Evaluation and Rating of Significant Transportation Projects in Northern Virginia

Project Evaluation Framework

January 30, 2014

The Virginia Department of Transportation (VDOT) and the Virginia Department of Rail and Public Transportation (DRPT) are conducting a study to evaluate all significant projects in and near the Northern Virginia District per the mandate of Virginia Code, section 33.1-13.03:1. The following statements represent a summary of the intent of the authorizing legislation and the objectives of this study:

Authorizing Legislation

Use transportation models and computer simulations to provide an objective, quantitative rating of at least 25 significant transportation projects selected according to priorities determined by the Commonwealth Transportation Board (CTB), in coordination with the Northern Virginia Transportation Authority (NVTA).

- *Evaluate and rate significant highway, rail, bus, and/or technology projects that reduce congestion and improve mobility during homeland security emergency situations.*
- *Priority should be given to projects that most effectively reduce congestion in the most congested corridors and intersections.*

For the purposes of this study, a "project" is defined as one or more complementary investments that attempt to provide a comprehensive solution to an identified congestion problem. A project may include a combination of highway, transit, technology and/or travel demand management improvements and any access components such as pedestrian, bicycle and parking improvements which enhance the project's effectiveness in reducing congestion. Multi-modal projects are encouraged and welcomed. The potential impact of transportation improvements will be evaluated with a single base demographic/land-use forecast. Thus, the effect, if any, of the project on land-use will not be captured by this study.

Projects will be analyzed and assigned a quantitative rating that reflects their ability to reduce congestion and, to the extent possible, their ability to improve mobility during a homeland security emergency situation. This document outlines the measures of effectiveness that will be calculated to evaluate each project. The relative weight assigned to each measure in the ultimate effectiveness rating will be developed through a stakeholder engagement process.

Project Evaluation Framework

Projects will be evaluated and rated based primarily on how well they reduce congestion. Congestion reduction can be measured in several ways and this document describes several measures and methods that should be helpful in quantifying the congestion benefits generated by each project.

Location

For the purposes of this study, congestion reduction will be measured in the area covered by VDOT's Northern Virginia District (i.e., the City of Alexandria, and Arlington, Fairfax, Loudoun, and Prince William Counties). This enables the study team to evaluate and rate each project using a common base of comparison. At the same time, the study team recognizes the potential usefulness to decision makers of summarizing performance measures for the specific impact area of a given project. As a result, the study team plans to calculate and document each performance measure within the specified impact area for information purposes, but not include these values in the project rating.

Time

The time dimension also has multiple perspectives. Since congestion is often a peak period problem, the usual practice is to focus on congestion reduction during the peak period. In Northern Virginia congestion is not limited to the peak period, so it is also desirable to consider and quantify congestion reduction during off-peak hours as well. As a result, all performance measures will be calculated for a 24 hour typical weekday.

The other major dimension of time is the year it takes place. The project selection model focused on congestion problems in the year 2020 to capture the benefits of improvements that are being implemented while at the same time giving priority to problems caused by existing development patterns. The evaluation and rating process will quantify benefits based on near-term conditions (2020), but will also consider long term impacts as well. The year 2040 has been selected for the long-term impact assessment. For projects that can be implemented in the near-term, a separate evaluation and congestion rating may be generated for both 2020 and 2040. For projects that cannot be completed until after 2025, only the long-term evaluation and congestion rating will be generated.

CLRP Considerations

The baseline for quantifying the change in each performance measure is the performance of the Constrained Long Range Plan (CLRP) for 2020 and/or 2040. This study will use the CLRP adopted by the regional Transportation Planning Board in 2013 to define what is included in the 2020 and 2040 baseline conditions. If a project proposed for evaluation by this study is included in the 2020 or 2040 CLRP, the project will be removed from the baseline network and run through the modeling process. In this case, the change in performance will measure the performance of the original 2020 or 2040 CLRP baseline against the performance of the network without the project.

Definitions of Congestion

For the purposes of this study, heavy congestion on roadway segments is defined for each network link in 15 minute time increments based on the simulated travel time during the 15 minute time period divided by the free flow travel time over the length of the link. A travel time ratio greater than or equal to 2.0 is considered heavily congested. This congestion criterion can also be viewed as a 50 percent reduction in travel speed during a 15 minute time period or taking twice the travel time to traverse the link.

In addition to the delays bus passengers experience due to roadway congestion, transit congestion will also be measured using transit vehicle load factors. From this perspective a transit route will be considered congested if it carries more passengers than it can reasonably accommodate. Separate congestion thresholds for transit load factors have been identified for different transit modes. Local bus routes are

considered congested if they carry more riders than the number of available seats (load factor > 1.0). Express bus and commuter rail routes are considered congested if they carry more riders than 90 percent of the available seats (load factor > .9). Metrorail is considered congested if a train carries more than 100 riders per train car (load factor >100 pass/car). These load factor thresholds were provided by the local transit agencies.

Performance Measures

The performance measures selected for the project evaluation framework are intended to be multi-modal criteria in that each measure focuses on the benefits received by persons rather than vehicles. Note, however, that most congestion problems will be experienced on roadway facilities or crowded trains. As a result, most multi-modal or demand management solutions will be evaluated based on how effective they are in improving travel times, delays and other performance measures for auto passengers and bus riders that travel through congested roadway segments.

The performance measures that will be used to evaluate and rate the effectiveness of each project in reducing congestion are defined as follows:

- **Transit Crowding** = reduction in the number of transit route miles experiencing crowded conditions.

  Crowded conditions are defined using a mode specific load factor (i.e., local bus > 1.0; express bus > 0.9; Metrorail > 100 passengers/car; commuter rail > 0.9).

- **Congestion Duration** = reduction in the number of hours of the day auto and transit passengers experience heavily congested travel conditions.

  For roadways, this measure will sum the number of 15 minute time periods during the course of the day that a lane-mile of roadway exceeds a travel time ratio of 2.0. For transit, this measure will sum the number of 15 minute time periods during the course of the day that each transit route mile exceeds the mode specific load factor.

- **Person Hours of Delay** = reduction in the number of person hours of travel time above free flow travel time.

  For roadways, this measure will multiply the difference between simulated travel time and free flow travel time on each link in each 15 minute time period by the number of passengers in autos and buses using the link during each 15 minute period. Person hours of delay for transit will also include the additional waiting time associated with failing to board the intended vehicle due to capacity constraints or transfer timing issues (i.e., you missed your transfer because of delays on the first route).

- **Person Hours of Congested Travel in Automobiles** = reduction in the number of person hours of travel in automobiles and trucks on heavily congested facilities.

  This measure will sum the number person hours of travel during each 15 minute time period that the roadway exceeds a travel time ratio of 2.0.

- **Person Hours of Congested Travel in Transit Vehicles** = reduction in the number of person hours of travel in buses and trains on heavily congested facilities or in crowded vehicles.

  This measure will sum the number of person hours of travel in buses for each 15 minute time period that the bus travels on a roadway that exceeds a travel time ratio of 2.0 plus the number of person hours of travel on buses or trains with ridership that exceed the mode specific load factor.

- **Accessibility to Jobs** = increase in the number of jobs that can be reached from each household based on a 45 minute travel time by automobile and a 60 minute travel time by transit.

  This measure will be calculated based on the simulated travel times on each link during a three hour AM peak period. An upper limit of 45 minutes will be used for highway trips and a 60 minute upper limit for transit in determining the number of jobs that can be accessed by households in the region[1].

- **Emergency Mobility** = increase in the person hours of travel time resulting from a 10 percent increase in peak hour trip making.

  This measure will increase the number of trips leaving activity locations within TAZ's during the PM peak hour (5:00-6:00 PM) by 10 percent. This will be accomplished by changing an appropriate number of trip start times of existing travelers that are scheduled to leave their activity locations after 6:00 PM to a random time between 5:00 and 6:00 PM. The simulation process will then be re-run using the new trip start times. The increase in the total person hours of travel will be compared to the original total person hours of travel to determine the impact to the system. Projects with the smallest increase in person hours of travel will be given a higher mobility benefit.

Congestion Reduction Rating

The Congestion Reduction Rating for each project will be based on the weight sum of the Congestion Reduction Score assigned to each performance measure. The stakeholder input through the Decision Lens process will be used to define the relative importance of each performance measure in the overall project rating.

[1] More specifically, accessibility to jobs will be calculated based on the simulated 15 minute travel times on each link during a three hour AM peak period. A path is built between three activity locations within each traffic analysis zone during each 30 minutes of the AM peak period (i.e., 54 paths). The average travel time of these zone-to-zone paths is compared to the 45 minute criterion. If the path can be completed in 45 minutes or less, the number of households in the origin zone is multiplied by the number of jobs in the destination zone. This sum is divided by the number of households in Northern Virginia to determine the number of jobs that can be reached within 45 minutes by the average household. The same process is used to build transit paths and estimate the number of jobs that can be reached within 60 minutes using transit by the average household.

Performance Measure	Near-term Benefits (2020)		Long-term Benefits (2040)	
	Attribute Weights[1]	Weighted MOE Score[2]	Attribute Weights[1]	Weighted MOE Score[2]
Transit Crowding	A%	A% * S11	A%	A% * S21
Congestion Duration	B%	B% * S12	B%	B% * S22
Person Hours of Delay	C%	C% * S13	C%	C% * S23
Person Hours of Congested Travel in Automobiles	D%	D% * S14	D%	D% * S24
Person Hours of Congested Travel in Transit Vehicles	E%	E% * S15	E%	E% * S25
Accessibility to Jobs	F%	F% * S16	F%	F% * S26
Emergency Mobility	G%	G% * S17	G%	G% * S27
Congestion Reduction Rating	100%	2020 Rating	100%	2040 Rating

1. Attribute weights will be determined through a stakeholder consensus building process
2. S11-S27 represent the project performance score from the modeling process

The Congestion Reduction Score for a given performance measure will be based on the relative impact of all projects on the change in congestion in Northern Virginia. A maximum Congestion Reduction Score of 100 points will be assigned to each performance measure and analysis year based on the project that generates the greatest change to the performance measure. All other projects will be assigned Congestion Reduction Scores based on the ratio of their performance to the project that performed best.

For example, if project #4 is predicted to generate the greatest reduction in person hours of delay (say 100,000 hours), project #4 will receive 100 points for person hours of delay (S13 or S23). If project #8 reduces person hours of delay by 70,000 hours, project #8 will receive 70 points (100 * 70,000 / 100,000) for person hours of delay (S13 or S23). Note, a single project is not likely to generate the greatest improvement for all performance measures and analysis years. This means that the 100 point score is likely to be awarded to a different project for each measure.

Project Costs

As part of the Scope of Work, the study team will prepare a planning level order of magnitude cost estimate for each project. If cost estimates are provided by the project sponsor or have been prepared as part of other studies, these cost estimates will be reviewed for consistency and included in the final report along with any clarifying explanations that may be appropriate. These planning level cost estimates will be provided so that, if desired, the congestion rating can be viewed in terms of congestion reduction relative to cost.