

National Capital Region Transportation Planning Board

**Evaluating a Network of Variably Priced Lanes for
the Washington Metropolitan Region**

Draft for Discussion, December 5, 2007

*Funded under a grant from the Federal Highway Administration's
Value Pricing Pilot Program*

Outline

Preface

1. Executive Summary
2. Introduction and Background
3. Scenario Development
4. Scenario Analysis
5. Impacts of Pricing Scenarios on Different Populations
6. Topics for Further Consideration

Preface

“Under urban conditions we cannot have both free flowing rush hour traffic and the absence of user charges or other constraints on highway use. One or the other of these desiderata must yield.”

“Pricing of highway use will thus make it possible to provide at reasonable cost uncongested and speedy transportation anytime, anywhere, and for anyone for whom the occasion is sufficiently urgent to warrant the payment of the corresponding charge. Without pricing, it is very likely that during the rush hours this degree of freedom of movement would not be available to anyone at any price.”

William Vickrey, Statement to the Joint Committee on Washington DC Metropolitan Problems, 1957.

2 – Introduction and Background

2.1: About the Transportation Planning Board

2.2: Value Pricing Policy and Planning Activities

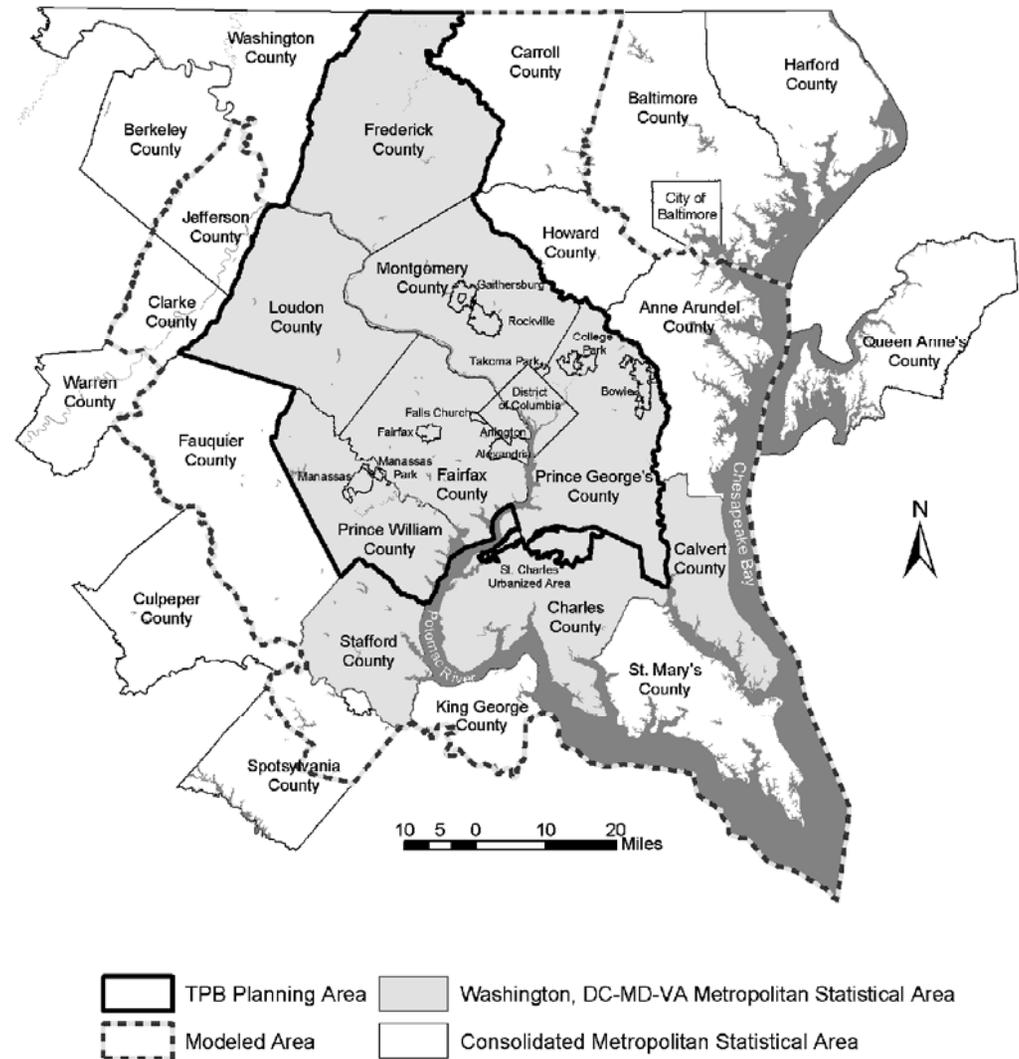
2.3: 2007 Value Pricing Projects

2.4: Current and Projected System Performance

2.5: Travel Demand Methodology

2.1: About the Transportation Planning Board

- Approximately 3,000 square miles
- MSA includes 5 million people and 3 million jobs in 2005
- Growth of **1.6 million people** (32%) and **1.2 million jobs** (40%) projected by 2030
- The National Capital Region **Transportation Planning Board (TPB)** prepares a financially constrained, 20+ year transportation plan (CLRP) for the TPB planning area
- Multi-state region: District of Columbia, Maryland and Virginia

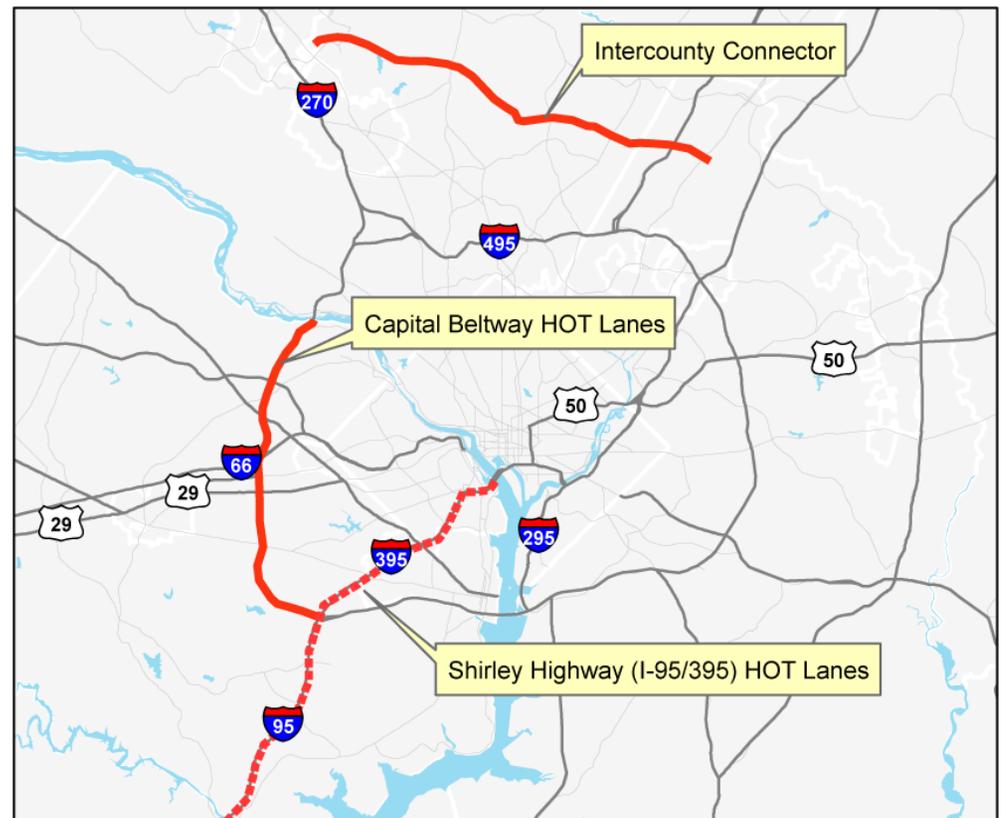


2.2: Value Pricing Policy and Planning Activities

- June 2003, Regional Value Pricing Conference
- September 2003, Establishment of Value Pricing Task Force
- Value Pricing Studies
 - Fall 2005 to Fall 2006, Assisting VDOT in Analyzing Key Corridors
 - Fall 2006, Sensitivity Analysis of Enhanced Transit
 - Regional Accessibility and Mobility Study

2.3: 2007 Value Pricing Projects

- Intercounty Connector (ICC)
 - 2004 CLRP Update*
- Beltway HOT
 - 2005 CLRP Update*
- I-95/I-395
 - 2007 CLRP Update (Underway)



* Federal Record of Decision approved

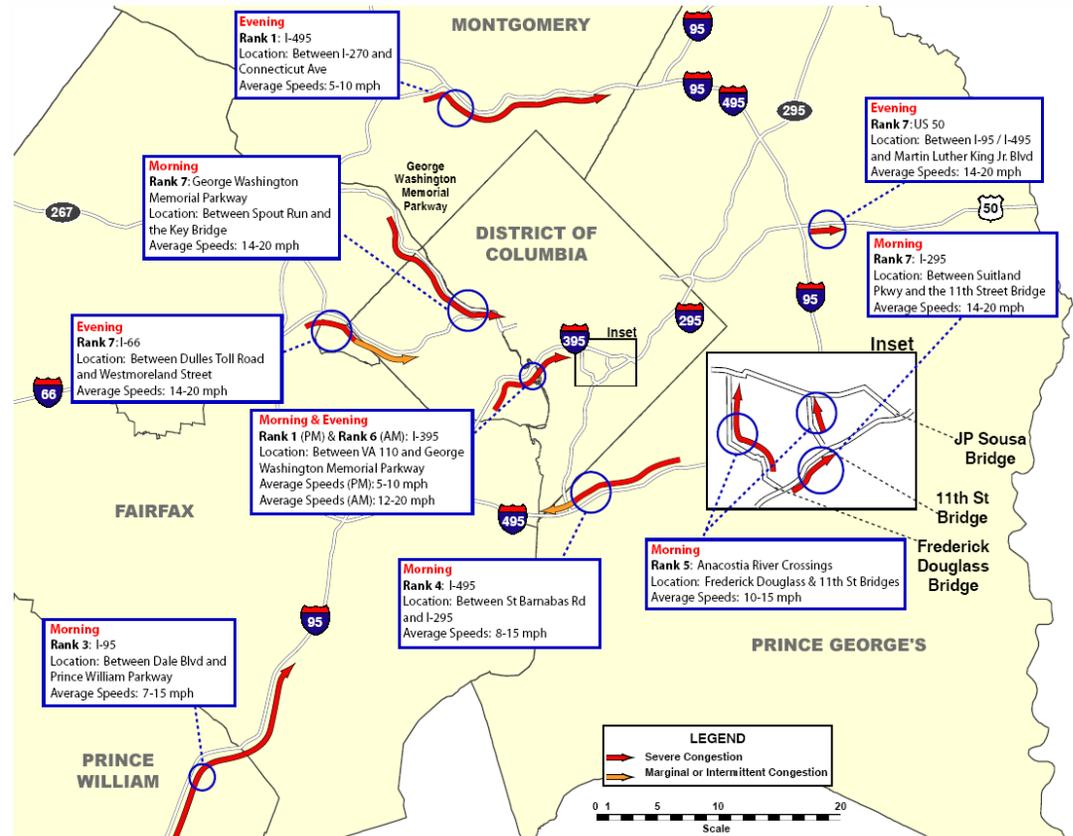
2.4: Current and Projected System Performance

2.4.1: Current Highway Congestion, 2005 Skycomp Report

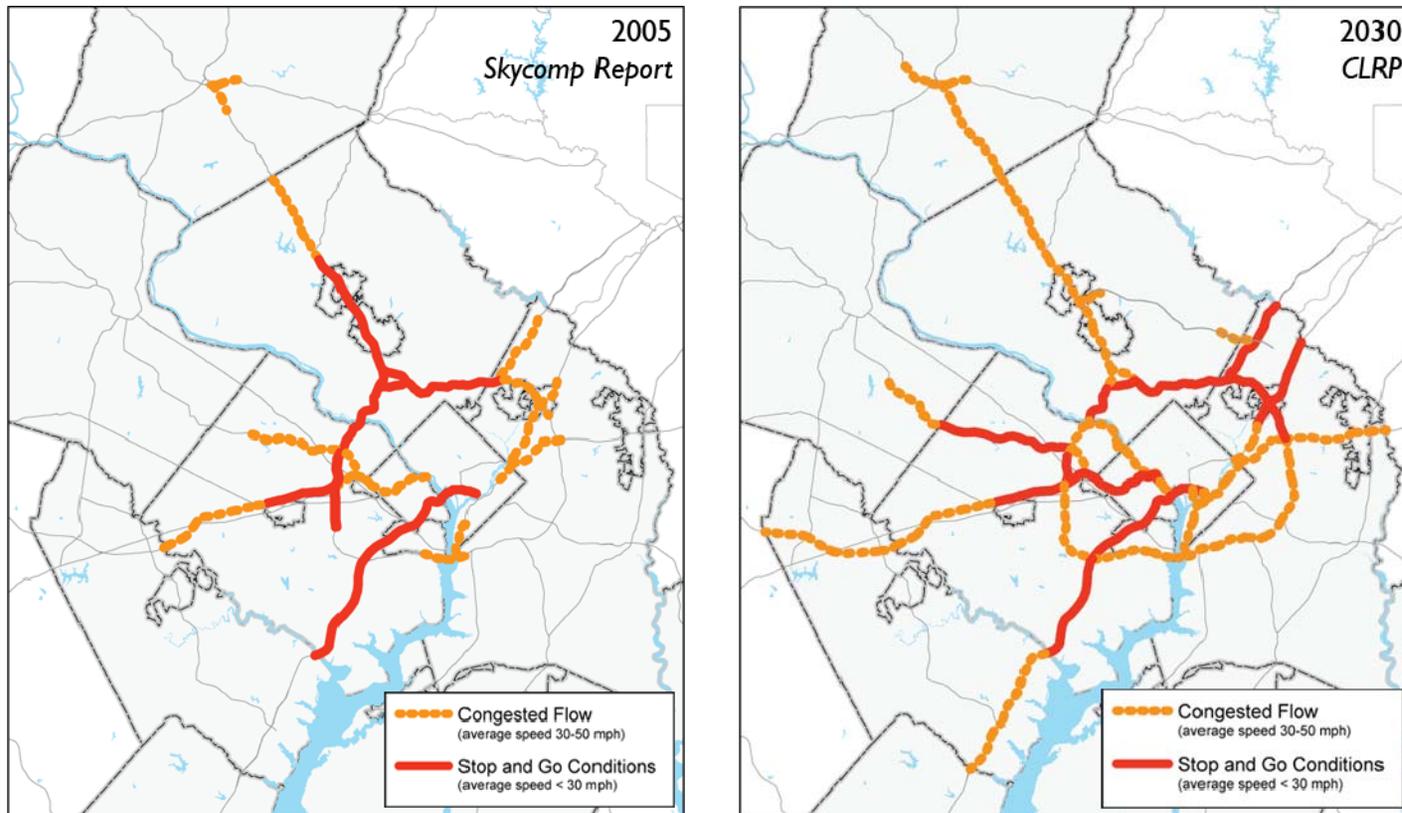
2.4.2: Projected highway congestion of the 2006 CLRP

2.4.1: Current Highway Congestion, 2005 Skycomp Report

- Top-ten most congested facilities
- Regional congestion analysis



2.4.2: Projected highway congestion of the 2006 CLRP



CLRP provides some relief from congestion along certain corridors, but overall congestion picture is worse in 2030.

2.5: Travel Demand Methodology

2.5.1: Study Assumptions

2.5.2: Technical Methods

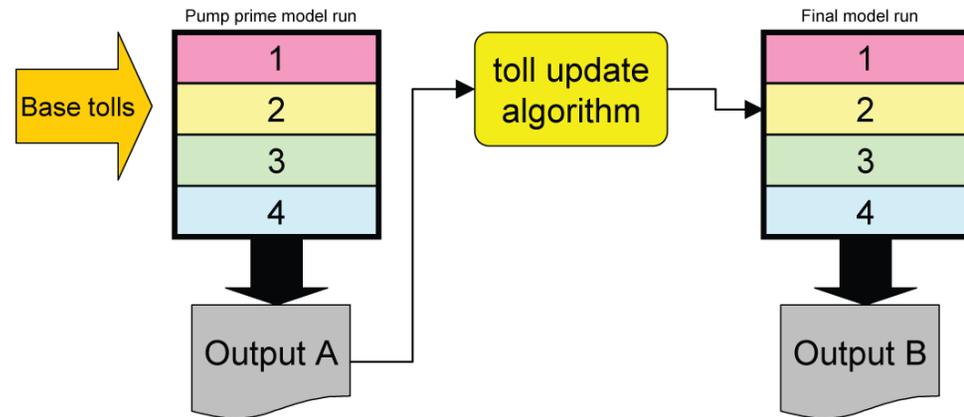
- Travel Demand Model
- Incorporation of Tolls in the Travel Demand Model

2.5.1: Study Assumptions

- All scenarios are for the year 2030, and all toll values and revenue calculations are in 2010-dollars.
- Variable tolls will be used on the lanes to prevent congestion and maintain freely flowing traffic.
- Occupancy requirements for all HOV lanes will be increased to at least three people or more, based on planning assumptions in the region's long-range plan.
- The variably priced facilities will be physically separated from the other lanes, where possible.
- At least one variably priced lane will be provided in the peak direction.
- Access and egress points will be primarily focused around the regional activity clusters.
 - COG and TPB adopted regional activity centers and clusters to help guide regional transportation planning decision-making. The 58 Centers are based on local government growth forecasts and categorized according to similar employment, residential, and growth pattern characteristics. The 24 Clusters tend to be groupings of Centers and are a more conceptual, stylized depiction of development than the Centers. The activity clusters are shown in many of the maps below, beginning with the map of Scenario A.

2.5.2: Technical Methods

- Travel demand model used to model impact on tolls.
- External toll update algorithm sets tolls to establish free flow on VPL network links.
- Tolls incorporated into the model in Trip Distribution (step 2) and trip assignment (step 4).
- Mode choice (step 3) is influenced by change in travel times by mode from step 2.



The model represents the region's jobs and households with over 2000 transportation analysis zones (TAZs), and includes tens of thousands of links in highway and transit networks. Each model run takes approximately 16 hours of computer processor time.

3 - Scenario Development

3.1: Roadmap for the Scenarios

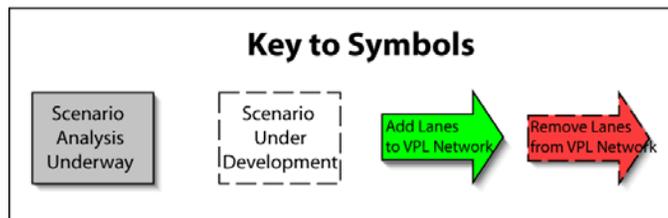
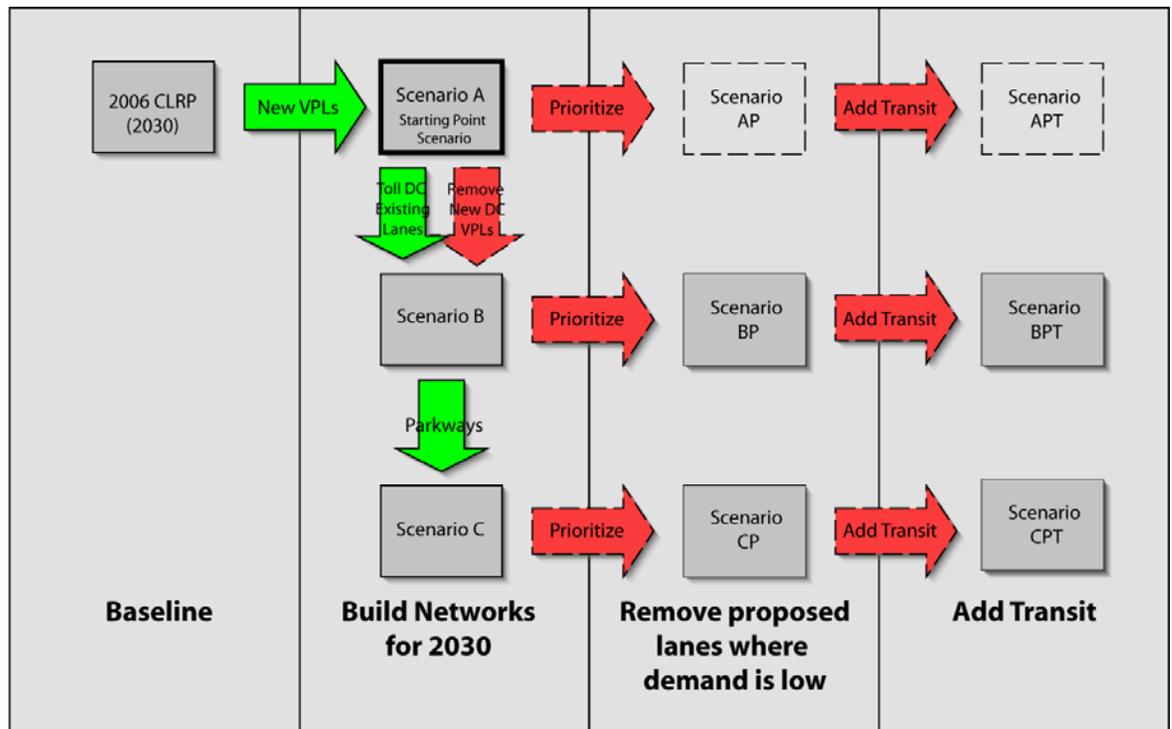
3.2: First Round Scenarios

3.3: Prioritized Scenarios

3.4: Scenarios with Enhanced Transit

3.1: Roadmap for the Scenarios

- Scenario A: New capacity.
- Scenario B: Toll existing DC facilities.
- Scenario C: Toll parkways
- Prioritize: Scenarios AP, BP and CP.
- Enhance Transit: APT, BPT and CPT



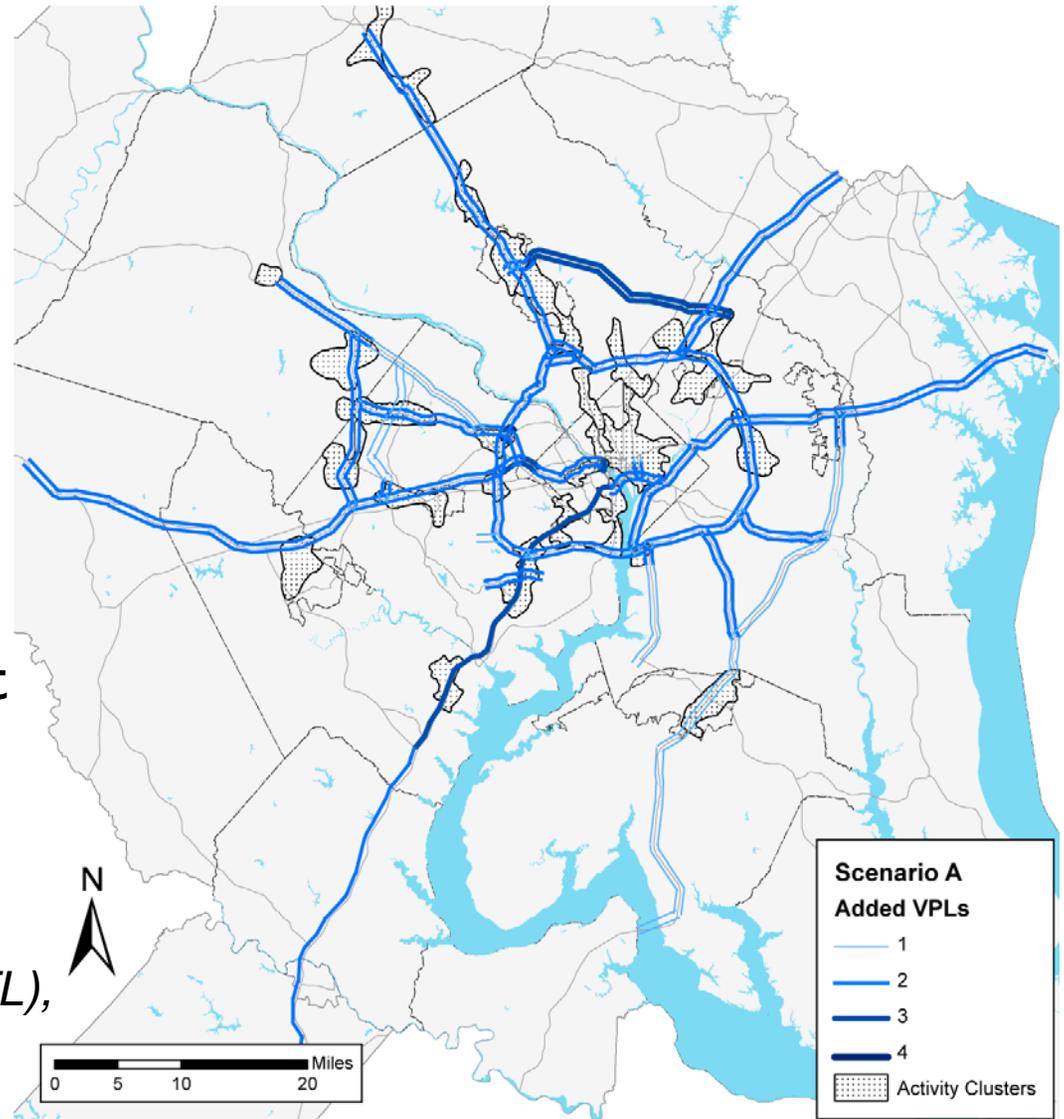
3.2: First Round Scenarios – Scenario A

In addition to the ICC, Beltway and I-95/395:

- **All Freeways:**
 - Add 2 VPLs
- **Arterials outside of beltway:**
 - Add 1 VPL
- **Existing HOV lanes:**
 - Convert to VPLs
- **Direct access ramps at key interchanges**
- **Incorporate existing transit service**

Variably Priced Lanes (VPLs):

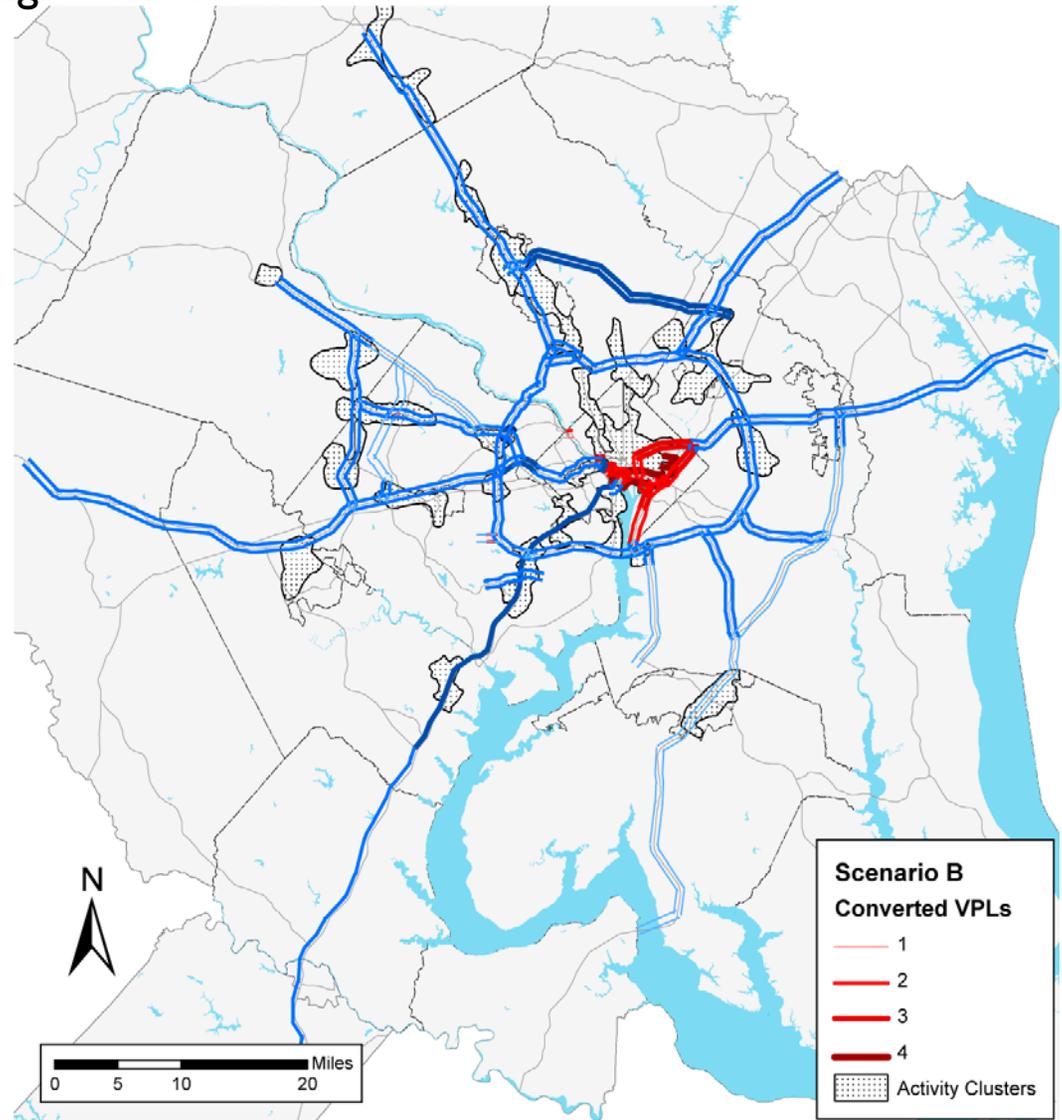
- *VA: HOT lanes, HOV 3+ free*
- *DC, MD: Express Toll Lanes (ETL), all pay*



3.2: First Round Scenarios – Scenario B

Add Variable Pricing to Existing DC Bridges and Other Facilities

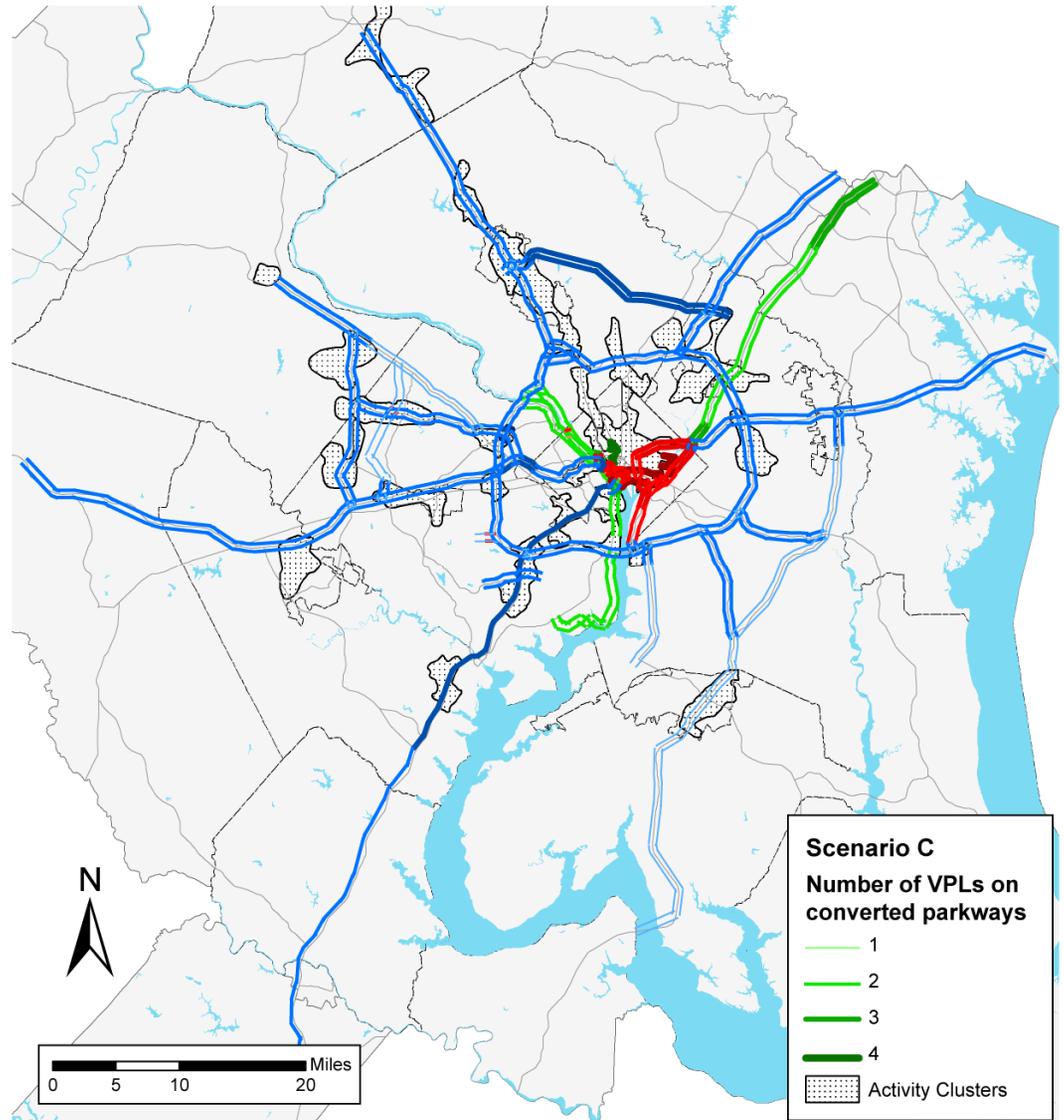
- **DC Bridges (Existing Capacity)**
 - Chain Bridge
 - Key Bridge
 - Memorial Bridge
 - South Capitol Street (Frederick Douglas) Bridge
 - Pennsylvania Avenue (John Phillip Sousa) Bridge
 - East Capitol Street (Whitney Young Memorial) Bridge
 - Benning Road Bridge
- **Other DC Facilities (Existing Capacity)**
 - New York Avenue from the District line to I-395 at 4th St NW
 - Independence Ave SW and Maine Ave SW between the Memorial Bridge and the Southeast/Southwest Freeway
 - Remove added capacity on Southeast/Southwest Freeway and I-295 and toll all existing lanes.
- **Additional VPLs to Address Scenario A Chokepoints**
 - Fairfax County Parkway northbound and southbound at the Dulles Toll Road (VA-267)
 - Braddock Road westbound at the Capital Beltway (I-495)
 - Indian Head Highway (MD-210) southbound at the Capital Beltway (I-495)



3.2: First Round Scenarios – Scenario C

Add Parkways to Scenario B, Tolls applied to existing capacity

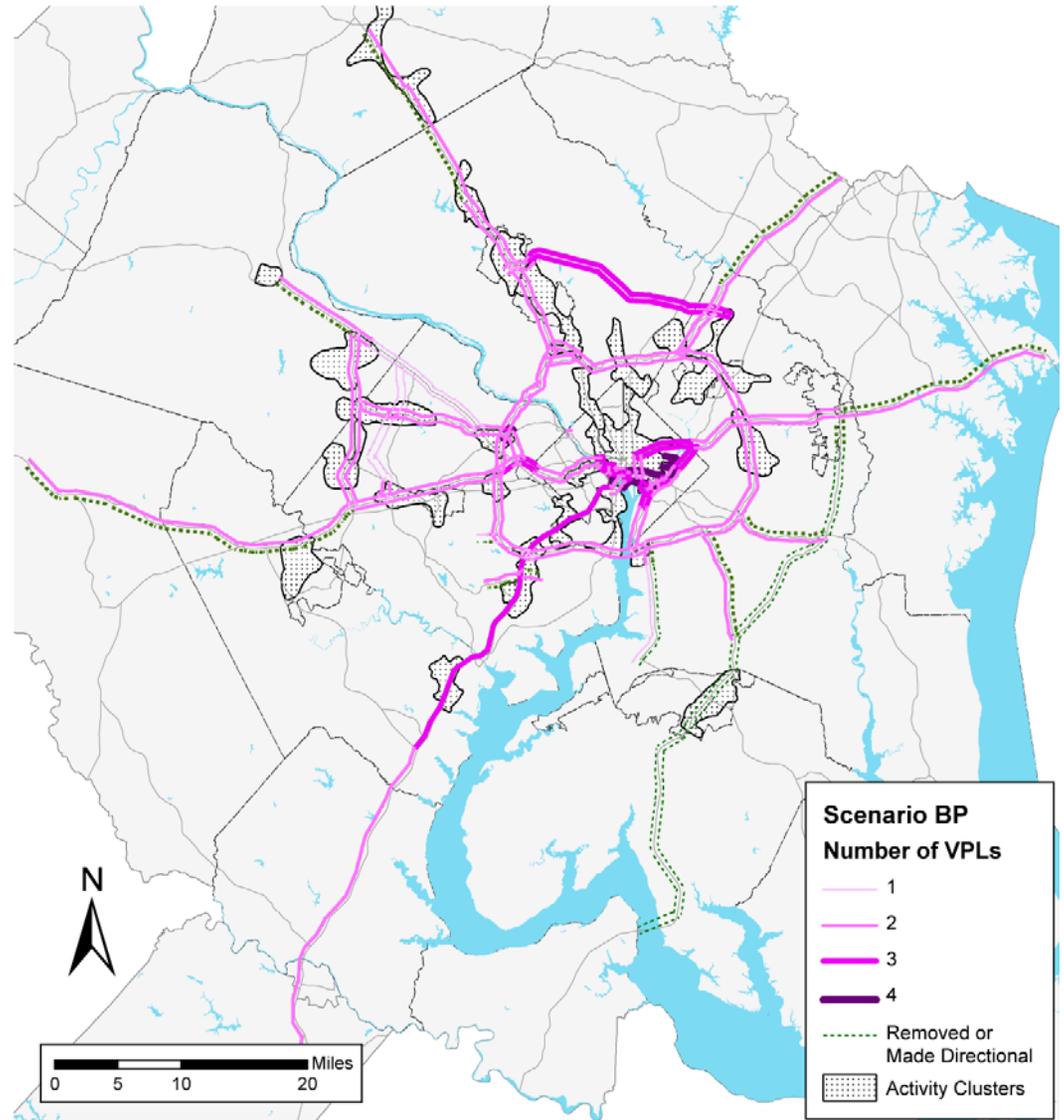
- Baltimore Washington Parkway (MD-295)
- George Washington Parkway
- Rock Creek and Potomac Parkway
- Clara Barton Parkway
- Suitland Parkway



3.3: Prioritized Scenarios – Scenario BP

Prioritizing from B, Drop facilities/directions with low toll rates

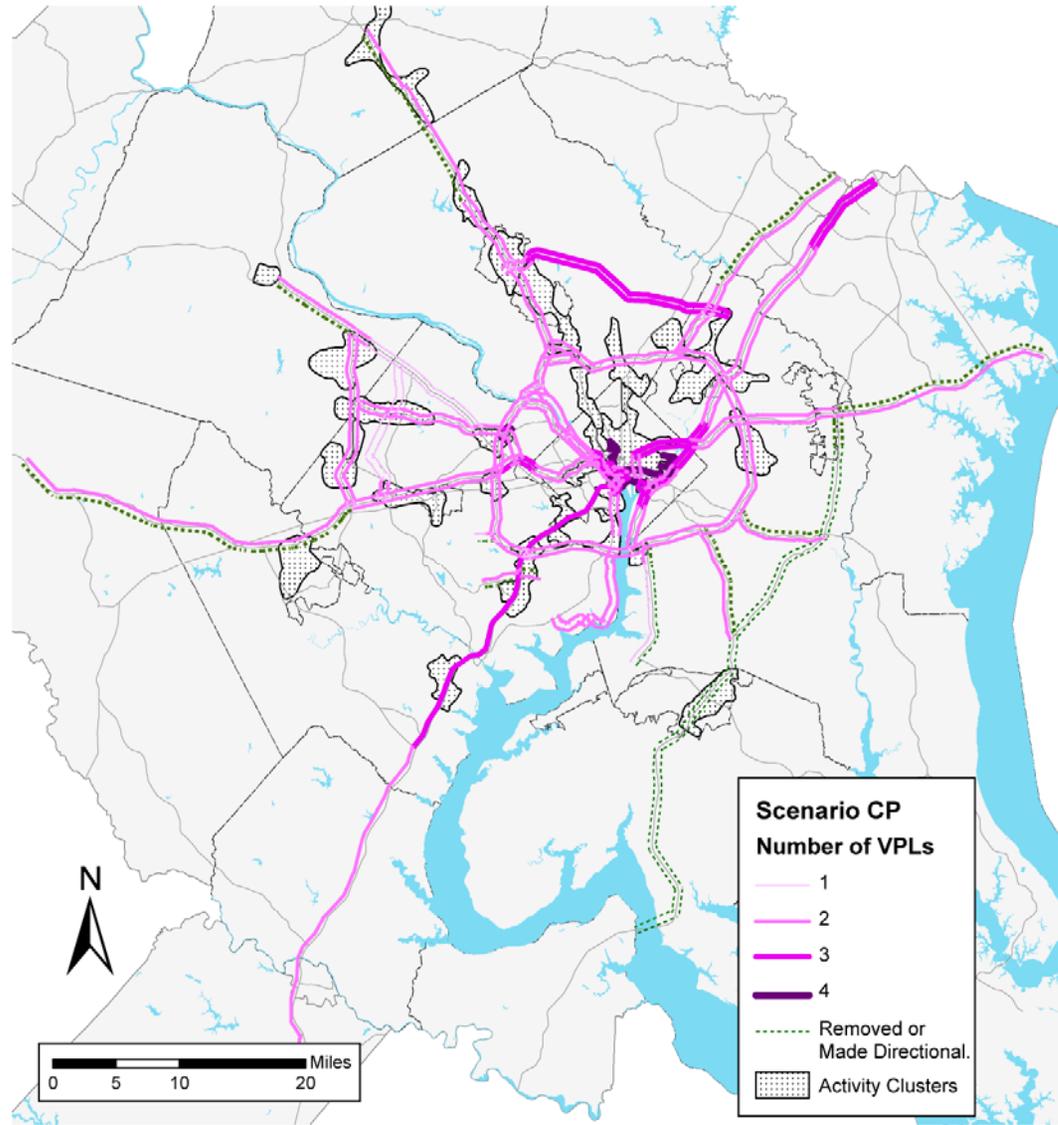
- 2030 Scenario B network pared back where demand is low, as indicated by low toll rates:
 - Segments that have high toll rates in the peak direction only are changed to directional toll lanes
 - Segments with low toll rates in both directions are removed from the network



3.3: Prioritized Scenarios – Scenario CP

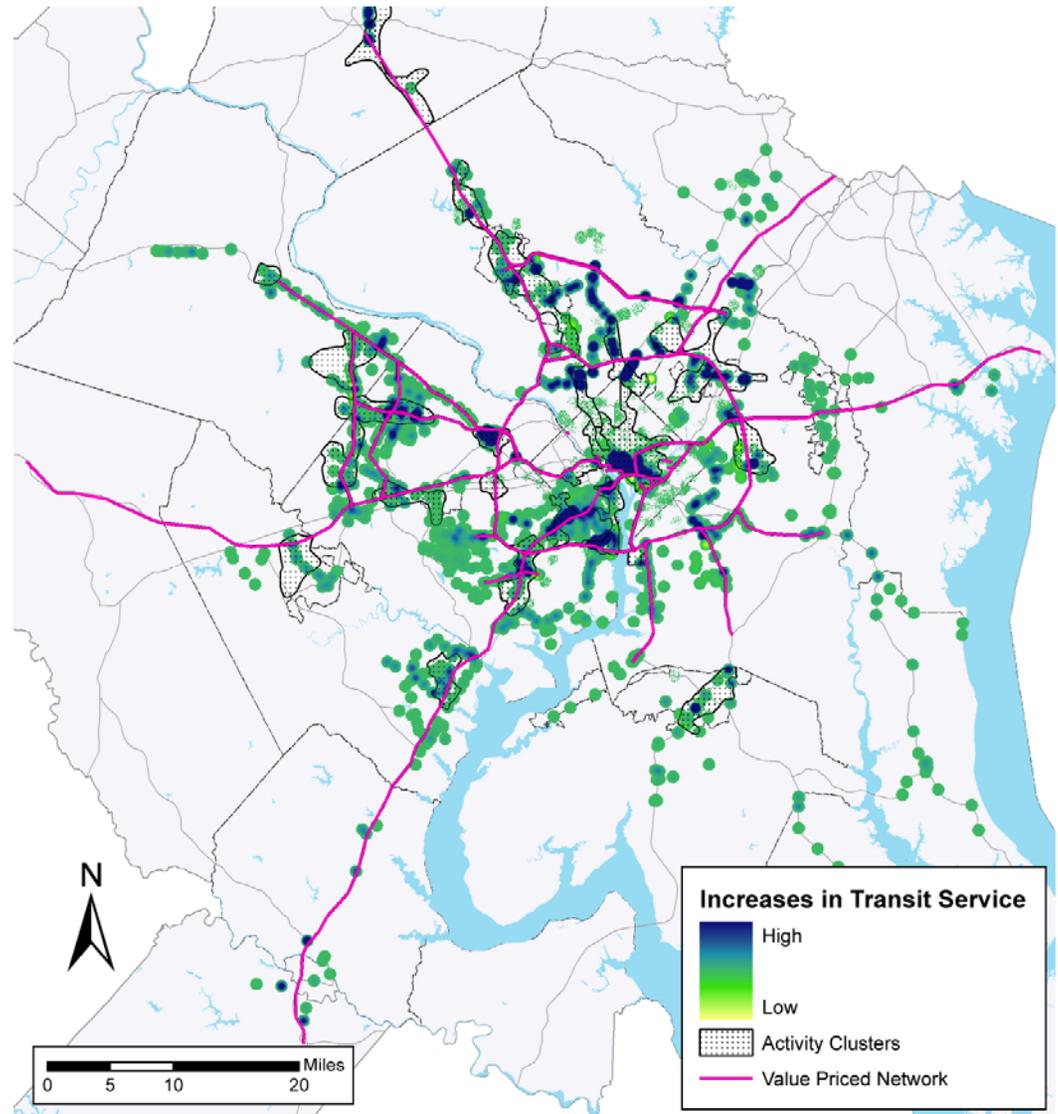
Prioritizing from C, Drop facilities/directions with low toll rates

- 2030 Scenario C network pared back where demand is low, as indicated by low toll rates:
 - Segments that have high toll rates in the peak direction only are changed to directional toll lanes
 - Segments with low toll rates in both directions are removed from the network



3.4: Scenarios with Enhanced Transit

- Create a bus transit network that operates on the network of variably priced lanes:
 - All planned transit along BP, CP Networks
 - Add Beltway bus routes from the TPB-assisted studies
 - Create routes on VA 28 and Fairfax County Parkway
 - Running between I-66 and VA-7
 - Include stops at major activity centers
- Enhance bus speeds/frequencies:
 - Increase speeds, reducing run-times by 10%
 - Increase frequency, reducing headways by 50%
- Scenario CPT: Add new and enhance existing bus routes on Parkways



4 - Scenario Analysis

4.1: Potential Demand and Revenue

4.2: Scenario Cost Estimates

4.3: Scenario Financial Feasibility

4.4: Impact of Transit on Performance of the Scenarios

4.5: Evaluation of Potential Land Use Impacts

4.6: Connectivity to the Regional Core and Activity Centers

4.1: Potential Demand and Revenue

4.1.1: Scenario A, Scenario B, Scenario C

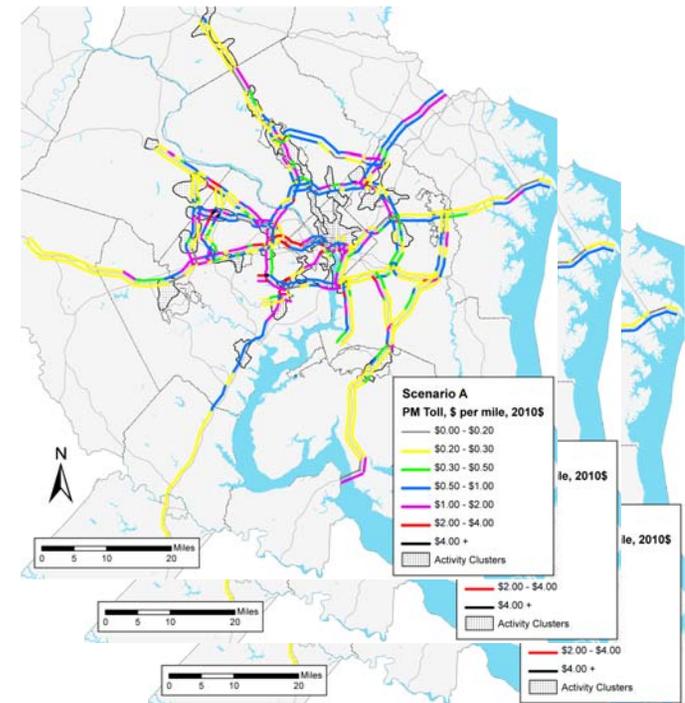
4.1.2: Comparison Across Scenarios

4.1.3: Scenario AP, Scenario BP, Scenario CP

4.1.4: Comparison Across Scenarios

4.1.1: Scenario A, Scenario B, Scenario C

- Scenario A: To ensure free flow, toll rates vary significantly by segment, direction and time of day
- Scenario B - Compared to Scenario A:
 - High toll rates on DC Bridges (mostly between \$3 and \$10 per mile; between \$1 and \$4.25 per one-way crossing)
 - System-wide toll revenue increases by 33%
 - Small reduction in system-wide VMT (<1%)
 - HOV use decreased by 3%
 - Transit trips increase by 2%
- Scenario C - Compared to Scenario B:
 - System-wide toll revenue increases by 31%
 - Small reduction in system-wide VMT (<1%)
 - HOV use increases slightly (<1%)
 - Small increase in transit trips (1%)



4.1.2: Comparison Across Scenarios

- VPL Network grows across scenarios, but GPL network loses lanes
- VMT, HOV Use and Transit
 - All scenarios increase regional VMT
 - More priced existing lanes result in smaller VMT increase
- System Revenue
 - Revenue increases as pricing of existing lanes increases
- Bridge Tolls
 - Parkways add small increase in bridge tolls.

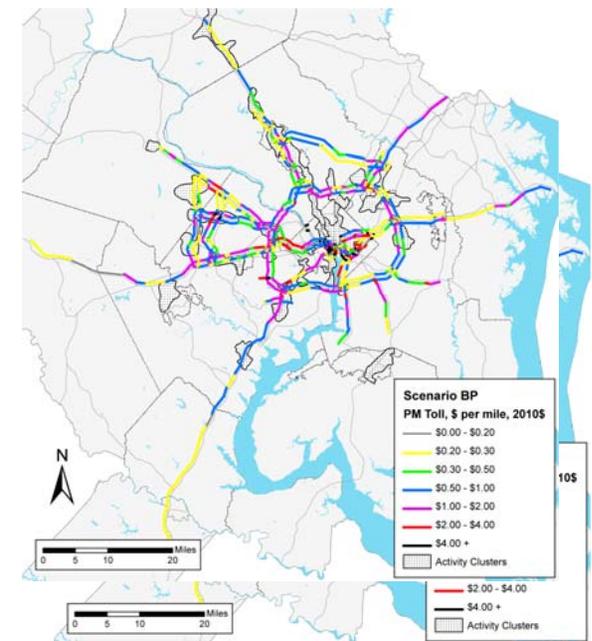
	Scenario A	Scenario B	Scenario C
<i>PM Priced Lane Miles</i>	1664	1758	1979
Regional VMT*	4%	3%	2%
HOV Use*	12%	9%	9%
Transit Use*	3%	5%	6%
Annual System Toll Revenue, millions (% of Scenario A)	\$1,700	\$2,300 (33%)	\$3,000 (74%)
Average Bridge Toll (% of Scenario B)	n/a	\$2.70	\$3.00 (15%)

* Compared to base case, 2006 CLRP

4.1.3: Scenario AP, Scenario BP, Scenario CP

Comparisons to first-round scenarios

- Scenario AP: under development
- Scenario BP:
 - Decrease in revenue (9%)
 - 7% HOV increase
 - Insignificant VMT decrease, transit use
- Scenario CP
 - Decrease in revenue (5%)
 - Decrease in HOV use (4%)
 - Insignificant VMT decrease, transit use



4.1.4: Comparison Across Scenarios

- Prioritized scenarios reduce VMT, have mixed impact on HOV use and no impact on transit use.
- Prioritization slightly decreases both revenues and average bridge tolls.

	Scenario A	Scenario B	Scenario BP	Scenario C	Scenario CP
<i>PM Priced Lane Miles</i>	1664	1758	1424	1979	1640
Regional VMT*	4%	3%	2%	2%	2%
HOV Use*	12%	9%	17%	9%	5%
Transit Use*	3%	5%	5%	6%	6%
System Toll Revenue, millions (% of Scenario A)	\$1,700	\$2,300 (33%)	\$2,100 (21%)	\$3,000 (74%)	\$2,900 (67%)
Change in Average Bridge Toll (% of Scenario B)	n/a	\$2.70	\$2.61 (-4%)	\$3.00 (15%)	\$2.97 (-1%)

* Compared to base case, 2006 CLRP

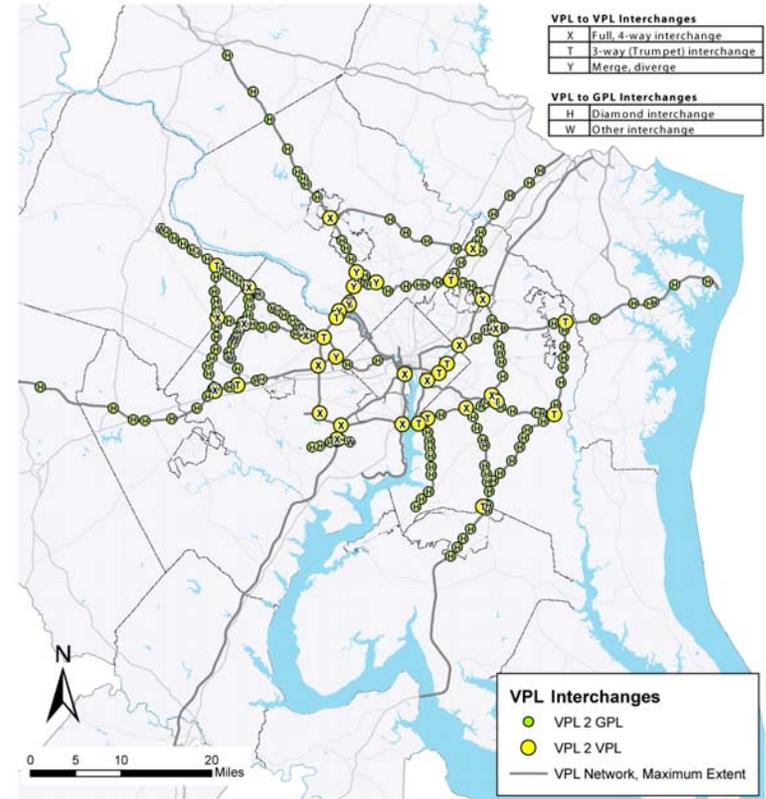
4.2: Scenario Cost Estimates

Methodology:

- Determine extent of scenario networks:
 - New lane miles
 - Converted lane miles
 - Major (VPL to VPL) interchanges
 - Minor (VPL to GPL) interchanges
- Estimate unit costs for the above criteria
 - Cost estimates based on MDOT and VDOT studies and CLRP project submissions

4.2: Scenario Cost Estimates

- Determine Extent of Scenario Networks
 - Interchanges, VPL to VPL and VPL to GPL
 - Lane Miles, converted and new



	A	B	BP	C	CP
New VPL to VPL Interchange	35	32	32	29	29
New VPL to GPL Interchange	172	172	172	152	152
Widened non-VPL Interchange	-	-	-	-	-
Non-Separated New VPL	-	-	-	-	-
New GPL Lane Mile	997	929	929	633	633
Converted Existing Lane Mile	337	481	819	481	819

4.2: Scenario Cost Estimates

- Unit Costs
 - VDOT costs based on Beltway HOT Lanes project
 - MDOT costs based on West Side and South Side Mobility Studies
 - VDOT and MDOT costs reconciled, adjusted to 2010\$

Summary	MDOT	VDOT	Reconciled Costs 2007\$	Reconciled Costs 2010\$
Cost Per New/Major Interchange	\$230	\$175	\$200	\$220
Cost Per Modified/Intermediate Interchange	\$130	\$100	\$120	\$132
Cost Per Non-access/Minor Interchange	\$25	\$25	\$25	\$28
Cost Per Non-Separated New VPL Lane Mile	\$25		\$25	\$28
Cost Per New Separated VPL Lane Mile	\$45	\$11	\$30	\$33
Cost Per Converted Lane Mile	\$4	\$3	\$4	\$4

Costs in millions

4.2: Scenario Cost Estimates

- Interchanges are a large part of the scenario costs.
 - Large number of access and egress points (VPL to GPL interchanges) significantly impacts costs
- New VPL Lane Miles second largest cost component

	A	B	BP	C	CP
New VPL to VPL Interchange	\$7,700	\$7,000	\$6,400	\$7,000	\$6,400
New VPL to GPL Interchange	\$22,700	\$22,700	\$20,100	\$22,700	\$20,100
Widened non-VPL Interchange	\$0	\$0	\$0	\$0	\$0
Non-Separated New VPL	\$0	\$0	\$0	\$0	\$0
New VPL Lane Mile	\$32,900	\$30,700	\$20,900	\$30,700	\$20,900
Converted Existing Lane Mile	\$1,500	\$2,100	\$2,100	\$3,600	\$3,600
Total	\$64,800	\$62,500	\$49,500	\$64,000	\$50,900

Costs in millions

4.3: Scenario Financial Feasibility

Criteria for financial feasibility:

- 20-year project revenues greater than or equal to capital costs
- Virginia revenues low, possibly due to HOV policy

Capital Costs	A	B	BP	C	CP
Regional	\$64,800	\$62,500	\$49,500	\$64,000	\$50,900
DC	\$2,900	\$600	\$600	\$700	\$700
MD	\$37,500	\$37,500	\$26,000	\$38,400	\$26,900
VA	\$24,400	\$24,400	\$22,800	\$24,900	\$23,300

20-year project revenues	A	B	BP	C	CP
Regional	\$34,300	\$45,800	\$41,500	\$59,800	\$57,100
DC	\$800	\$10,200	\$10,000	\$11,700	\$11,800
MD	\$20,800	\$22,800	\$19,300	\$33,000	\$30,300
VA	\$12,700	\$12,800	\$12,100	\$15,100	\$15,000

Costs in millions

4.3: Scenario Financial Feasibility

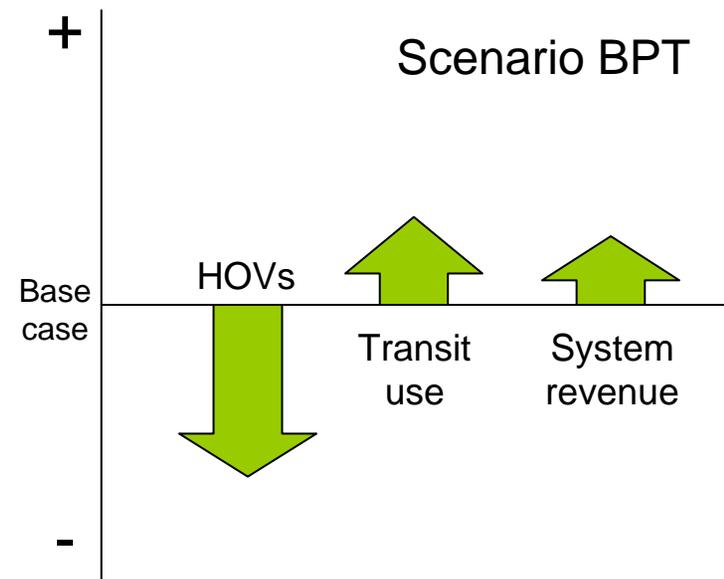
- Only CP meets criteria
 - Parkways are low-cost revenue generators
- Virginia HOV-3 free policy impacts revenues and feasibility

	A	B	BP	C	CP
Regional	53%	73%	84%	93%	112%
DC	26%	1600%	1572%	1637%	1656%
MD	55%	61%	74%	86%	113%
VA	52%	53%	53%	61%	64%

4.4: Impact of Transit on Performance of the Scenarios

Scenario BPT

- Increasing Transit Service on the Value Priced Network Results In:
 - Decrease in HOV use: 12%
 - Increase in total system transit use: 4.6%
 - Negligible increase in total VMT
 - Total system revenue increased by 3.6%
- Would expect toll rate decreases and little change in volumes and speeds.
- Results to date indicate that transit will impact tolls in a few “high transit” corridors, but will have little impact in many corridors with modest transit demand and service.
- Analysis of CPT still in progress.



4.5: Evaluation of Potential Land Use Impacts

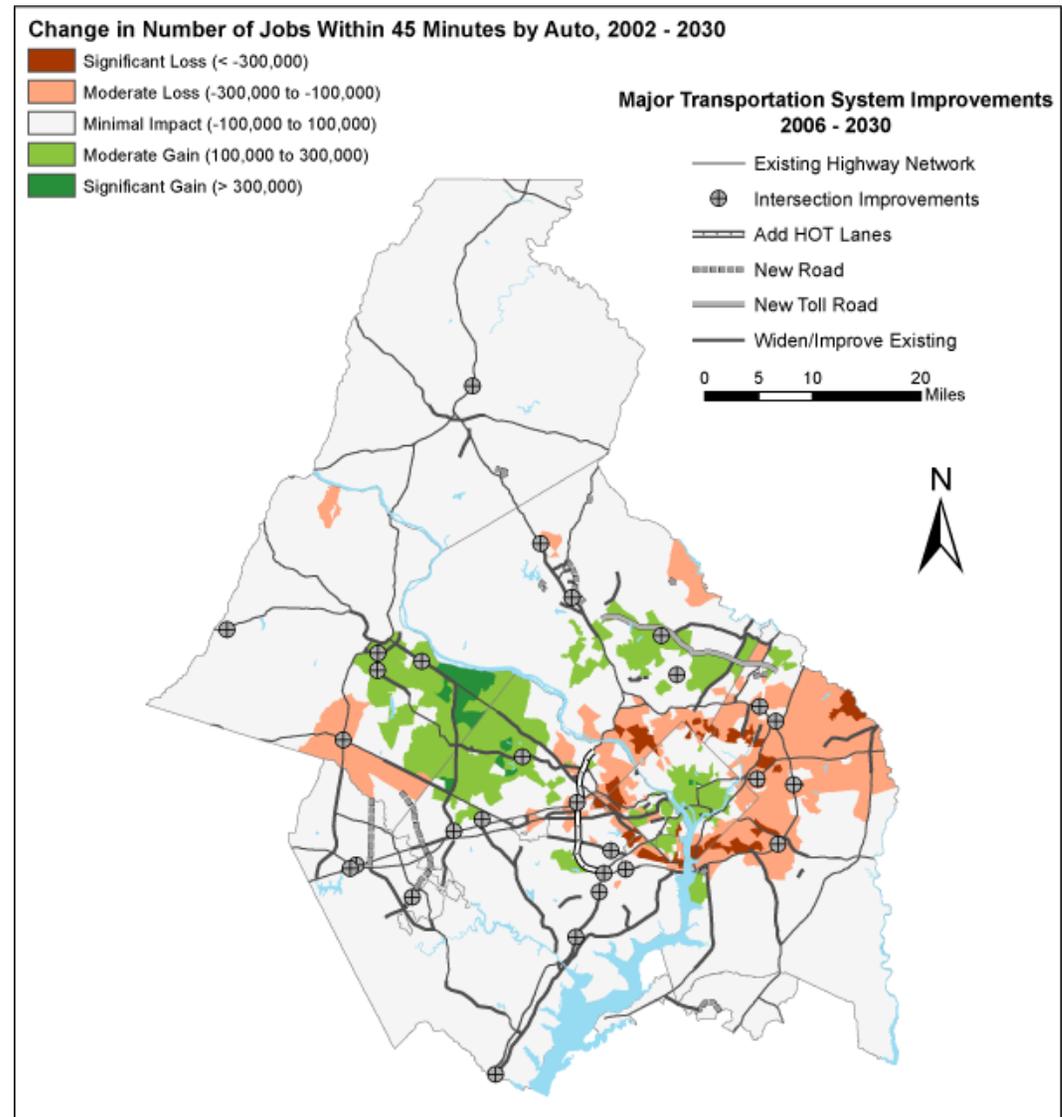
Rationale

- Land Use changes are influenced by transportation improvements.
- These changes can be attributed to increases in accessibility.
- TPB Accessibility Analysis tool is used to compare change in accessibility between the CLRP for 2030 and the Regional Value Priced Network Scenario

4.5: Evaluation of Potential Land Use Impacts

Methodology

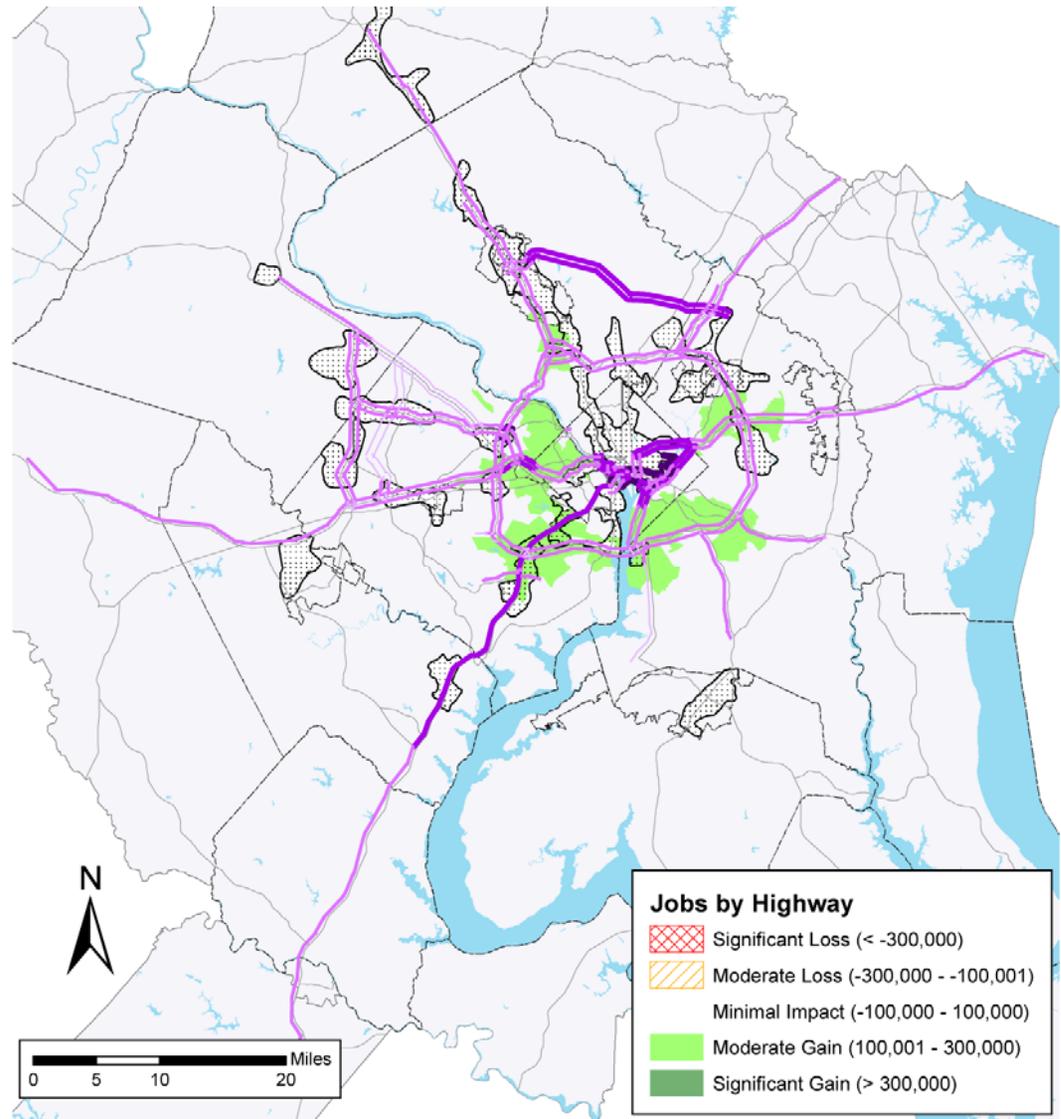
- **Employ Accessibility Analysis Tool:**
 - Used to assess performance of CLRP
 - Mapping accessibility to jobs and housing within 45 minutes by mode
 - Modes: Highways, Transit
 - Access to jobs a factor in location of households.
 - Access to households a factor in location of work sites.
- Focus on highway accessibility, due to the auto-oriented nature of sprawl
- Performed for BPT. Other analyses pending.



4.5: Evaluation of Potential Land Use Impacts

Location of Households, BPT

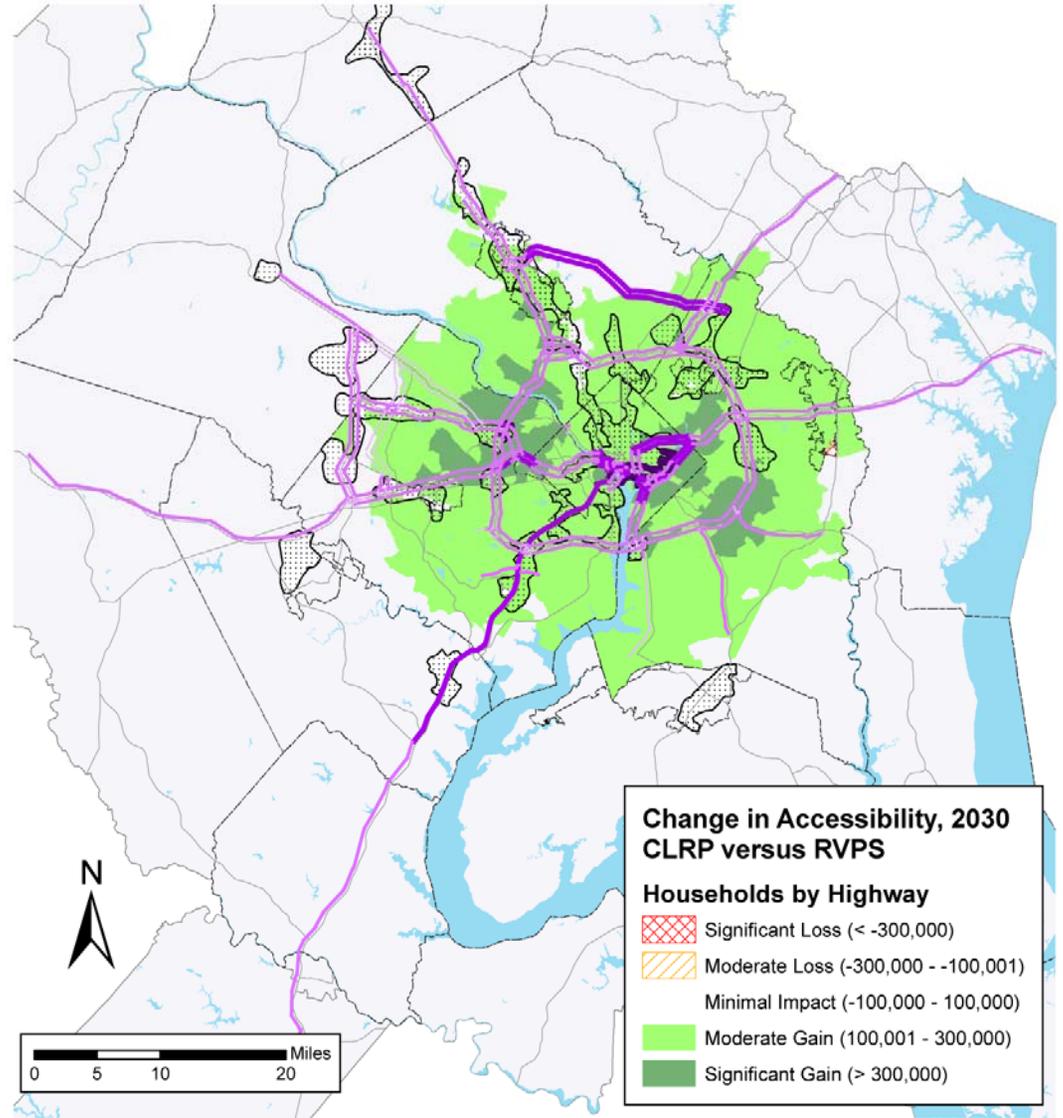
- Moderate impact on accessibility to jobs via highways.
 - Impacts concentrated around major access points in the VPL network.
 - Minimal impact in the exurbs.
- Minimal impact on accessibility to jobs by transit or walk-access transit



4.5: Evaluation of Potential Land Use Impacts

Location of Jobs, BPT

- Significant gains in accessibility to households near intersections of major roadways in the VPL network.
- Moderate gains throughout the regional core and inner suburbs.
- Minimal impact in the exurbs.



4.6: Connectivity to the Regional Core and Activity Centers

Methodology

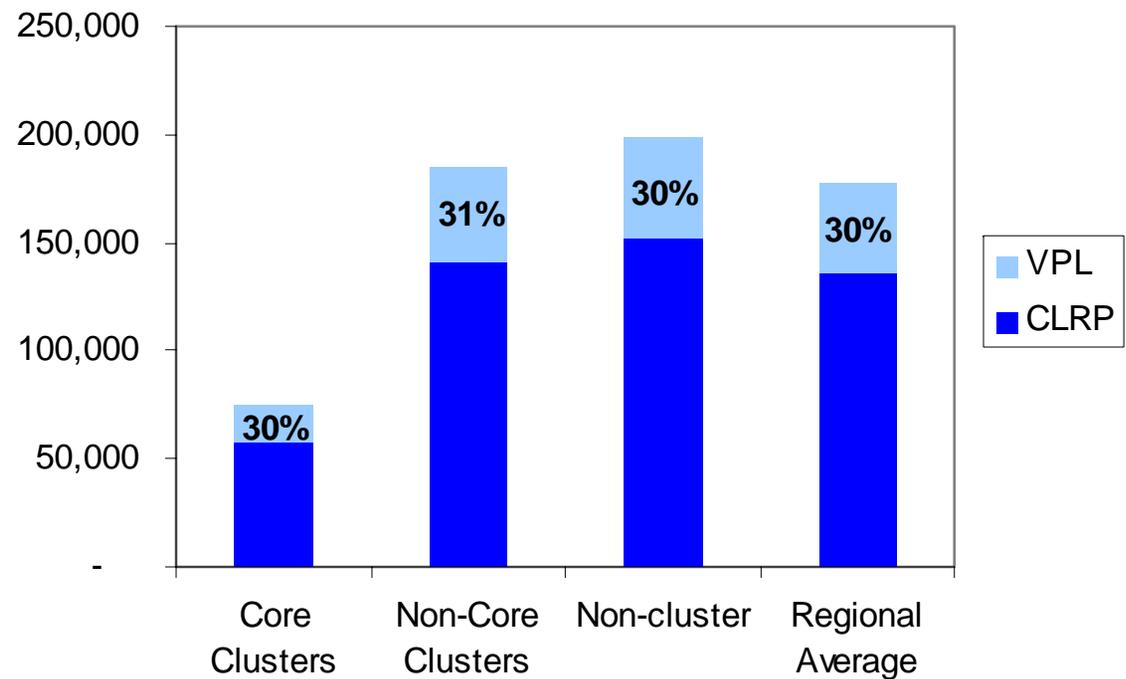
- Based on accessibility analysis
- Categorizes transportation analysis zones:
 - Core cluster
 - Suburban cluster
 - Non-cluster
- Increased accessibility to zones in clusters represents increased connectivity to the clusters.
- Currently performed on BPT. Others pending.

4.6: Connectivity to the Regional Core and Activity Centers

VPL Impacts on Land Use: Change in Accessibility to Jobs, BPT

- Percentage increases are evenly distributed among core clusters, non-core clusters and non-cluster areas
- Non-core clusters and non-cluster areas maintain highest accessibility

Change in Accessibility to Jobs by Highway for Activity Clusters

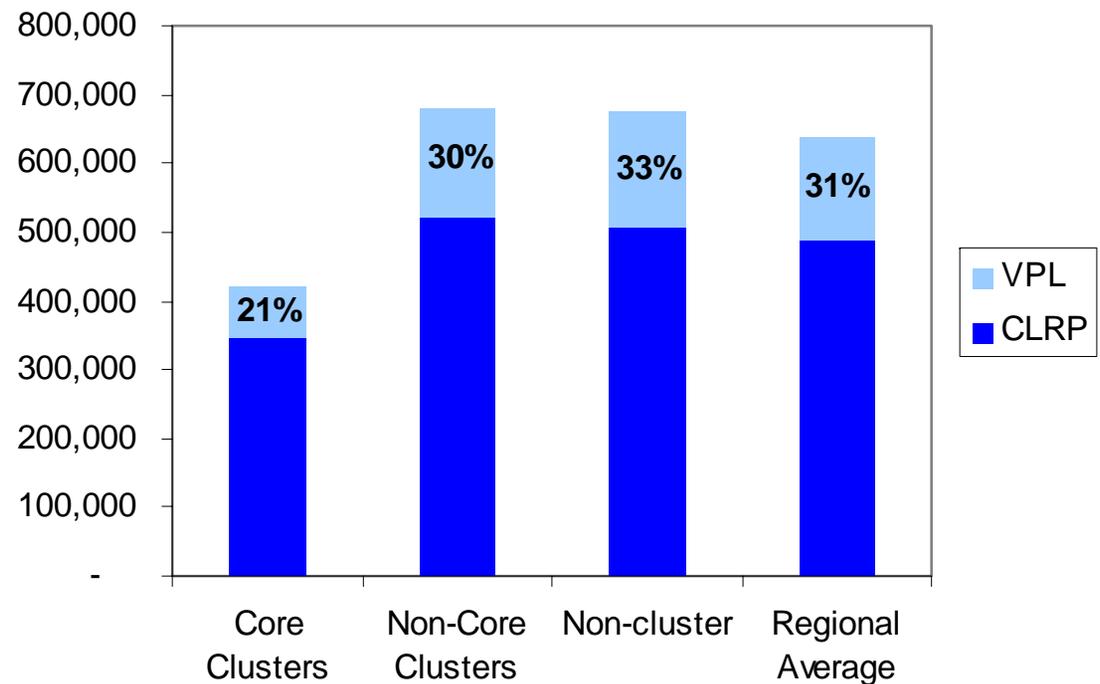


4.6: Connectivity to the Regional Core and Activity Centers

VPL Impacts on Land Use: Change in Accessibility to Households by Highways, BPT

- Non-core clusters and non-cluster areas experience greatest increase in accessibility and maintain the highest levels of accessibility

Change in Accessibility to Households by Highway for Activity Clusters



5 - Impacts of Pricing Scenarios on Different Populations

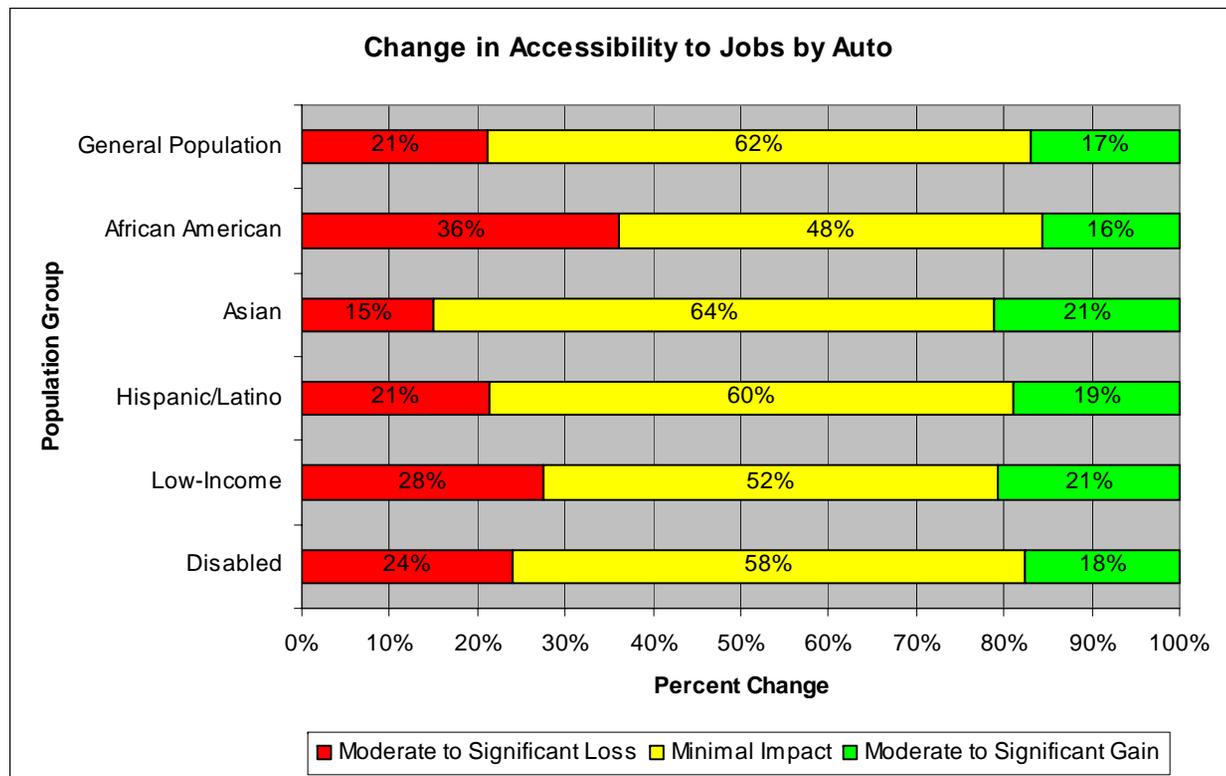
5.1: Methodology

5.2: Analysis Summary

5.3: Assessing the Impact of Tolling Existing Lanes

5.1: Methodology

- Equity Analysis: What will be the impacts on low-income and minority populations?
- Will apply equity analysis techniques from the CLRP to the VPL Scenarios.
- Analysis pending for all scenarios.
- Example of equity analysis for the 2006 CLRP:



5.2: Analysis Summary

Pending.

5.3: Assessing the Impact of Tolling Existing Lanes

- Tolling of existing lanes impacts three groups of people differently:
 - Tolled
 - Tolled-off
 - Un-tolled
- Innovative ways to redistribute benefits should be investigated before such tolling schemes are put in place.

*It is not denied that worthy reasons may be found to support attempts at restriction or redirection of motor vehicle use in some urban areas. Pricing might be one of the better tools to accomplish this. But the rationale of a rationing policy should be drawn up in **broad planning terms**, involving **community amenities** and esthetics, rather than in the narrow context of social costs which users impose on each other. This requires a **balancing of the total consequences** of rationing, the adverse as well as the beneficial, not only as they affect users but also as they affect the community-at-large.*

– Zettel and Carll, 1964.

6 - Topics for Further Consideration

6.1: What Scenarios Could be Assessed in Future Studies?

6.2: What Considerations Affect the Inclusion of VPLs in a Regional Network?

6.3: Coordination with Current Corridor Studies in the Region

6.4: Public Education about the Impacts and Rationale for Pricing to Manage Congestion Should Be Considered

6.1: What Scenarios Could be Assessed in Future Studies?

- CAC Recommendation of evaluating a “scenario that focuses mainly on converting existing lanes to VPLs”
- Evaluating Bus Rapid Transit (BRT) in the Scenarios
- Trucks Should Be Considered In Future Studies

6.2: What Considerations Affect the Inclusion of VPLs in a Regional Network?

- Inclusion of the Parkways in the Regional Network
- Right-of-way Availability for the New VPLs
- How will Chokepoints Affect VPL Network Performance?
- How Could the VPL Facilities be Phased for a Regional Network?

6.3: Coordination with Current Corridor Studies in the Region

- How will this study inform and feed into other corridor studies in the region?

6.4: Public Education about the Impacts and Rationale for Pricing to Manage Congestion

- International examples stress the importance of public information and education to gain a high level of public acceptance.

Discussion