Northern Virginia
Transportation Commission

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-- INVESTMENT ANALYSIS --
-- REVISED --

VIRGINIA RAILWAY EXPRESS VERSUS EQUIVALENT HIGHWAY CAPACITY

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Northern Virginia Transportation Commission

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This analysis compares the cost of constructing and operating the Virginia Railway Express, a commuter railroad in Northern Virginia, to the cost of constructing an equivalent lane of Interstate highway in the I-66 and I-95 corridors in which VRE operates, and operating enough automobiles in those lanes to serve the same number of peak period commuters as are projected to use VRE during Fiscal Year 1996. The analysis demonstrates that at present levels of operation, between 1992 (VRE's start-up year) and 2012, VRE will cost $264 million <u>less</u> to build, maintain, and operate than would the lanes of Interstate. While VRE is not a substitute for all highway construction and cannot solve all of the region's commuting problems, the railway was and continues to be a very sound investment decision by the citizens of Northern Virginia.

The Virginia Railway Express (VRE) began commuter rail operations in June, 1992. Ridership has grown steadily, reaching an average daily level of about 8,000 passenger trips. The two commissions sponsoring VRE (Northern Virginia Transportation Commission and Potomac & Rappahannock Transportation Commission) have purchased locomotives, railcars, fuel and insurance; contracted with Amtrak for maintenance and crews; built facilities; and leased access to tracks from three freight railroads and Amtrak. In addition, the Virginia Department of Transportation has built parking lots and participating local governments have constructed several stations. Operating and capital costs of the project are currently financed jointly by customer fares, six participating and two contributing jurisdictions, and state aid. As of Fiscal Year 1995, federal funding is also available for capital projects.

Estimated total construction, capital,and operating costs for the VRE project were approximately $150 million through FY 1994. The approved operating and capital budget for FY 1996 is about $27.3 million. To what extent are expenditures of such magnitude justified in an era of scarce public resources?

The VRE project has delivered significant benefits, including removing the equivalent of a rush-hour lane of low-occupant vehicles from the crowded I-66 and I-95 corridors of Northern Virginia (see page 3). Customers rate the quality of service as excellent, and ridership is growing despite two four-percent fare increases and an overall fare level that exceeds the average cost of parking automobiles in core employment locations.

Compared to other commuter rail systems in the United States and Canada, VRE provides exceptional service at an operating cost below the national average on a per passenger mile basis, while recovering a greater percentage of those costs from customers, as demonstrated below, using the most recent federal and VRE data available:

Federal Transit Administration Section 15 Data	Operating Cost Per Pass. Mile	Fare Per Pass. Mile	Recovery Ratio (Fares/Op.Cost)	Average Trip Length	Pass. Miles Per Vehicle Mile
National Avg., FY 93	$.30	$.14	.48	22 miles	32
VRE, FY 1994	$.24	$.13	.55	32 miles	60

Also, a significant part of VRE's initial $150 million cost has been invested in assets that, with appropriate maintenance, will continue to yield benefits for 20 years or longer. These assets include railcars, locomotives, and a self insurance trust. The fact that many of these assets can be readily liquidated has served to minimize the initial risk to Virginia taxpayers. For example, as of June 30, 1994, the insurance fund contained $20.8 million in liquid assets.

Despite the current success of VRE and its potential to expand rapidly to serve future needs, the project should be evaluated in comparison to competing alternatives. In an environment in which severe traffic congestion restricts peak period commuting, buses, carpools, vanpools, and low occupancy vehicles all rely on the existence of sufficient highway capacity. Consequently, VRE's costs should be compared to the equivalent costs of building and maintaining new highways to serve peak hour commuters as well as the costs of operating competing transportation modes on those highways during peak periods.

The following analysis compares the costs of moving passengers along these corridors on VRE to the costs of its principal competitor, the private automobile. Costs are grouped into four primary categories to assure comparability: 1) initial capital investments, 2) maintenance and administration, 3) the cost of providing the transportation itself, and 4) air quality considerations. Detailed information regarding assumptions, sources, and calculations is provided in the attached worksheets.

1) Initial capital investments: $86.5 million (VRE) v. $338 million (Interstate)

The initial costs of establishing the fixed facilities of the VRE system were $66.1 million. This includes the costs of constructing parking lots and stations, upgrading track and signals, and building yards and maintenance facilities. The costs of purchasing VRE railcars and locomotives are accounted for in category 3 below. In addition, VRE has provided $20.7 million to the Commonwealth's Division of Risk Management to establish a self-insurance trust. This investment yields interest which is used to pay the premiums for additional private insurance.

To cover an equivalent distance with interstate highway in Northern Virginia, the respective costs are about $4.4 million per lane-mile in the inner suburbs and Prince William County and $2.7 million per lane-mile in the Stafford County area. These estimates are taken from comparable construction projects in the approved Virginia Fiscal Year 94-95 Six-Year Improvement Program, and include the costs of some engineering as well as construction. While some highway construction costs might be lower (e.g. paving existing shoulders to create an additional lane,) it should also be noted that the figures only reflect costs to construct lanes up to the Virginia bank of the Potomac River, and not on the bridges crossing the Potomac or in the District of Columbia. District of Columbia staff has indicated that the cost of such construction in the District would be so prohibitively expensive that they could not provide an estimated cost. Furthermore, this figure does not include right-of-way, which in some congested areas of the corridor would be very expensive.

Highway costs also do not reflect the significant level of investment in insurance reserves necessary for VRE, because the liability of the Commonwealth is capped by state statute. Thus, while motorists are provided with some protection through privately obtained insurance, the state does not have to insure itself against lawsuits. Sponsors of VRE chose to change state statutes to waive the $25,000 cap in order to provide explicit protection to VRE customers. Insurance has been provided in order to indemnify the railroads and protect customers for an annual aggregate of up to $200 million in damages.

Determining the theoretical maximum capacity of the VRE facilities versus the highway is problematic. VRE capacity is constrained in the short term by available parking, freight train competition for track time, and available rolling stock. Nonetheless, under current conditions VRE can move about 3,700 people per hour during rush hours (five trains of seven cars on each line with a capacity of 106 people per car). A highway lane could carry about 2,300 people per hour at equivalent speeds assuming the current regional average of 1.14 persons per car, and in fact, this number is nearly exactly that found by inbound traffic counts on I-395 just before the 14th Street Bridge during the peak morning hour. Of course, if auto occupancies were assumed to be greater (for instance, if more lanes were reserved for high occupancy vehicles) the assumed capacity of the highway lane would be correspondingly increased. Similarly, assuming more railcars, more frequent trains, or other VRE improvements not presently available would boost the capacity of the VRE alternative in this analysis.

Both highway and the rail corridors also perform functions other than carrying commuter traffic. For instance, both the tracks used by VRE and the highways used by passenger vehicles carry freight and can provide defense capabilities in a national emergency. These non-commuting benefits, however, are not within the scope of this analysis, since the underlying assumption of the analysis is that the region is contemplating an investment to relieve rush hour congestion in two mainline corridors in order to move commuters more effectively. Existing highway and rail capacity is already available for freight and national defense needs and for off-peak transportation.

VRE total initial investment costs are $86.5 million, compared to highway costs of $338 million. Of course, while these two investments accomplish the same purpose -- laying down the facilities upon which vehicles can move -- it should be remembered that they do have dissimilar characteristics. VRE capacity is available for trips in both directions, but permission of the railroads is required to expand the frequency of service. Once an agreement is reached, capacity could be increased significantly at relatively little marginal cost. A single lane of highway would have to be reversible to provide the same two-way capacity enjoyed by VRE. Furthermore, while an interstate lane can also accommodate vehicles during off-peak hours, once it is filled to capacity during rush hours, the only way to accommodate more vehicles is to construct yet another lane, requiring at least another $338 million capital investment. During peak hours, the tracks used by VRE are not at maximum capacity, and can accommodate an increase in of VRE patronage.

VRE	System	$66,134,806
	Insurance Trust Fund	20,368,000
		$86,502,806
Interstate	68 miles @ $4.4 million/mile (Inner Jurisdictions)	$300,000,000
	14 miles @ $2.7 million/mile (Stafford County)	37,800,000
		$337,800,000

2) Maintenance and Administration: $14.1 million annually (VRE) v. $2.9 million annually (Interstate - partial costing)

Based on the level of service provided in the Fiscal Year 1996 budget, the annual cost of maintaining and administering VRE will be just over $14 million. This figure covers payments to the freight railroads for use of the tracks, improvements to those tracks, operation of the fare vending systems, marketing costs, maintenance and refurbishment of the stations and parking lots, and other general overhead. Corresponding interstate highway maintenance costs are budgeted at $41,000 per lane mile, or $3.4 million for the equivalent distance. Overhead costs of administration by VDOT and local authorities as well as costs of police protection are omitted, as are the costs of maintaining the bridges across the Potomac River and highways in the District of Columbia. Conversely, the costs of customer security and system maintenance are fully included within VRE's budget.

VRE	System Costs (Tracks extending from outlying stations to Union Station)	$13,990,473 Per Year
	Costs to jurisdictions of maintaining stations & lots	139,628 Per Year
		$14,130,101
Interstate	82 miles @ $41,000/mile	$3,362,000 Per Year
	VDOT expenditures:	
	Overhead	N/D
	Legal expenses & settlements	N/D
	Cost of Maintaining Bridges over Potomac	N/D
	Police expenditures: Highway Patrol	N/D

N/D = Not Determined

3) Costs of Providing Transportation: $.22 (VRE) v. $.30 (Interstate) Per Passenger Mile

A portion of VRE's mission is to operate safe and reliable transportation on the facilities it built, leases, and maintains. To acquire rolling stock, pay crews and buy fuel to accomplish this costs about 22 cents per passenger mile at projected ridership levels. As passenger loads grow, this per-passenger-mile cost will decrease.

The Federal Highway Administration has calculated that the average cost to the public to acquire private compact automobiles and operate them along the same corridor is 26 cents per mile. This analysis also takes into account the cost of parking those cars once they arrive at their destination -- whether that is a rural parking lot or one in the urban core. Neither the VRE nor the vehicular numbers reflect "user fees," or charges to the passenger which are directed back into the system being utilized. For instance, VRE fares, which are used to cover costs already accounted for in this analysis, are not included here. Similarly, fuel taxes and registration fees, which are traditionally dedicated to highway systems, have been deducted from the federal estimates of operating costs for an automobile.

Independently performed ridership estimations project an FY 96 ridership of 8,672 daily trips. Assuming that these trips average 35 miles one-way (reflecting VRE's current use versus the 32 miles shown in the table for Fiscal Year 1994 on page two), VRE costs in this category total about $15.95 million for FY 1996. (The $15.95 million is greater than VRE's Fiscal Year 1996 operating budget would indicate, because it includes the annual debt service for rolling stock, a figure generally considered to be a capital budget item, but included in this section for comparability to auto costs.) The same number and length of trips by low-occupant automobiles would cost approximately $22.4 million annually. This is based on the cost of those vehicles driving an average of 35 miles each way along the Interstate; neither analysis calculates the cost of accessing either the VRE station or the highway.

The cost of parking has been added to each mode based on an estimate of the value of the space used by those automobiles. Thus, due to higher land values, the estimated "cost" of parking in the urban core is significantly higher than that of leaving one's automobile at an outlying station. Most VRE commuters, and many of those who drive into the urban core, do not actually pay for parking, but the opportunity cost of the space their car uses is paid by someone, be it the local jurisdictions (in the case of the VRE parking lots), employers, or the public in general, as cars parked on the street take up room that could be used for other purposes, such as buildings, sidewalks, or parks. For the purposes of this calculation, the number of spaces used in each case was assumed to be 3,803: the number of passengers divided by the regional average auto occupancy rate.

VRE	Acquiring and operating rolling stock $15,951,617/(8,672 passenger trips x 35 miles x 250 working days) = .17 Per Passenger Mile	$15,951,617 Annually
	Parking ($.61/space)	580,110 Annually
		$16,531,727 Annually
Interstate	Acquiring and operating private automobiles $.26/Passenger Mile x 8,672 passenger trips x 35 miles x 250 working days =	$17,303,650 Annually
	Parking ($5.40/space)	5,134,737 Annually
		$22,438,387 Annually

4) Air Quality Considerations: $276,000 (VRE) v. $4.4 million (Interstate) Annually

Based on current levels of service, VRE trains annually emit 1.8 tons of hydrocarbons, 1.3 tons of carbon monoxide, and 1.9 tons of oxides of nitrogen. However, if current VRE riders were to use the interstate instead, they would add about 22.3 tons of HC, 147.6 tons of CO and 40.6 tons of Nox to the region's air each year. These figures demonstrate the *difference* between commuters starting their cars and driving to work and those same commuters starting their cars, driving to the train station, and finishing their commute on the train.

Because Northern Virginia is in a "serious" non-attainment area with regards to federal air quality standards, transportation-related measures must be employed to reduce air pollution levels. In upcoming years, the region will be required to meet ever stricter standards, and the marginal cost of actions to reduce emissions can be expected to rise. In the event that the region does not meet its required targets, federal transportation monies may be withheld.

Currently, the average cost of eliminating a ton of hydrocarbon emissions through Transportation Control Measures either adopted or considered by the Metropolitan Washington Transportation Planning Board is estimated to be $98,000. The average cost of eliminating a ton of oxides of nitrogen, the other pollutant for which the region must meet a federal emissions budget, is estimated at $56,000. Consequently, the cost of mitigating VRE's air emissions would be approximately $276,000, as opposed to a cost of $4.4 million to mitigate those emissions generated if VRE riders drove on the interstate instead. Thus, VRE can be seen to be saving the region approximately $4.1 million annually in air quality investments.

5) The Bottom Line: Net Present Valuation of Cost over Twenty Years at $417 million (VRE) v. $681 million (Interstate)

Considering the above cost comparisons, Northern Virginia's choice of VRE over the equivalent peak period capacity of a new highway lane in the congested I-95 and I-66 corridors makes sound economic sense. VRE is nearly four times less expensive for initial start-up expenses, if insurance costs are assumed to be comparable. While on an annual basis, VRE may cost more to maintain and administer than the hypothetical new highway lane, the actual provision of peak-period transportation using VRE is less costly than using the private automobile, and VRE is a big winner in air pollution savings.

Commuter rail also presents the public, both those using and those in the vicinity of the various modes of transportation, with fewer risks of injury. While fatality rates for commuter rail are only slightly lower than those on highway systems (.08 fatalities per ten million passenger miles traveled v. .11 on the highways) non-fatal injury rates on highway systems are more than three times as high as those on commuter rail systems -- 9.76 injuries per 10 million passenger miles traveled versus 2.9 injuries to passengers for the same amount of travel on commuter rail.

Looking to the future, peak capacity can be added to VRE at a considerably lower marginal cost than that at which it can be added to the Interstate system. Adding two lanes of peak period capacity to the Interstate highway would cost at least $676 million (twice the $338 million required for one lane). Of course, the acquisition of right-of-way would become more expensive and difficult with each additional lane. This escalation in costs due to acquisition of right-of-way is easily demonstrated by the I-395 corridor in Arlington, where there is very little room for the highway to expand without causing great disruption to the surrounding communities.

This disparity in the marginal costs of increased capacity would remain even if the existing railroad tracks were to become so congested as to require construction of an additional track. While clearly this would drive up the cost of the initial capital investment in VRE, the cost of building track in this region is currently estimated at $2 million per mile, still less than the estimated cost of most of the highway construction in this analysis. The marginal costs of extending service on VRE or extending the extra lane on the Interstate would also vary greatly; while both the capital and the maintenance figures for the Interstate are based on a per mile number, and thus increase as the length of the road increases, the administrative costs to VRE would only increase slightly, resulting in an overall *decrease* in the cost per mile of service.

Of course, VRE cannot completely replace the private automobile. Many people cannot conveniently access a station, work somewhere other than along the mainline corridor, or must travel at times other than peak periods. Having a highway system that is safe and reasonably free of congestion is essential to accommodate those persons' travel needs. But many commuters *can* be effectively served by VRE. If the removal of those commuters from the highways eliminates the need to expand highway capacity, then the cost of that rail alternative versus the cost of expanded roadways provides an economic measure of the public investment value of the alternatives.

In this analysis, considering the stream of relative costs over an assumed 20 year investment horizon, with no assumed salvage value and a discount rate of seven percent (a conservative estimate of the federal cost of borrowing funds for twenty years,) the net present value of VRE savings relative to the new peak period highway capacity and associated automobile costs is an astonishing $263.6 million. Assumptions, sources, and calculations underlying this analysis are contained in the following worksheets.

Cost Comparison -- VRE vs. Additional Lane of Interstate April 24, 1995

This analysis compares the start-up and operating costs of VRE to the costs of adding one lane of Interstate from Manassas (Rte. 234) and Fredericksburg, Va. to the Potomac River to serve peak period commuters. The analysis assumes FY 96 projected levels of VRE ridership and congested Interstate highways in the two corridors.

Sources and Calculations

1) Initial Capital Investment: $86.5 million (VRE) v. $337 million (I/S)

Cost of putting the stationary system in place (planning, engineering, laying pavement, building stations, etc.)

1) A	VRE	System		$66,134,806
		Insurance Trust Fund		20,368,000
				$86,502,806
	Stations & Parking		18,617,000	
	Yards		8,169,000	
	Inventory		1,338,000	
	Cash Available		1,905,000	
	Debt Service Reserves		13,962,806	
	Jur'l. Stations & Parking		22,143,000	
			66,134,806	

State liability is legally limited; thus highway systems are not required to be insured as are rail systems.

1)B	Interstate	68 miles @ $4.4 million/mile =	$299,200,000
		14 miles @ $2.7 million/mile =	$37,800,000
			$337,000,000

Cost in Stafford County (14 miles) based on average figure for outer jurisdictions, VDOT Office of Tranportation Planning
Cost in other jurisdictions (68 miles) based on average of cost per lane mile of Northern Virginia Interstate construction projects listed in the Virginia Commonwealth Transportation Board FY 94-95 Six Year Improvement Program. Costs do not include rights-of way, and would most likely be higher due to extreme difficulties in acquiring Rights of Way in certain portions of the corridors.

Theoretical Maximum People Transported One Way Per Hour: 3,710 (VRE) v. 2,280 (I/S)

VRE	5 trains	@ 7 cars @ 106 people	3,710 People

Based on average number of seats in cars, running regular number of cars in each train travelling in one direction during the space of an hour.

Interstate	Density per lane of 50 mph highway at high traffic volume	2,280 People

Capacity =	2000 vehicles/hour
Avg. Occupancy	1.14
	2280 people

– Capacity figure based on 50 mph multilane highway, level of service E, from May 1992 Addendum to the 1985 Highway Capacity Manual
– Traffic counts conducted by VA. Dept. of Transportation, Spring, 1993.

2) Ground Infrastructure, Facilities, and Administration: $14.1 million (VRE) v. $3.4 million (I/S) annually

Cost of repairing and maintaining facilities (pavement, tracks, stations,) and overall administrative costs.

A	VRE	System	$13,990,473 Per Year
		Costs to jurisdictions of maintaining stations & lots	$139,628
			$14,130,101

	FY96
Operating Budget	7,830,181
CIP	4,085,000
TVM Lease	262,000
5% Capital Reserve	479,583
Payment to Capital	321,600
Debt Service	1,012,109
	13,990,473

Cost to jurisdictions based on 20-year annualization of fifteen percent of original capital costs. CIP projects designed to increase capacity rather than maintain the service levels reflected are not included.

2) B	Interstate	82 miles @ $41,000		$3,362,000 Per Year
		VDOT expenditures:	General Admininstration	N/D
			Legal expenses & settlements	N/D
		Police expenditures:	Highway Patrol	N/D

NOVA VDOT is annually allotted $41,000 per lane mile of Interstate for maintenance, capital improvements, and local administration.

3) **Cost of Providing Transportation (Per Passenger Mile): $.22 (VRE) v. $.30 (I/S)**

Cost of moving people along the corridor, either in rail cars or automobiles, and maintaining vehicles.

A **VRE** Cost of acquiring and operating rolling stock

	FY 96
Operating Budget	11,073,315
CIP	250,000
Locomotive Lease	320,000
Debt Service	4,308,302
	15,951,617

Anual cost	Rolling Stock:	15,951,617	
Parking Costs	($.61/day/car)	$580,110	Per Year
Annual Total		$16,531,727	

Average Daily Ridership (Projected):	4,336
Average Trip Length	35
Working Days in Year:	250
Average Rolling Stock Cost per Passenger Mile:	0.22

3)B **Interstate** Cost of acquiring, operating, and parking automobile 0.30 Per Passenger Mile

Travelling	17,303,650
Parking	5,134,737
Total	$22,438,387

Cost of acquiring and operating automobile	0.26 Per Mile
Average Number of Cars:	3,803
Average Trip Length	35
Working Days in Year:	250
Average Annual Total Costs:	$17,303,650

Cost to owner of operating vehicle based on calculations by FHWA, 1991 (Pub. #FHWA-PL-92-019)
Figure includes depreciation, insurance, maintenance, and fuel.
Does not include taxes or registration fees (regarded as transfer, as are VRE fares).

Parking Costs ($5.40/day/car) $5,134,737 Per Year

$\frac{\textit{4336}\text{ Passengers}}{\text{1.14 (avg. vehicle occupancy)}}$ = 3,804 vehicles not travelling to core daily

Average parking cost based on April, 1995 survey of parking garages; $5.40/day is proportional average of monthly parking fees in the analysis zones of the four inner VRE stations, prorated to determine daily rate. Rates in the area of particular stations are listed below:

King Street: $4.00	L'Enfant Plaza: $7.00
Crystal City: $3.60	Union Station: $5.60

4) Emissions Factors: $276,000 (VRE) v. $4.4 million (I/S)

4)A	VRE	HC/VOC Costs:	$172,085			
		NOx Costs:	$104,273			
		Annual Costs:	$276,357			
	HC/VOC:	Cost/Ton	$98,334	NOx:	Cost/Ton	$55,612
		Tons/year	1.75		Tons/year	1.875
			$172,085			$104,273

8 trains x 38 miles + 12 trains x 58 miles = 1000 miles

Pollutant	Emmissions Factor (g/mi)	Mileage	Working Days	Kilograms Per Year	Tons Per Year
HC	30.8	1000	250	7700	1.75
CO	22	1000	250	5500	1.25
NOx	33	1000	250	8250	1.875

4)B	Interstate	HC/VOC Costs:	$2,192,848			
		NOx Costs:	$2,255,067			
		Annual Costs:	$4,447,915			
	HC/VOC:	Cost/Ton	$98,334	NOx:	Cost/Ton	$55,612
		Tons/year	22.3		Tons/year	40.55
			$2,192,848			$2,255,067

Interstate emissions calculations detailed on attached page.

Estimate is of emissions from cars projected to be removed from highways due to VRE. Increased capacity would also increase demand, and therefore emissions, as commuters switched from buses, etc. to low-occupant vehicles.
Emissions due to trips to stations have been subtracted from Interstate emissions. (Figures take into account cold starts, VMT, and hot soaks, and account for emissions generated by trips to stations.)

The cost of emissions mitigation projects is based on Metropolitan Washington Transportation Planning Board staff estimates of the costs and benefits of Transportation Control Measures that have been included in the metropolitan Washington FY 95-00 Transportation Improvement Program (TIP) or that are being considered for inclusion in the FY 96-01 TIP.

5) The Bottom Line

5) A	VRE	Commuter rail data from FY 1992 Section 15 data, published by Federal Transit Administration, Office of Technical Assistance and Safety
5) B	Interstate	Safety data published in Table FI-1 of "Highway Statistics", 1992, published by the Federal Highway Administration, U.S. DOT.

Auto Emissions Saved - Base Ridership   FY 96 - Projected

Ridership figures projected for FY 96 (total only, projections not yet done by station)

All Figures are daily

Auto Emissions: General Formula:

((1) VMT to and From Core Eliminated x (2) Emissions Factor (35 mph)) - ((3) VMT to and from Station x (4) Emissions Factor (20 mph)) + [(5) Trips Eliminated x ((6) Emissions Factor for Cold Starts + (7) Emissions Factor for Hot Soaks)] + ((8) Trips to and From Stations x (9) Emissions Factor for Hot Soaks) = Kilograms Eliminated Per Day, Tons Eliminated Per Day

Project Figures

	(1) VMT to and From Core Eliminated	(2) Emissions Factor (35 mph)	(3) VMT to and from Station	(4) Emissions Factor (20 mph)	(5) Trips Eliminated	(6) Emissions Factor for Cold Starts	(7) Emissions Factor for Hot Soaks	(8) Trips to and From Stations	(9) Emissions Factor for Hot Soaks	Kilograms Eliminated Per Day	Tons Eliminated Per Day
Hydocarbons	204,110	0.436 88,991.954	25,951	0.808 20,968.654	915	2.330	1.879 3,852.613	4,805	1.879 9,029.476	80.905	0.0892
Carbon Monoxide	204,110	3.434 700,913.692	25,951	7.104 184,358.064	915	20.891	0.000 19,122.104	4,805	0.000 0.000	535.678	0.5905
Nitrogen Oxide	204,110	0.842 171,860.608	25,951	1.011 26,236.768	915	1.691	0.000 1,547.819	4,805	0.000 0.000	147.172	0.1622

Station	Estimated Riders Previously Driving	Miles to and From Core	Total Daily Pass. Miles	% Elim.	(1) VMT Eliminated	Miles to and From Station	(3) VMT to and From Station	Added Trips to and From Stations	Percent not Driving to Stations	(5) Trips Eliminated From Added	(8) Actual Added Trips To and From Stations
Broad Run/Airport	150	74	11,080	1	11,080	8	998	299	0.16	48	252
Manassas	324	70	22,659	1	22,659	8	2,158	647	0.16	104	544
Manassas Park	170	64	10,898	1	10,898	8	1,135	341	0.16	54	286
Burke Centre	276	47	12,971	1	12,971	8	1,840	552	0.16	88	464
Rolling Road	168	39	6,555	1	6,555	8	1,121	336	0.16	54	282
Backlick Road	52	27	1,407	1	1,407	8	347	104	0.16	17	88
Fredericksburg	409	116	47,425	1	47,425	12.8	4,361	818	0.16	131	687
Leeland Road	221	108	23,861	1	23,861	12.8	2,357	442	0.16	71	371
Brooke	175	101	17,718	1	17,718	12.8	1,871	351	0.16	56	295
Quantico	148	73	10,770	1	10,770	12.8	1,574	295	0.16	47	248
Rippon	243	55	13,362	1	13,362	12.8	2,592	486	0.16	78	408
Woodbridge	480	49	23,522	1	23,522	12.8	5,120	960	0.16	154	806
Lorton	45	42	1,881	1	1,881	12.8	478	90	0.16	14	75
TOTALS	2,860		204,110		204,110		25,951	5,721		915	4,805

Assumptions:

Highway Miles average 35 mph.
Cold Starts average 25 mph
Occupancy rates accessing stations = 1.2 people per vehicle
Estimated Riders Previously Driving = 66% of total ridership

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Northern Virginia Transportation Commission