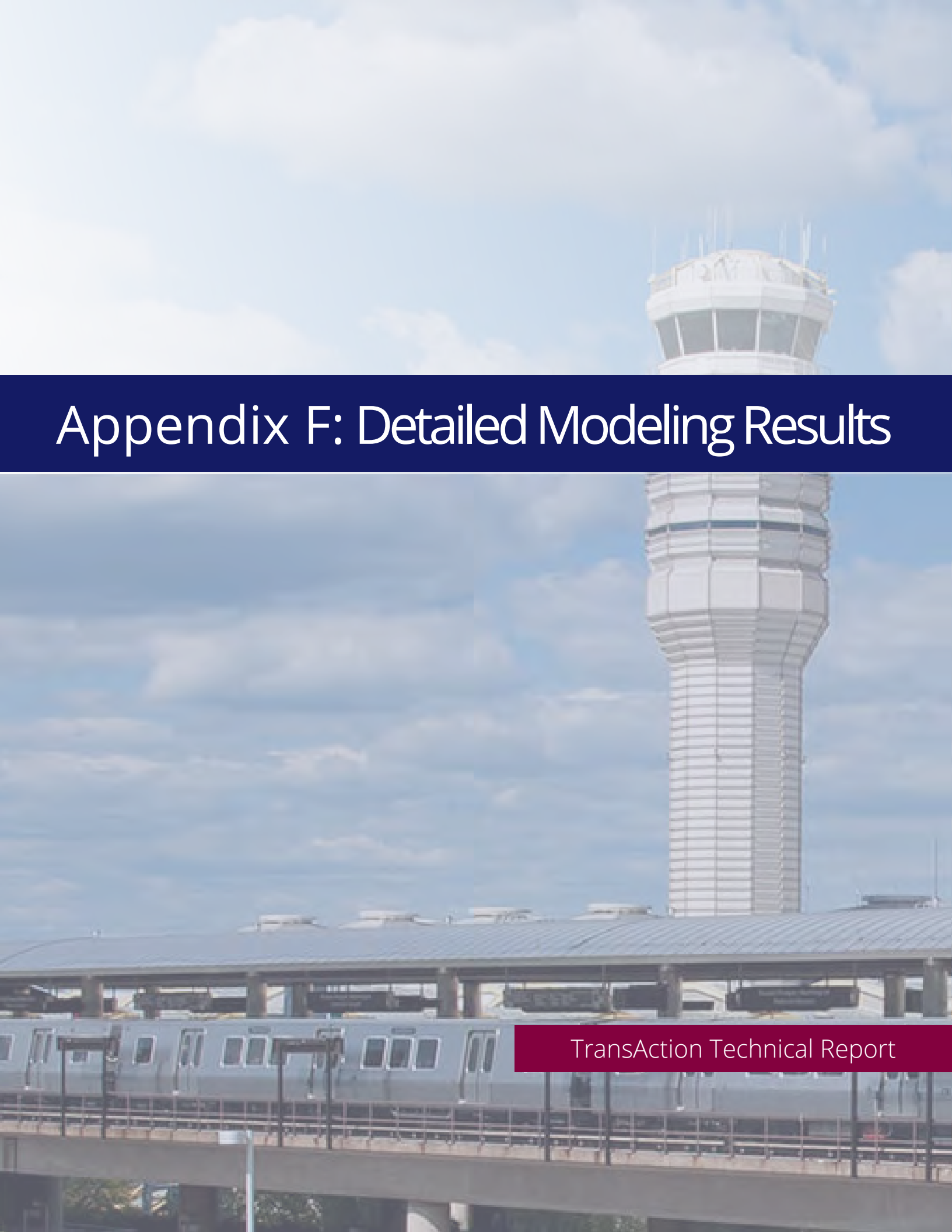

Appendix F: Detailed Modeling Results

TransAction Technical Report

(This page intentionally left blank)

METHODOLOGY FOR CALCULATION OF PERFORMANCE MEASURES

(This page intentionally left blank)

Approved TransAction Measures - December 8, 2016

Definitions of Measures and Scoring Methodology Options

(Adopted January 2017)

Definitions of Measures

Goal 1: Enhance quality of life and economic strength of Northern Virginia through transportation

1.1.1 Total Person Hours of Delay **(HB599)**

Daily number of person-hours of travel above free-flow travel time for motorized trips (automobile and transit).

1.1.2 Transit Crowding **(HB599)**

Daily number of transit route-miles[1] experiencing crowded conditions (local bus > 1.0 seating capacity; express bus and commuter rail > 0.9 seating capacity; Metrorail > 100 passengers/car).

1.1.3 Person Hours of Congested Travel in Automobiles **(HB599)**

Daily number of person-hours of travel in congested conditions, where "congested" is travel time in excess of 2.0 times the free-flow travel time.

1.1.4 Person Hours of Congested Travel in Transit Vehicles **(HB599)**

Daily number of person-hours of travel in congested conditions (buses on roadways), where "congested" is travel time in excess of 2.0 times the free-flow travel time.

1.2.1 Congestion Severity: Maximum Travel Time Ratio

Maximum ratio of congested travel time to free-flow travel time during the AM and PM peak period.

1.2.2 Congestion Duration **(HB599)**

Number of hours of the day auto and transit passengers experience heavily congested travel conditions (travel time ratio greater than 2.0) times the number of facility miles.

1.3.1 Percent of jobs/population within 1/2 mile of high frequency and/or high performance transit

Percent of activity (population + 2 * employment) within 1/2 mile of Metrorail, commuter rail, or high capacity bus service (at least 500 seats per hour or 12,000 seats daily)

[1] This is the sum of the number of route segments (route-miles) that are over capacity during the course of the day (i.e., number of scheduled runs for that route that have over capacity segments).

1.3.2 Access to Jobs within 45 mins by auto, and within 60 mins by transit **(HB599)**

Number of regional jobs that can be reached from each household in Northern Virginia based on a 45 minute travel time by automobile or a 60 minute travel time by transit

1.4.1 Average travel time per motorized trip between Regional Activity Centers

Average travel time per trip for motorized trips between and among zones within one mile of Regional Activity Center centroids.

1.4.2 Walkable/bikeable environment within a Regional Activity Center
Qualitative: High, Med, Low, None thresholds to be defined based on facilities within one mile of the RAC centroid:

- High: Dense grid of arterial streets with wide sidewalks and signal timing plans that favor pedestrian movements; bike lanes on most major arterials and bike rental stations at 0.25 mile intervals; good taxi and/or ride-hailing service with 5 minute wait or less; and transit circulator or shuttle bus routes connecting most activity locations and regional transit services within the RAC.
- Medium: -- 50% of the high amenities
- Low: -- 25% of the high amenities
- None: -- less than 10% of the high amenities

Goal 2: Enable optimal use of the transportation network and leverage the existing network

2.1.1 Safety of the transportation system

Qualitative: The VDOT Equivalent Property Damage Only (EPDO) value is calculated at the corridor segment level. For project addressing a safety concern, a proportional factor is applied and the absolute change in EPDO is quantified.

EPDO = (number of fatal crashes * 541.7) + (number of injury crashes * 29.2) + (number of property damage crashes * 1)

2.2.1 First and last mile connections

Qualitative: High, Med, Low, None thresholds to be defined based on access facilities within one mile of high capacity transit stations:

- High: all day shuttle bus or feeder bus services with at least 10 minute headways in the peak and 20 minute headways in the offpeak, good taxi and/or ride-hailing service with 5 minute wait time or less, sidewalks on all arterials and bike lanes on major arterials.
- Medium – 50% of high
- Low – 25% of high
- None – less than 10% of high

2.3.1 Share of travel by non-SOV modes

Share of non-SOV person volume per mile calculated by summing HOV2, HOV3+ and transit trips with trips less than 0.5 miles (approximating non-motorized travel) on network links.

2.4.1 Person hours of travel caused by 10% increase in PM peak hour demand **(HB599)**

Change in PM peak period person-hours of travel resulting from a 10 percent increase in PM peak hour (5-6pm) trip-making.

Goal 3: Reduce negative impacts of transportation on communities and the environment

3.1.1 Vehicle miles traveled (VMT) by speed VMT by speed class in AM and PM peak (8 am - 9 pm and 5 pm - 6 pm) and off-peak periods.

(VMT < 15 mph/hour or > 65 mph/hour = high emission rates)

Rating Methodology Options

For qualitative Measures 1.4.2 and 2.2.1, a NONE-LOW-MEDIUM-HIGH scale is used to rate how well a project provides for improved categories, relative to the 2040 Baseline condition, that advance the goals of that measure. If the project did not identify improvements for a particular category, or did not occur with a one-mile proximity of an activity center or high-capacity transit station, it received a NONE score. Otherwise, the project was rated according the guidelines defined in Table 1.

Scores for each of the three qualitative measures were developed at the project level.

A score of 0-5 (with 5 being the highest score) was assigned for a given project Measure 1.4.2: Walkable/bikeable environment within a Regional Activity Center and Measure 2.2.1: First and last mile connections were scored using the following rubric:

0: Projects not rated as providing benefits to that corridor segment
1: Projects rated as providing LOW benefits to either transit circulation/connectivity or bicycle/ pedestrian facilities
2: Projects rated as providing LOW or MEDIUM benefits across multiple categories
3: Projects rated as providing MEDIUM benefits across multiple categories
4: Projects rated as providing MEDIUM benefits across multiple categories and/or providing HIGH benefits in either transit circulation/connectivity or bicycle/pedestrian facilities
5: Projects rated as providing HIGH benefits across multiple categories

For qualitative Measure 2.1.1, a binary YES-NO response is provided for each project to denote whether it specifically addresses a safety need (i.e., referencing a vehicular of bicycle/pedestrian safety improvement or projects that limit potentially dangerous interactions between vehicles and cyclists/ pedestrians) within its project description. A 10% reduction in Equivalent Property Damage Only (EPDO) measure, based on VDOT crash data, will be applied to grid cells within the project impact area.

In the Baseline network, the values for Measure 1.4.2 and Measure 2.2.1 are zero, representing existing conditions. Improvements in either of those measures are represented with a positive value for the Project network. Overlapping projects are additive to each measure score. A binned value is assigned for each grid cell based on the magnitude of the total improvement in walkable/bikeable places or first-last mile connections. These values are then averaged across all grid cells within a project impact area to quantify the benefit contributed by each measure.

For Measure 2.1.1, the grid cells in the Baseline network have a starting EPDO calculated based on FHWA's equation: https://safety.fhwa.dot.gov/hsip/resources/fhwasa09029/sec4.cfm
The change in the EPDO (reduction) is calculated for grid cells within the impact area for project improvements with a stated goal of safety.

Table 1: Guidelines for rating project improvements

Category	Measure	Score	Description
Pedestrian Facilities	1.4.2 & 2.2.1	Low	Minor pedestrian improvements within activity center
		Medium	Larger scale pedestrian improvements within activity center or project providing pedestrian access to transit station
		High	Program of pedestrian improvements within activity center or project providing key pedestrian connections to high capacity transit stations
Street Grid	1.4.2	Low	Complete streets projects; intersection improvements specifying bike/pedestrian connectivity; unspecified multimodal improvements
		Medium	New roadway connections within activity center
		High	County or city-wide program of improving street grid connectivity (roadway, bike/pedestrian)
Ridesharing	2.2.1	Low	Park-n-Ride (new construction/expansion/added capacity)-might permit additional slug line capacity/space for informal car sharing; Pedal-n-Ride facilities focused on public bus access
		Medium	Kiss-n-Ride (expansion/added capacity)
		High	Kiss-n-Ride (new construction) creates new ride share opportunity
Bikesharing	1.4.2 & 2.2.1	Low	Bicycle lockers; bicycle racks
		High	Bikeshare / bike rental stations; Projects that identify bikeshare as a goal without reference to a specific facility
Bicycle Facilities	1.4.2 & 2.2.1	Low	Bike-related project lies along the periphery of an RAC or provides minimally better access to transit stations
		Medium	Bike-related project lies well within an RAC or provides moderately better access to a transit station
		High	Bike-related project provides good bicycle access within an RAC and/or to a transit station
Transit Circulation in Activity Centers	1.4.2	Low	Supportive transit facilities in activity centers (transit center, information systems, bus facilities, etc.)
		Medium	Local transit service improvements within activity center
		High	Transit circulator service or high-capacity transit improvements in activity center
First/last mile transit connections	2.2.1	Low	Supportive transit facilities near high-capacity transit stations (transit center, information systems, bus facilities, etc.)
		Medium	High-capacity transit improvements
		High	High frequency transit connections serving high-capacity transit stations

(This page intentionally left blank)

MODELING RESULTS BY SEGMENT AND MEASURE

(This page intentionally left blank)

Plan Results

Each performance measure is scored on a 0-100% scale, where 0% , or "--", indicates no benefit along a corridor segment over the baseline condition and 100% indicates maximum regional benefit for a corridor segment.

A negative score indicates a reduction in a performance measure associated with a negative impact, such as congestion, while a positive score indicates an improvement in the condition of the transportation system, such as improving regional accessibility.

A performance rating is calculated by multiplying the absolute score for each performance measure by its associated measure weight.

	Measure	1.1.1 Person Delay	1.1.2 Transit Crowding	1.1.3 Person Delay in Auto	1.1.4 Person Delay in Transit	1.2.1 Congestion Severity	1.2.2 Congestion Duration	1.3.1 Transit Coverage	1.3.2 Accessibility to Jobs	1.4.1 Activity Center Connectivity	1.4.2 Bicycle and Pedestrian Facilities	2.1.1 Safety	2.2.1 Transit Station Connectivity	2.3.1 Vehicle Occupancy	2.4.1 System Resiliency	3.1.1 Emissions Reduction	Performance Rating
	Corridor Segment / Measure Weight	10%	5%	5%	5%	5%	10%	5%	5%	5%	5%	5%	10%	10%	5%	10%	
1-1	Rt. 7/Rt. 9 — West Virginia State Line to Town of Leesburg	-9%	0%	-10%	-2%	-18%	--	--	20%	-100%	20%	100%	--	--	-8%	-9%	**15.8**
1-2	Rt. 7/Dulles Greenway — Town of Leesburg to Rt. 28	-5%	-3%	-11%	-9%	-14%	-46%	36%	64%	-54%	51%	28%	51%	--	-99%	-59%	**34.5**
1-3	Rt. 7/Dulles Toll Road/Silver Line — Rt. 28 to Tysons	-53%	-5%	-55%	-24%	-45%	-51%	14%	36%	-28%	61%	13%	62%	--	-54%	-65%	**39.9**
1-4	Rt. 7/Dulles Toll Road/Silver Line — Tysons to US 1	-62%	-100%	-68%	-49%	-18%	-99%	36%	42%	-27%	76%	11%	78%	--	-18%	-85%	**54.7**
2-1	Loudoun County Parkway/Belmont Ridge Road — Rt. 7 to US 50	-55%	0%	-61%	-8%	-35%	-28%	--	70%	-58%	71%	7%	62%	--	-78%	-100%	**43.9**
2-2	North-South Corridor/Bi-County Parkway — US 50 to I-66	--	-1%	0%	0%	-1%	--	--	60%	-52%	41%	--	--	--	--	--	**7.7**
2-3	Rt. 234 — I-66 to I-95	-28%	-5%	-28%	-7%	-36%	-12%	--	66%	-61%	31%	--	18%	--	--	-35%	**21.0**
3-1	Rt. 28 — Rt. 7 to I-66	-22%	-12%	-31%	-21%	-8%	-46%	50%	62%	-45%	71%	2%	53%	--	-100%	-87%	**40.7**
3-2	Rt. 28 — I-66 to Fauquier County Line	-23%	-7%	-24%	-11%	-9%	-8%	100%	70%	-56%	43%	--	29%	--	--	-29%	**24.9**
4-1	Prince William Parkway — I-66 to I-95	-42%	-23%	-44%	-24%	-34%	-35%	36%	77%	-59%	29%	--	20%	1%	-67%	-48%	**34.2**
5-1	Fairfax County Parkway — Rt. 7 to US 50	-28%	-12%	-32%	-16%	-28%	-28%	--	39%	-23%	51%	7%	56%	--	-18%	-45%	**27.0**
5-2	Fairfax County Parkway — US 50 to Rolling Road	-34%	-7%	-38%	-23%	-39%	-22%	36%	86%	-38%	49%	0%	29%	--	-43%	-47%	**31.0**
5-3	Fairfax County Parkway — Rolling Road to US 1	-17%	-19%	-20%	-19%	-36%	--	100%	100%	-41%	65%	--	20%	--	--	-26%	**26.4**
6-1	I-66/US 29/VRE Manassas — Prince William County Line to Rt. 28	-52%	-23%	-49%	-26%	-8%	-38%	86%	74%	-59%	39%	97%	27%	--	-37%	-40%	**40.5**
6-2	I-66/US 29/US 50/Orange-Silver Line — Rt. 28 to I-495	-73%	-27%	-77%	-88%	-49%	-61%	64%	67%	-33%	92%	10%	78%	22%	-38%	-73%	**58.1**
6-3	I-66/US 29/US 50/Orange-Silver Line — I-495 to Potomac River	-37%	-84%	-42%	-100%	-10%	-58%	29%	40%	-29%	100%	12%	100%	--	-20%	-67%	**49.5**
7-1	I-495 — American Legion Bridge to I-66	-49%	-26%	-51%	-13%	-50%	-38%	43%	45%	-23%	51%	0%	64%	--	-75%	-56%	**39.6**
7-2	I-495 — I-66 to I-95	-19%	-23%	-22%	-23%	-28%	-22%	50%	79%	-29%	82%	2%	64%	--	-52%	-30%	**33.0**
7-3	I-495 — I-395 to Woodrow Wilson Bridge	-88%	-42%	-88%	-13%	-67%	-40%	36%	58%	-30%	65%	4%	58%	100%	-67%	-71%	**59.2**
8-1	I-95/US 1/VRE Fredericksburg — Stafford County Line to Fairfax County Line	-95%	-29%	-96%	-70%	-100%	-32%	43%	88%	-62%	39%	--	22%	--	--	-72%	**48.5**
8-2	I-95/US 1/VRE Fredericksburg — Prince William County Line to I-495	-79%	-62%	-86%	-89%	-49%	-41%	71%	82%	-39%	69%	1%	27%	8%	-34%	-100%	**54.6**
8-3	I-395/US 1/VRE Fredericksburg/Blue-Yellow Line — I-495 to Potomac River	-100%	-97%	-100%	-53%	-37%	-100%	21%	40%	-30%	59%	13%	62%	60%	-38%	-92%	**65.8**
9-1	US 15 — Potomac River to Rt. 7	-9%	--	-9%	-1%	-39%	-3%	--	46%	-58%	20%	17%	--	--	-3%	-10%	**11.8**
9-2	US 15 — Rt. 7 to I-66	-10%	-1%	-11%	-2%	-50%	-6%	--	50%	-56%	20%	19%	--	--	-3%	-13%	**13.6**
9-3	US 15 — US 50 to US 29	-6%	-3%	-5%	0%	-15%	-2%	--	47%	--	--	6%	--	--	-14%	-6%	**5.8**
10-1	Braddock Road/VRE Manassas — Rt. 28 to I-495	-71%	-32%	-75%	-44%	-40%	-28%	71%	81%	-36%	73%	7%	27%	--	-42%	-77%	**45.4**
10-2	Columbia Pike/Braddock Road — I-495 to Pentagon	-21%	-50%	-21%	-48%	-18%	-19%	7%	42%	-31%	82%	6%	85%	49%	--	-31%	**35.8**
11-1	US 50 — Fauquier County Line to City of Fairfax	-59%	-14%	-61%	-30%	-50%	-30%	21%	67%	-51%	86%	7%	65%	--	--	-75%	**42.3**

(This page intentionally left blank)