide alternative transportation, such as public buses and high-speed trains;
- charge for road use in a way that prices each driver's contribution to congestion; and
- manage development patterns to reduce congestion growth.

Virginia has traditionally relied on the first two methods for reducing congestion. To date, these efforts have not stopped increases in congestion, although investments in these areas have slowed the increase and cost of congestion in the Northern Virginia area. Transit services are an essential part of the transportation infrastructure in many areas of the Commonwealth and provide mobility and travel choices for Virginia's citizens, visitors and those traveling through the state. Transit ridership has increased significantly each year since 2003, and the number of trips made on transit in the areas served by the 56 transit operators averaged 25 trips per person in 2007.

Public transportation relieves congestion and reduces delay by removing vehicles from the roadways. If public transportation were discontinued in Virginia, the 192 million transit trips made in 2007 would likely have been made in automobiles or not at all. Notable growth has occurred in the Hampton Roads and Lynchburg service areas. According to the Texas Transportation Institute, the effect of public transportation improvements in the Washington, DC/Northern Virginia area reduces the amount of delay by 25,655 thousand hours. And annual

congestion cost savings from public transportation for the Virginia Beach and Richmond areas are $23.4 million and $3.5 million, respectively."

Virginia has an extensive **High Occupancy Vehicle (HOV)** system in the Northern Virginia and the Hampton Roads areas with over 137 miles of interstate lanes dedicated to carpools and buses during peak hours. However, the facilities differ in design and effectiveness. The Northern Virginia facilities on I-95/I-395 are barrier- separated and require three or more persons per vehicle, while all others allow for two or more persons. In Northern Virginia (2007), one lane of the I-95 HOV facility provided free-flowing traffic conditions to 10,750 people in 2,840 vehicles equating to almost four people per vehicle. By comparison, one conventional I-95 lane carried 5,420 people in 5,000 vehicles, or a little more than one-half of the people carried by one lane of the HOV facility.

Park and Ride Spaces

There are approximately 330 Park and Ride lots statewide (114 lots owned by VDOT, 26 owned by jurisdictions, transit companies, local colleges, etc., and approximately 189 lots that are "unofficial"). These lots provide nearly 59,000 spaces - an increase of 3.5% from 2005. Transit serves 139 lots containing approximately 46,500 spaces.

On the HOV facilities in Hampton Roads, while the number of persons per lane continues to rise in the conventional lanes, the HOV lanes saw a decrease in 2007.

One incentive for commuters to use the HOV facilities is that they save travel time. In 2007, carpoolers in Northern Virginia saved almost 20,000 hours each AM peak period while those in Hampton Roads saved almost 3,400 hours.

Virginia has begun construction of **High Occupancy Toll (HOT)** lanes on the I-495 Capital Beltway in Northern Virginia. HOT lanes price travel based on the level of congestion, thereby efficiently allocating road capacity based on market demand. As HOT lanes become congested, the toll increases. When completed in 2013, the project will provide two HOT lanes in each direction stretching 14 miles from the Springfield Interchange to just north of the Dulles Toll Road. HOV-3 vehicles and buses will be able to ride free while non-HOV vehicles will pay a variable toll to use the facility. These HOT lanes will connect with HOT lanes on I-95, and HOV lanes on I-66 and the Dulles Toll Road to provide a seamless HOV network in the region.

VDOT has undertaken other measures to keep travelers informed about potential delays. Road Weather Information System **(**RWIS) play a critical role in VDOT's emergency response operations by providing key weather related information. **Traveler Information Services** provide the latest information on road closures, work zones, traffic incidents, and real-time traffic from a score of roadway cameras. Programs like **Commuter Connections** connect workers with carpools, while **Telework!VA** provides financial incentives and training for businesses to establish their own employee telework programs.

Land Use

Land use is determined both by the number of individuals who choose to live in an area and zoning and other regulations imposed by local and state governments. Transportation networks and geographic barriers also influence land use by influencing the ability of people to

commute to work from different locations. Effective coordination of transportation and land use can be measured in many ways and is generally best addressed at the regional rather than at the state level. Decisions about land use and development determine the transportation needs of an area – in terms of the number of trips and the modes that can be used to make those trips. Thus, both land use decisions and transportation investments affect the level of mobility and accessibility in the region, the viability of each mode, and the overall efficiency of transportation facilities and services. Complicating the relationship between land use and transportation is the fact that transportation decisions are best made at the regional level, but land use decisions are made at the local level.

Higher Density Development

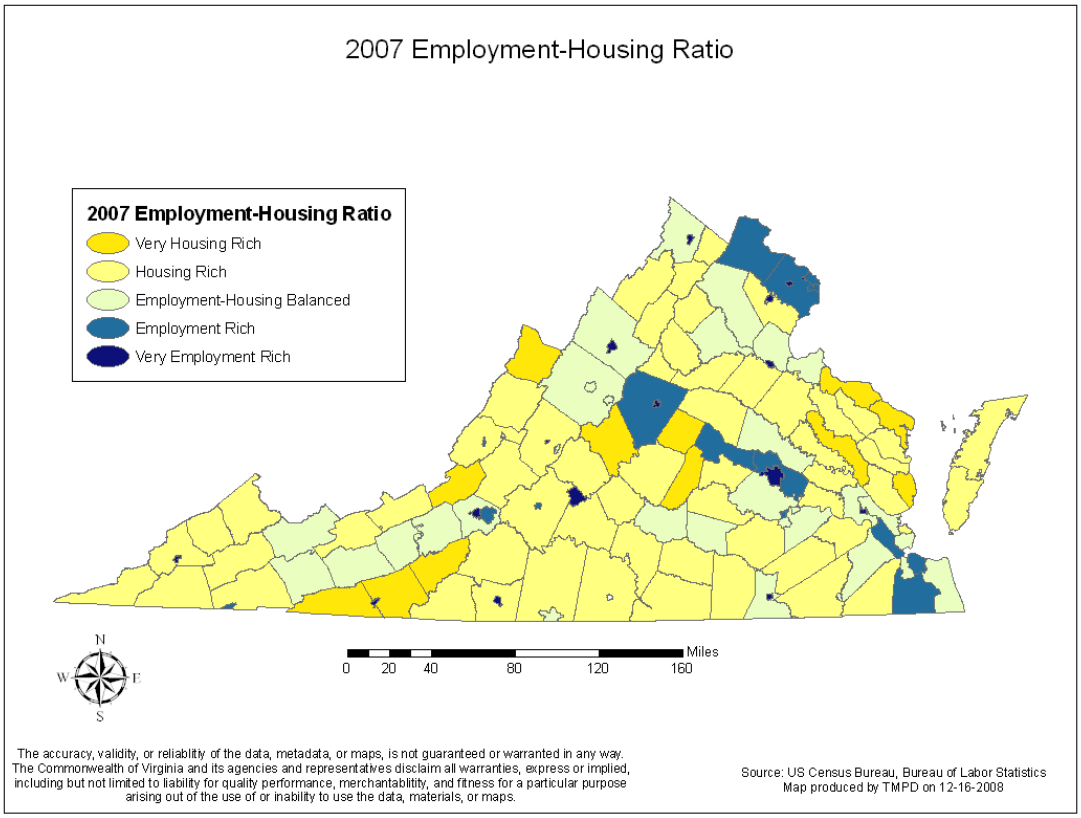
One policy approach to concerns about increasing congestion due to VMT increases is to encourage higher density residential development. Higher population density can facilitate the use of transit, walking and biking because it makes such services and infrastructure cost-effective. Density in the major metropolitan areas has been increasing slightly over time, although the changes were insignificant in 2007. A forecast for VTrans2035 of annual VMT was developed for the four PDCs that will generate 81 percent of the population increase between 2010 and 2025 based on increasing the allocation of population growth to the jurisdictions with the highest density in each PDC. Reductions from these four PDCs reduce statewide DVMT by about 9.1 million, or about 2.6 percent of the statewide total of 345.4 DVMT. (The 9.1 million DVMT reduction translates into an annual savings of 1.507 million metric tons of CO_2.)

Jobs-Housing Balance

The jobs-housing balance indicates the ratio of available housing to available jobs within a geographic area. A poor jobs-housing balance may mean that workers are unable to live close to where they work, resulting in longer commutes, traffic congestion, and more rapid deterioration of infrastructure. The jobs-housing ratio is useful because it allows both localities and the state to offer countermeasures that can influence congestion. However, this information is of limited utility because there is no perfect value that describes an ideal jobs-housing balance. Among other difficulties, home-based work trips account for only about 16 percent of total trips, and a little more than 20 percent of total VMT (notwithstanding the fact that these trips are non-discretionary and largely confined to peak travel times). In addition, a single aggregate ratio does not reflect the disconnect of low-paying jobs adjacent to high-cost housing.

Overall, the Commonwealth of Virginia maintains a healthy jobs-housing ratio. In 2007 the statewide ratio was 1.10. However, the map below indicates that while the statewide jobs-housing ratio is relatively balanced, regional ratios vary greatly.

A balance between housing and jobs in an area provides the opportunity for individuals to live closer to work and maintain shorter commutes. High-density housing can provide enough passengers for efficient transit usage; and when good public transit is provided and used, traffic congestion can be reduced. On the other hand, low-density housing can exacerbate congestion by increasing commuting distance and decreasing public transportation options.



As has long been the trend in Virginia, high concentrations of employment opportunities are located in urban areas. All jurisdictions identified as very employment rich (jobs-housing ratio > 1.6) were incorporated cities. Richmond, Lynchburg, Martinsville, Emporia, Charlottesville, Winchester, Harrisonburg, Fairfax City, Manassas, and Manassas Park are some of the cities that fell into this category. Suburban employment growth is apparent in Loudoun and Goochland Counties and the City of Chesapeake.

For Virginia's population centers of Northern Virginia, Richmond, and Hampton Roads, the jobs-housing ratio shows that a significant jobs surplus exists in both Richmond and Northern Virginia while Hampton Roads is only slightly jobs rich. Although Northern Virginia and Richmond are drawing the majority of their workers from within their regions, there exists a significant number of workers commuting from outside areas.

Of the large counties, Prince William has the lowest share of workers that are employed and live in the same county and Chesterfield is the next lowest. The American Community Survey also reports the number of people who worked outside the state of residence. In 2003, twenty-two percent of the workers living in Fairfax County worked outside of Virginia. In addition, 17% of those living in Prince William County worked outside the state. The Hampton Roads region, second only to the Northern region of Virginia in population and housing density, is looking to this kind of balanced development to support its objective of limiting VMT growth.

Traffix

A major Hampton Roads congestion-management initiative is Traffix. The mission of the Traffix program is to encourage Hampton Roads commuters to stop wasting money on gas and to reduce transportation-related emissions. Since its beginnings in 2006, Traffix has promoted increases in ridesharing, transit, and teleworking through its affiliation with the NuRide program, the Metro Area Express (MAX), and a guaranteed ride home program. Market research has indicated that the Traffix program has made people more aware of alternative modes of transportation, reduced carbon emissions by 367 tons, averted 96 tons of ozone emissions, and reduced the amount of runoff pollution heading into the Chesapeake Bay Watershed by 2500 gallons.

The Traffix program has reached 150 companies with 100 employees or more, and has involved over 100,000 employees. Between 2006 and 2008, the Ride Share program has gone from 465 participants to 2,544; NuRide members have increased from 67 to 2,011; telework participants have gone from zero to 62; vanpools have almost doubled, from 33 to 61; the guaranteed ride home program has provided 1,397 rides in 2008, up from 287 in 2006; and MAX has carried over 110,000 trips in just four months (through October 2008). Traffix has also carried out an innovative "Cure SOV" campaign, using a multimedia campaign in print, direct mail, radio, TV, outdoor advertising, and Web-based promotion.

Alternative Modes of Travel

Non-motorized modes of travel such as bicycling and walking have an important part to play in managing congestion, particularly in concert with other strategies. Efforts to increase density and improving jobs-housing balance set the stage for more people to substitute bike or walking trips for auto use.

Over 2% of Virginia's population walked to work in 2007, just below the national average. The percentage had been growing steadily since 2003; however there was a drop in 2007. Not surprisingly, more people walk to work in the large metropolitan areas where both the Washington DC and the Hampton Roads regions exceed the statewide percentage. In 2007, 0.3% of Virginia citizens over 16 rode a bicycle to work. This is lower than the national average of 0.5% but higher than neighboring states. In the Northern Virginia region, 0.5% rode bicycles to work.

In 2004, the Commonwealth developed a State Bicycle and Pedestrian Policy that requires VDOT to initiate highway construction projects with the assumption that they will accommodate walking. From 2003 through 2007, VDOT estimates that over 445 miles of subdivision street sidewalks have been made available for public use. These will improve the environment in which walkers travel and provide more options. Virginia continues to be a leader in the miles of numbered Bicycle Routes (USBR) with over 41% of the nation's total USBRs.

RELEVANT LESSONS FROM OTHER STATES

Virginia is not the only state facing congestion challenges in a resource-constrained environment. The experience of other states can be instructive as the Commonwealth of Virginia moves forward in addressing traffic congestion and other transportation issues.

Washington

Traffic congestion has been a significant issue in the Puget Sound (Seattle and Tacoma) area, due largely to the topography of the region; Seattle is confronted with a number of water obstacles and hilly terrain that make construction or expansion of roadways extremely difficult. Faced with a number of such bottlenecks, the Washington State DOT has had to get into the system management and operations mode. Key aspects of the approach include:

- Incident management;
- Ramp metering;
- Signal Synchronization/retiming;
- Removing capacity bottlenecks;
- Travel conditions and commute time information;
- High-occupancy vehicle lanes and public transportation facilities; and
- Readily understood performance measures.

The approach concentrates on addressing everyday congestion problems, as well as the weather, collisions, or vehicle breakdowns that cause frustrating variations in travel times as well as safety, environmental and other negative effects. The management approach includes projects and programs, but starts with aggressive action and performance measurement under the adage "Do Something and Measure It." The attitude is reflected in the equipment and personnel assigned to incident response, attention to adjusting the ramp meters and the incorporation of performance evaluation into operating practices. The use of straightforward performance measures helps to build public and legislative support for funding of transportation system management and operations.

The incident response program was doubled in 2002 and a formal partnership was established between WSDOT, the Washington State Patrol, private tow companies, and a media-sponsored motorist assistance van. An aggressive program of improved incident response has reduced the impact of incidents on non-recurring delay. Ramp metering has also proven itself effective. By providing a regular flow of traffic and lower entering volumes at busy entrance ramps, ramp meters allow the freeway mainlanes to carry more volume and at higher speeds. The short entrance ramp wait time (average of 2 minutes) is made up for with the shorter freeway travel times, and in 30 percent fewer rear-end and sideswipe collisions and lower travel delay.

A combination of improved operational treatments and relatively minor capacity expansions are attacking the problem that WSDOT has dubbed "lost productivity." Freeways carry the highest volume of traffic when speeds are 45 to 50 mph. The lanes are "full"—operating with around 2,000 vehicles per hour per lane, versus traffic volumes less than 1,500 vehicles per hour in each congested lane, at speeds closer to 20 to 30 mph.

WSDOT's goal is to stay on top of the "speed-volume" curve, working toward improving productivity of the system by investing in opportunities that provide optimal throughput"[3]

California

In Southern California, SR 91 has express lanes with electronic tolling at variable prices – similar to the High Occupancy Toll Lanes now under construction on the Capital Beltway. These lanes carry twice as many vehicles as the "free" lanes during peak hours. As a bonus for HOT lane users, the express lanes move traffic three times as fast as in the free lanes. In the Los Angeles region, up to 85 miles of HOV lanes will be converted to HOT lanes. At the same time, the City of Los Angeles will purchase high capacity buses fueled by compressed natural gas, which will also operate in the HOT lanes.

In another arena, the California Legislature has passed a bill, SB 3756, which mandates reductions in vehicle miles traveled through a strengthened link between transportation and land use planning. Local governments will plan sustainable growth by clustering homes, business, and transportaton hubs together, providing citizens housing options near where they work and live. These land use plans are submitted to the California Air Resources Board to ensure they meet regional emission reduction targets. The result is the Sustainable Communities Strategy. With such a plan in place, local communities are eligible for billions of dollars in state and federal transporation grants, assisting the development of sustainable regional transportation systems.

Texas

The major metropolitan areas in Texas have developed an extensive process for quantifying the need for congestion reduction and estimating the costs and the benefits of actions. The Texas Metropolitan Mobility Plan has a goal of eliminating serious congestion from all travel corridors in the eight largest population centers. The long-range transportation planning models in each area were used to estimate the capacity improvements required to accomplish this goal. The capacity costs were estimated using roadway construction costs, but the actual combination of projects, programs, and policies will not be identified until the corridors are studied in more detail. What the TMMP did accomplish, however, is to provide additional information to the decision-makers and public about the beneficial effect of additional transportation spending and allow a more informed discussion about the choices faced by residents.

New Jersey

The New Jersey Department of Transportation (NJDOT) has created a program aimed at improving the quality of life, safety, and mobility of New Jersey's citizens by re-thinking many of the assumptions about transportation. The New Jersey Future in Transportation (NJFIT) program is a comprehensive and cooperative approach to transportation and land use planning that rethinks the relationship between the two. Alarmed by the increasing levels of congestion on New Jersey's highways, and concerned about research linking a national epidemic of obesity with land use choices and transportation, NJDOT is working with metropolitan planning organizations and other state agencies to "downsize

[3] http://www.ops.fhwa.dot.gov/congestion_report/

alternatives, increase transportation options, lower design speeds, and provide more pedestrian-friendly streetscapes in several projects across the State."[4] NJDOT has also assembled a "toolbox" of strategies that combine traditional capacity improvements and innovative techniques, with a focus on education and communication. Solutions include traffic calming measures, transit-oriented design, environmental sensitivity, and a mix of land uses, among others, working in partnership with local governments and civic institutions.

MAJOR OPPORTUNITIES FOR FUTURE INITIATIVES

Increase system capacity. Although Virginia's roadway network provides mobility, VMT growth continues to outpace the state's population and growth in road capacity. Further stimulating growth in VMT is a strong growth rate in automobile ownership.

Expand high occupancy vehicle (HOV) and high occupancy toll (HOT) facilities. Virginia is committed to providing better mobility and accessibility through HOV facilities. These lanes are designed to move more people and allow users to travel faster, thus increasing the overall capacity of the system. Currently, Virginia has 137.6 miles of HOV, over 10 percent of the HOV lane-miles in the U.S. Virginia is also considering allowing single occupancy vehicles to use the HOV lanes for a toll. These facilities, HOT lanes, would capture people's willingness to pay for additional mobility while ensuring free-flowing traffic.

Expand travel options. As demand for the transportation system is increasing, it is important to identify alternatives to the automobile, such as bicycle and pedestrian facilities and transit service. Coordinating transportation and land use will also make these options viable. Virginia supports bicyclist and pedestrian access by promoting the usage of the new state bicycle map, considering bicycle and pedestrian accommodations on all projects, and allocating two percent of certain maintenance funds to provide accommodations.

Implement travel demand management (TDM) programs. Through DRPT, the Commonwealth partners with local commuter assistance programs, Metropolitan Planning Organizations, various Transportation Management Associations, and others to provide TDM programs throughout the Commonwealth. TDM programs help manage travel demand to make our systems more efficient by moving more people in fewer vehicles, moving trips out of the peak period, or eliminating trips altogether. TDM measures include HOV lanes, carpooling and vanpooling, teleworking, and park-and-ride lots. Virginia has 346 park-and-ride lots that provide nearly 57,000 spaces, including 120 lots owned by VDOT.

Each full-time teleworker saves the taxpayer $2,800 per year in road maintenance and expansion costs; this does not include teleworkers' personal savings in tolls, fuel, car maintenance, and public transportation costs. According to a study conducted by the Department of Rail and Public Transportation, in 2007, 12% of Virginia's workers teleworked on average at least once a week, up from 3.2 % in 2000. In addition, 21% of Northern Virginia workers (up from 13% in 2004), 13% of Richmond's workers, and 7% of those in Hampton Roads teleworked.

[4] http://www.state.nj.us/transportation/works/njfit/

Transit Oriented Development Compact, mixed use development near new or existing public transportation infrastructure can serve housing, transportation and neighborhood goals. Pedestrian-oriented design, an important feature of TOD, encourages residents and workers to drive their cars less and ride mass transit more. Construction of higher density residential development, along with office and retail space, adjacent to Metrorail and commuter rail stations has the potential to concentrate development in an area well-served by high capacity transit. This kind of development can support high-intensity commercial activity with a relatively low impact on levels of traffic congestion. This pattern of development has already paid off in the Orange Line corridor in Northern Virginia, with stations like Ballston serving as the anchor for high-rise residential towers, commercial office space, and retail centers like the Ballston Common Mall.

Expand "Smart Highways" Program Virginia has been a leader in the use of technology to effectively manage traffic. From simple programs such as improving the synchronization of traffic signals on arterials, to the use of ramp meters and reversible HOV lanes for freeway management, VDOT has demonstrated an ability to make effective use of new technology. Together with low-tech measures such as the Safety Service Patrols, which offer roadside assistance to keep traffic rolling, transportation systems management and operations measures can have a major impact on reducing congestion.

The State of Virginia has also been involved in cutting-edge technology development. Northern Virginia was one site for proof-of-concept testing for the national IntelliDrive program (formerly Vehicle-Infrastructure Integration, or VII). By linking vehicles to roadside equipment, IntelliDrive will bring safety and mobility applications to motorists, from intersection collision avoidance to warnings about roadway conditions such as icy pavement. Technologies such as Active Traffic Management (ATM), which is currently in operation in the United Kingdom, make better use of capacity through variable speed limits (VSL) and lane guidance, including the use of shoulders as travel lanes in peak periods. VSL could also aid drivers by reducing speed limits under adverse weather conditions

Application of technology can help to speed the flow of freight, as well. Weigh-in-motion technology can move trucks through weigh stations more quickly, while commercial vehicles equipped with transponders can even bypass weigh stations altogether through electronic screening and safety information exchange.

Table 1: INRIX National Traffic Scorecard

Metropolitan Area	Population/ Rank (National)	Year	Congestion Rank (National)	Increase (decrease) in congestion[5]	Travel Time Index (TTI)	Worst Bottleneck[6]/ Rank (National)	Worst weekday travel hour (TTI)
Washington, DC Metro (VA, MD, DC)	5,306,565 (8)	2007	4	4.5%	1.28	Henry Shirley Memorial Highway NB @ GW Parkway, Arlington, VA (#84)	Friday, 5-6 PM (1.56)
		2008	5	(25.6)	1.20	Henry Shirley Memorial Highway NB @ GW Parkway, Arlington, VA (#84)	Thursday, 5-6 PM (1.42)
Hampton Roads	1,658,754 (34)	2007	32	3.2%	1.15	US 60/HWY 143/Exit 267, Hampton, VA (#188)	Friday, 4-5 PM (1.38)
		2008	32	(28.6%)	1.11	City Hall Ave/Exit 10, Norfolk, VA (#165)	Friday, 4-5 PM (1.32)
Richmond	1,212,977 (43)	2007	56	1.2%	1.03	Toll Booth, Powhite Parkway SB, Richmond, VA (#3294)	Friday, 5-6 PM (1.06)
		2008	60	(46.7%)	1.02	I-195 NB @ US 33/US 250/Broad St, Richmond, VA (#2424)	Thursday, 5-6 PM (1.04)

[5] Congestion is measured by the ratio between a "reference speed" under uncongested conditions and hourly average speed. For each of the 40 peak "drive time" hours in a week (6 to 10 AM and 3 to 7 PM each weekday), travel on 31,000 road segments covering 47,000 road miles nationwide is tracked through GPS-equipped probe vehicles. Average travel speed during the most congested hours in the nation's 100 largest metropolitan areas was used to calculate a travel time index for the region.

[6] Bottlenecks were identified by comparing average hourly speeds to reference speeds over the entire week (168 hours). Hours in which the average hourly speeds were less than 50% of the reference speed were considered "congested."