

## National Capital Region Transportation Planning Board

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### MEMORANDUM

**TO:** Members of the TPB's Bus On Shoulders (BOS) Task Force

**FROM:** Eric Randall  
Department of Transportation Planning

**SUBJECT:** Preparations for the April 17 Meeting of the BOS Task Force

**DATE:** ~~April 5, 2013~~ With Update of April 17, 2013

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#### **Meeting Date and Location**

The third and final meeting of the BOS Task Force is scheduled for April 17, 2013, at 10:00 am in COG Meeting Rooms 4&5 (prior to TPB that day). The proposed agenda for the meeting includes:

- An update on VDOT's I-66 Inside the Beltway Pilot Project and steps to implementation.
- Additional information from SHA on the feasibility of BOS on the I-270 and MD-5/US-301 corridors.
- An overview of a planning-level BOS benefit-cost analysis model, with preliminary findings and sensitivity analysis results.
- Discussion of preparation of final report.

Following the task force meeting, the Task Force Co-Chairs will update the Transportation Planning Board at the afternoon's TPB meeting.

All materials of the BOS Task Force are available online at: <http://www.mwcog.org/bostf>

#### **Additional Information**

##### Virginia Department of Transportation

VDOT will provide an update on the activities of their working group in support of the I-66 Inside the Beltway Bus on Shoulder Pilot Program. A report has been prepared and is currently being finalized, which will lay out a schedule for preliminary engineering and additional actions that need to be completed for implementation of the pilot project for BOS operations.

##### Maryland State Highway Administration

SHA has collected additional information on the condition of shoulders along the I-270 and MD-5/US-301 highways. Meeting participants will be briefed on the following:

- Tools SHA used to determine shoulder widths (Planning Level)
- Describe what pinch points/conflict points there are
- Cursory aerial view of I-270 and MD 5
- Analysis from I-70 to Montgomery County Line along I-270 (pinch points identified)
- Analysis from the Montgomery County Line to Germantown along I-270 (pinch points identified)
- Analysis of the Germantown to Shady Grove section of I-270 (pinch points identified)
- Analysis of MD 5/US 301 (I-495 to Waldorf) (pinch points identified)
- Unforeseen issues and concerns along both corridors
- Shoulder improvement costs for cost-benefit analysis. Some examples include:
  - Maintenance of Traffic (MOT)
  - Environmental Site Design (ESD)
  - Traffic Barriers
  - Pavement
  - Drainage
  - Earthwork
  - Milling/Resurfacing
- Next Steps

### Transportation Planning Board Staff

TPB staff has developed a benefit-cost analysis (BCA) model for planning-level assessment of BOS operations on select corridors/routes. The BCA model requires input data on the characteristics of the corridor for which BOS operations are proposed: length of shoulders, travel speed data, and the number of buses and of passengers.

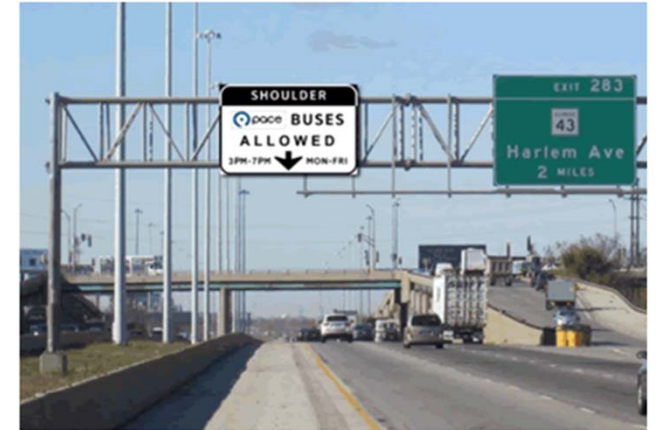
The BCA model uses the travel data to calculate the improvement in travel time and in reliability from buses making use of shoulders to circumvent traffic according to typical operating protocols. Based on operational cost data and the passenger value of time, the results are converted into dollars to calculate the financial and passenger benefits of BOS operations. These benefits are then compared to cost assumptions, including the capital cost of necessary shoulder improvements and project start-up costs as well as ongoing operations costs. A benefit/cost ratio over ten years is then calculated.

The BCA model provides a “first cut” indication of the potential for BOS on an analyzed corridor. The model reacts to changes in estimated implementation costs and transit ridership, and a sensitivity analysis of the impact of different inputs can be made. For example, inputting an increase in transit ridership would provide more benefits and a higher benefit/cost ratio, but should be evaluated against a range of low, medium, and high implementation cost estimates to provide a broader assessment of the feasibility of BOS on an analyzed corridor.

BCA model results for the three study corridors are being refined, and a sensitivity analysis for a range of project costs and transit ridership for each will be presented at the task force meeting.

Attached is a presentation on the activities of the task force given at the ~~April 5 TPB Technical Committee, which reviews the progress of the task force and includes an illustrative example of the BCA model.~~ April 17 BOSTF meeting summarizing activities.

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***TPB***  
**Bus On Shoulders (BOS)**  
***Task Force***

***Meeting # 3***

April 17, 2013  
Eric Randall, DTP

# Today's Agenda

- 10:00 Welcome and Introductions – **Co-Chairs**
- 10:05 Review of Task Force Work Plan and Progress  
– *Eric Randall, TPB Staff*
- 10:10 Update on I-66 (Inside the Beltway) BOS Pilot Program  
– *Kanti Srikanth, VDOT*
- 10:30 Evaluation of Select Corridors in Maryland  
– *Barry Keidrowski, SHA*
- 10:50 Review of BOS Benefit-Cost Analysis Model  
– *Eric Randall, TPB Staff*
- 11:10 Open Discussion
- 11:45 *Adjourn for TPB Meeting*

# TPB Task Force on BOS

- At the July 18, 2012 meeting of the Transportation Planning Board (TPB), it was requested that a task force be established to identify promising locations in the region to operate buses on the shoulders of highways.
- The proposed membership, work plan, and schedule were approved at the September 19 TPB meeting.



**BOS is an arrangement by which buses providing public transportation service operate on designated highway shoulders, when safe and practical to do so, in order to circumvent peak traffic congestion.**

# Members and Schedule

## Departments of Transportation

- District of Columbia (DDOT)
- Maryland (MDOT)
- Virginia (VDOT)

## Transit Operators

- WMATA
- PRTC
- MTA Commuter Bus
- Loudoun Transit

## Jurisdictions

- Fairfax County
- Frederick County
- Montgomery County
- Prince George's County
- Other TPB Member Agencies

Schedule										
Tasks	2012				2013					
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
<b>Task 1</b>	[Blue bar]									
Summary of Local and National Experience with Bus On Shoulders	[Blue bar]									
<b>Task 2</b>		[Blue bar]								
Assessment of the Feasibility of BOS at Specific Locations		[Blue bar]								
<b>Task 3</b>				[Blue bar]						
Analysis of Selected Locations in the Region				[Blue bar]						
Meetings		[Orange triangle]			[Orange triangle]			[Orange triangle]		
Technical Memoranda			[Red square]		[Red square]			[Red square]		

9/19/2012

# Work Plan



## **Task 1 – Summary of Local and Other Experience with BOS**

- Evaluate BOS experience in the region and elsewhere, including safety, roadway engineering, and bus service operations aspects as well as federal regulations and state legislation.

## **Task 2 – Assessment of the Feasibility of BOS at Specific Locations**

- Stakeholder agencies will identify potential corridors for BOS operation on the region's highway network, based on 1) existing highway congestion locations, 2) current bus service, and 3) highway shoulder conditions.

## **Task 3 – Analysis of Select Corridors/Routes in the Region**

- Identify issues and challenges with safe implementation.
- Conduct a benefit-cost analysis for implementation of BOS service on selected corridors/routes.

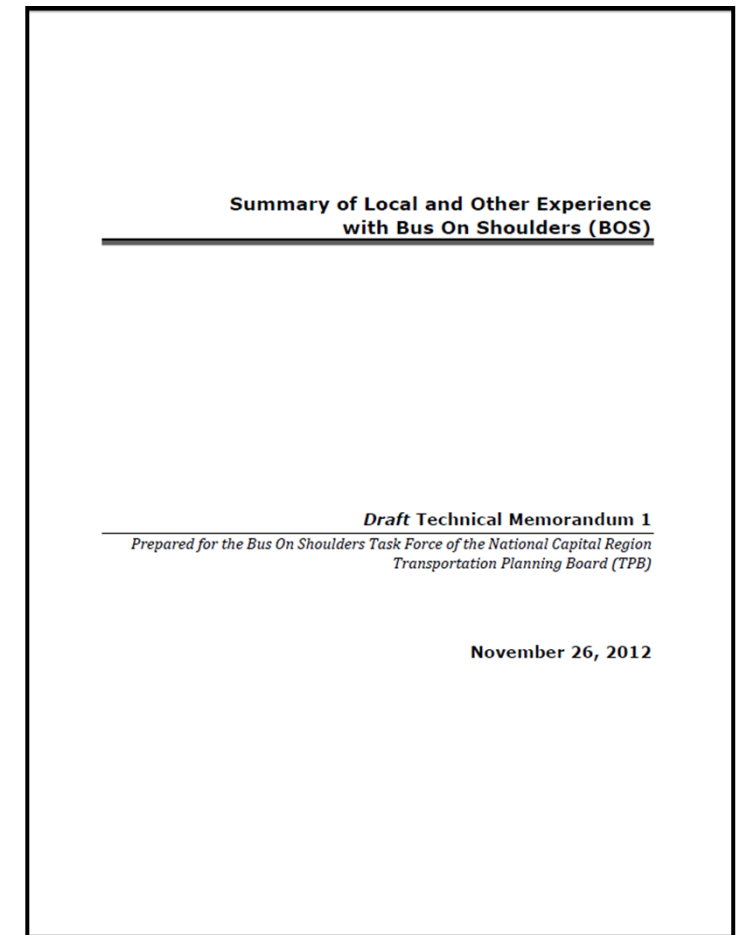
# Task Force – Meeting #1

## Meeting #1 – October 17

- Discussed local and national/world experience with BOS.
- Requested inputs on corridors to study.

## Draft Technical Memo #1 – Nov. 26

- Summary of local and national/world experience with key issues: implementation, design, operational, and regulatory.





# Task Force – Meeting #2

## Meeting #2 – January 19

- Discussed three study corridors:

### Maryland

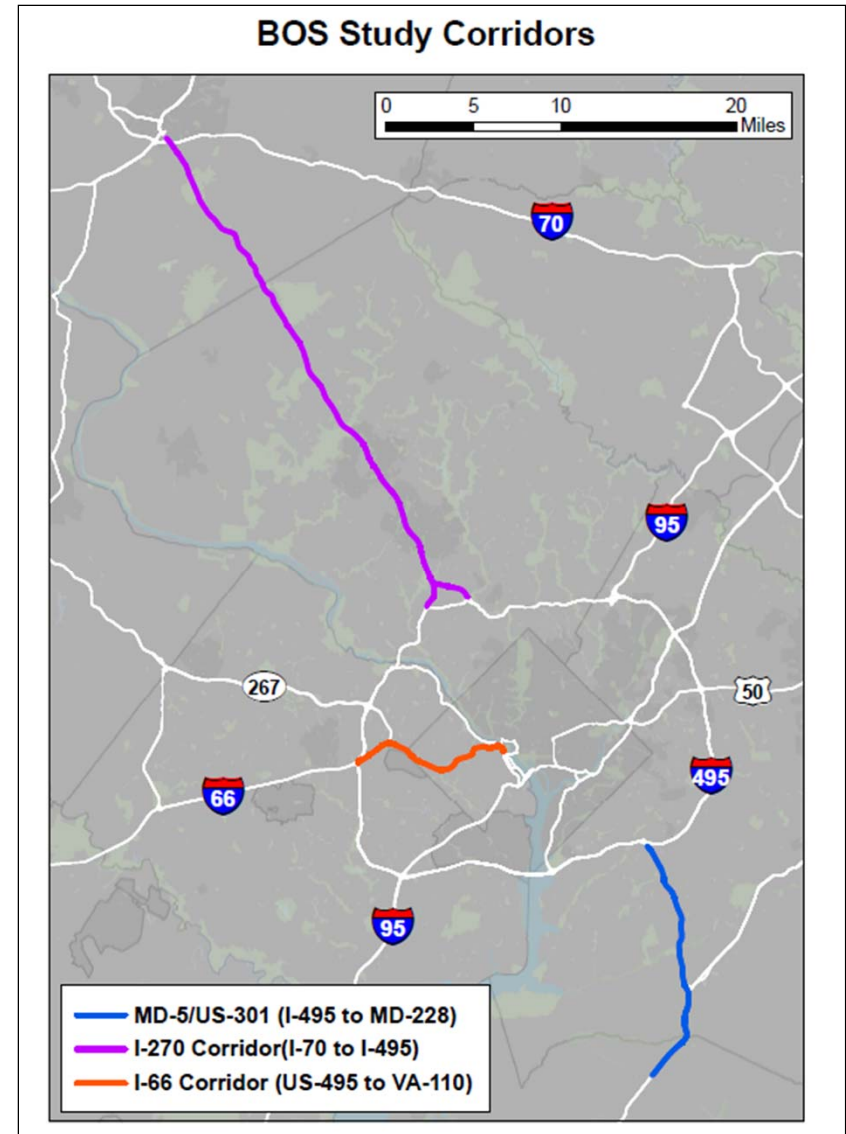
- MD 5/US 301 Corridor in Prince George's and Charles Counties.
- I-270 Corridor from City of Frederick to the Capital Beltway.

### Virginia

- I-66 Inside the Beltway.

## Meeting Highlights and Draft Memo #2 – February 28

- Summary of discussion of factors affecting BOS feasibility on the three study corridors.



# Today's Meeting and Final Steps

## Today's Meeting

- Presentations and discussions of latest information
- Ms. Krimm and Mr. Zimmerman provide update to this afternoon's TPB meeting

## Final Steps

- Complete technical memorandum #3 with corridor information and BCA results.
- Compile meeting discussions and materials, and three technical memoranda, into report
  - Draft for comment by early June. Finalize by end of June.
- Update TPB in early 2014 on VDOT I-66 Pilot Implementation and further BOS developments.

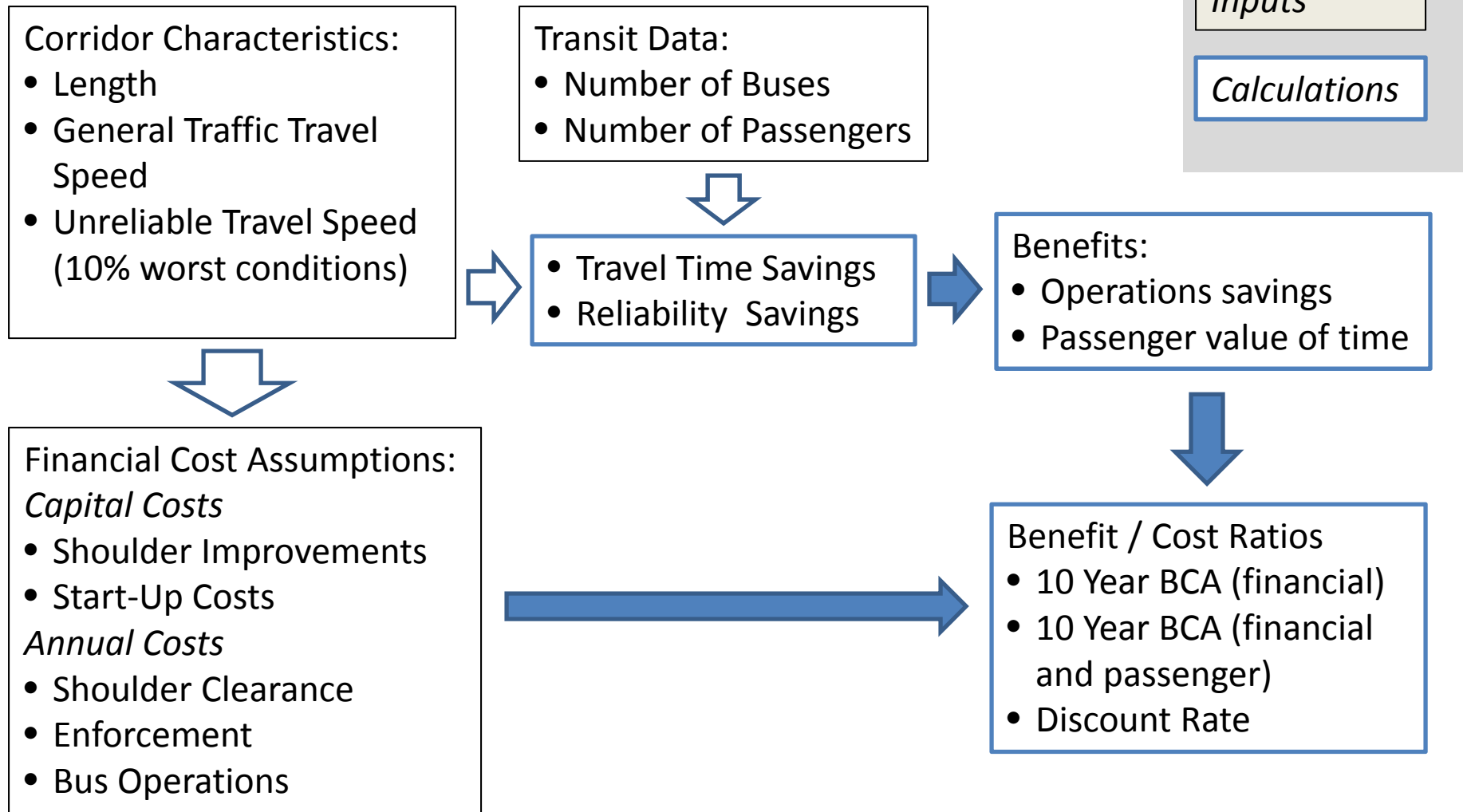
# **BOS Benefit-Cost Analysis (BCA) Model**

# BCA Model – Purpose

The BCA Model is a planning tool:

- “First cut” indication of the feasibility of BOS on an analyzed corridor.
  - Not a substitute for a systematic engineering project study.
- Inputs: corridor length, traffic conditions, number of buses, number of bus passengers, and estimated implementation costs
- Reacts to changes in any of these inputs. A sensitivity analysis of the impact of different inputs can be made.
  - *What if traffic gets worse?*
  - *What if transit ridership doubles?*
  - *What if construction costs are low? Or high?*

# BOS – BCA Model Flowchart



*Sensitivity analysis can vary inputs based on assumptions or new information*

# BCA Model – Application to I-270

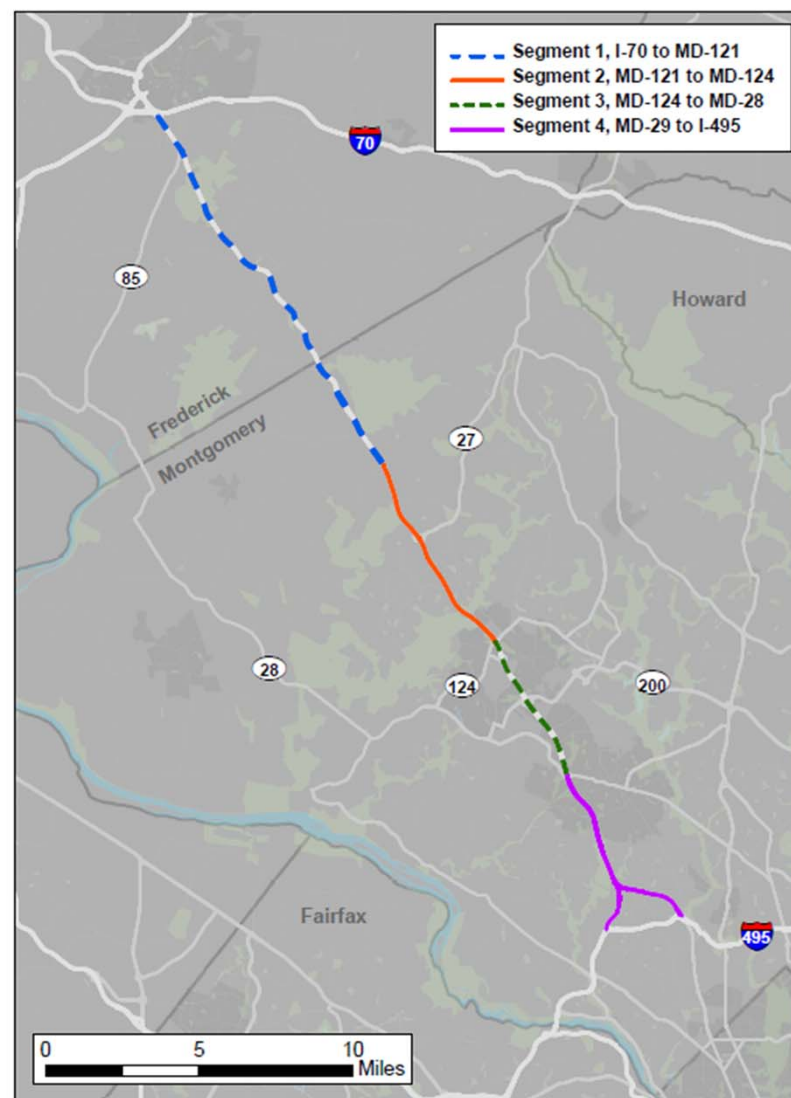
I-270 Study Corridor Segments

Input current data on I-270

- Traffic speeds
- Transit use
- Initial shoulder improvement cost estimates

Assessed for four segments along corridor, in southbound (S/B) direction for the AM peak.

- Totaled results for overall corridor
- Conducted sensitivity analysis, varying inputs



# BCA Model: I-270 (S/B, AM) Inputs

<b>Bus On Shoulders (BOS) Benefit-Cost Analysis</b>		I-270 - Segments				
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>TOTAL</b>
		I-70 interchange (Frederick) to MD-	MD-121 to MD-124 (Gaithersburg)	MD-124 to MD-28 (Rockville)	MD-28 to Beltway	
<b>Corridor Characteristics</b>						
Length of Bus On Shoulder Segment	miles	14.35	6.87	4.96	6.51	<b>32.69</b>
General Traffic Travel Speed	miles per hour	45.4	33.1	26.8	38.2	
Unreliable Travel Speed (10% worst conditions)	miles per hour	29.5	16.3	16.3	24.1	
<b>Transit Data</b>						
Number of Buses	Scheduled trips (peak hour)	4	25	25	4	<b>25</b>
	Scheduled trips (peak period)	12	70	70	11	<b>70</b>
	peak factor	33%	33%	33%	33%	
Number of Passengers	Ridership (peak hour)	416	1442.8	1442.8	94.6	<b>1443</b>
	Ridership (peak period)	2080	6558	6558	215	<b>6558</b>
<b>Preview for Illustrative Purposes Only – 04/05/13</b>						
<b>Travel Time Savings</b>						
	% of peak bus trips using shoulders	50%	50%	50%	50%	
	BOS speed	0	35	35	0	
	average speed differential	0	1.9	8.2	0	
	segment length	14.35	6.87	4.96	6.51	
	<b>Travel Time Savings (hr)</b>	<b>0.000</b>	<b>0.006</b>	<b>0.022</b>	<b>0.000</b>	<b>0.0273</b>
<b>Reliability Improvement</b>						
	% of peak bus trips arriving on time	90%	90%	90%	90%	
	BOS speed	35	31.3	31.3	35	
	average speed differential	5.50	15.00	15.00	10.90	
	segment length	14.35	6.87	4.96	6.51	
	<b>Reliability Savings (hr)</b>	<b>0.069</b>	<b>0.182</b>	<b>0.131</b>	<b>0.076</b>	<b>0.4575</b>



# BCA Model: I-270 (S/B, AM) BCA Results

		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>TOTAL</u>
		I-70 interchange (Frederick) to MD- 121 (Clarksburg)	MD-121 to MD-124 (Gaithersburg)	MD-124 to MD-28 (Rockville)	MD-28 to Beltway	
<b>Benefits and Costs</b>						
Capital Costs	<i>Assumptions</i>					
Shoulder Improvements (cost/mile)	\$1,500,000	\$21,525,000	\$10,305,000	\$7,440,000	\$9,765,000	\$50,535,000
Public Education (per project)	\$50,000					\$50,000
Operations Training (per bus driver)	\$600					\$42,000
O & M Costs						
Shoulder Clearance (annual, per mile)	\$10,000	\$5,000	\$5,000	\$5,000	\$5,000	\$30,000
Enforcement (annual, per mile)	\$5,000	\$2,500	\$2,500	\$2,500	\$2,500	\$15,000
Bus Operations (annual, per bus)	\$2,500					\$175,000
Travel Time & Reliability						
Operations Savings (weekday, \$/hour)	\$100	\$46	\$747	\$609	\$48	\$1,550
Passenger value of time (\$/hour)	\$12.00	\$797	\$7,041	\$5,745	\$122	\$13,718
Preview for Illustrative Purposes Only – 04/05/13						
<b>Project Summary</b>						
Capital Costs (once)		\$21,525,000	\$10,305,000	\$7,440,000	\$9,765,000	\$50,627,000
O & M Costs (annual)		\$7,500	\$7,500	\$7,500	\$7,500	\$220,000
Financial Benefits (annual)		\$11,420	\$186,716	\$152,352	\$11,944	\$387,432
Passenger Benefits (annual)		\$199,191	\$1,760,355	\$1,436,371	\$30,512	\$3,429,429
<b>10 Year BCA (financial)</b>		<b>0.00</b>	<b>0.17</b>	<b>0.19</b>	<b>0.00</b>	<b>0.03</b>
<b>10 Year BCA (financial and passenger)</b>		<b>0.09</b>	<b>1.88</b>	<b>2.13</b>	<b>0.04</b>	<b>0.71</b>
Discount Rate	3%					
<b>10 Year BCA (financial)</b>		<b>0.00</b>	<b>0.15</b>	<b>0.17</b>	<b>0.00</b>	<b>0.03</b>
<b>10 Year BCA (financial and passenger)</b>		<b>0.08</b>	<b>1.61</b>	<b>1.81</b>	<b>0.03</b>	<b>0.61</b>



# BCA Model: I-270 Sensitivity Analysis

- What if traffic gets worse?

	Current		5 mph worse
General Traffic Travel Speed	<b>35.8</b>		<b>30.8</b>
Unreliable Travel Speed (10% worst conditions)	<b>21.5</b>		<b>16.5</b>
Financial Benefits (annual)	\$387,432		\$675,454
Passenger Benefits (annual)	\$3,429,429		\$6,194,073
10 Year BCA (financial and passenger), 3% discount rate	<b>0.61</b>		<b>1.12</b>

# BCA Model: I-270 Sensitivity Analysis

- What if transit ridership doubles?

	Current		Doubles
Scheduled trips (peak hour)	25		50
Scheduled trips (peak period)	70	→	140
Ridership (peak hour)	1,443	→	2,886
Ridership (peak period)	6,558		13,116
Financial Benefits (annual)	\$387,432		\$749,863
Passenger Benefits (annual)	\$3,429,429		\$6,855,858
10 Year BCA (financial and passenger), 3% discount rate	0.61		1.21

# BCA Model: I-270 Sensitivity Analysis

- What if construction costs are low? Or high?

	<b>Low</b>	<b>Medium</b>	<b>High</b>
Shoulder Improvements (cost/mile)	\$1,500,000	\$3,000,000	\$6,000,000
Total Length (32.7 miles, one-way)	\$50,535,000	\$101,070,000	\$202,140,000
10 Year BCA (financial and passenger), 3% discount rate	<b>0.61</b>	<b>0.30</b>	<b>0.15</b>

# BCA Model: I-270 Sensitivity Analysis

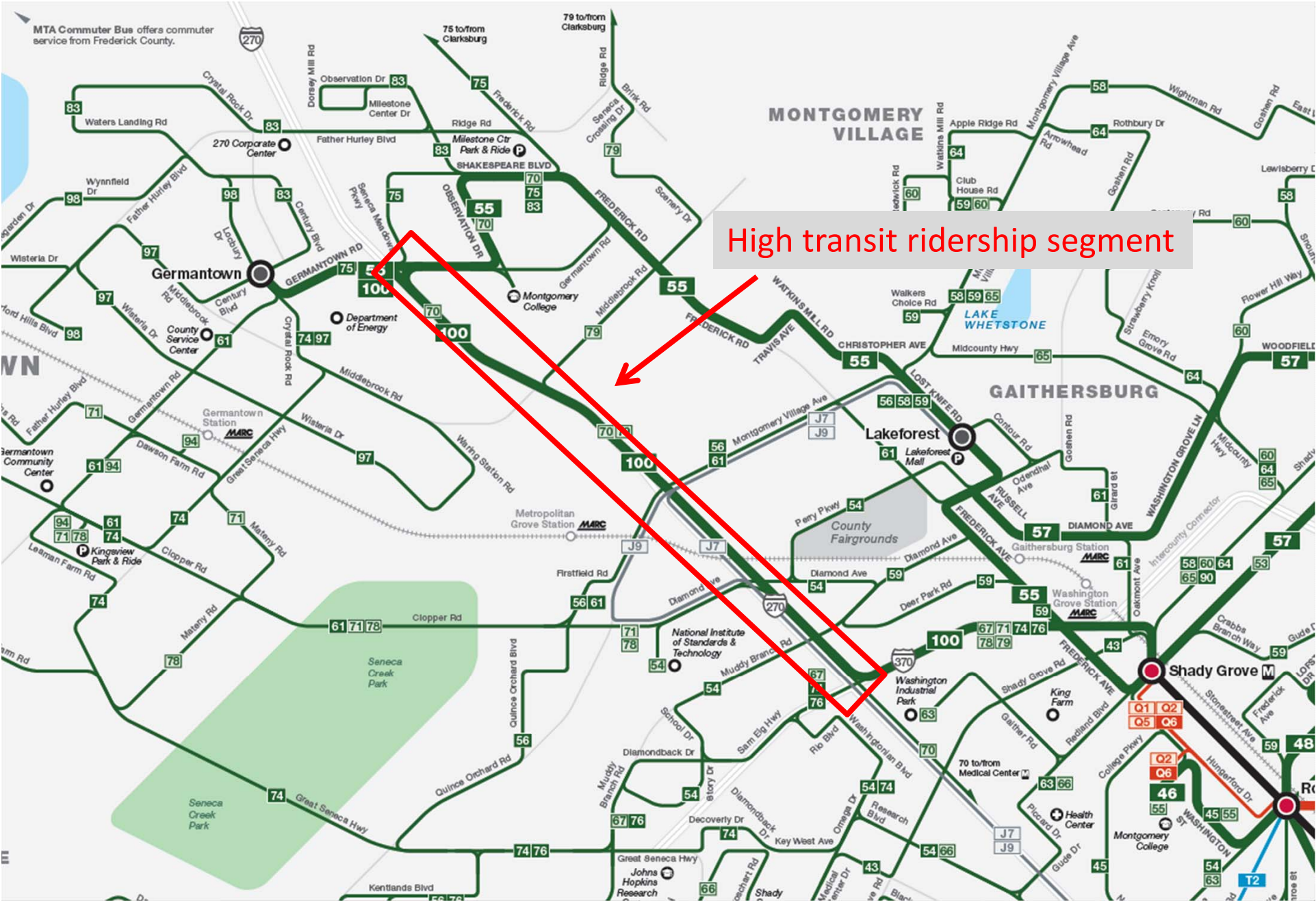
- What if all three happen?
  - Speeds down 5 mph, ridership doubles, range of costs

	<b>Low</b>	<b>Medium</b>	<b>High</b>
Shoulder Improvements (cost/mile)	\$1,500,000	\$3,000,000	\$6,000,000
10 Year BCA (financial and passenger), 3% discount rate	<b>2.24</b>	<b>1.12</b>	<b>0.56</b>

# Summary of I-270 Sensitivity Analysis

- Analysis of the current conditions and low shoulder costs for the overall I-270 corridor (S/B, AM peak) produces a planning-level benefit/cost ratio of 0.61
  - When each of the four segments is examined separately, the segments in Frederick County and closest to the Beltway are much less than 1.0
  - Segments closer to Rockville - with more transit use - have ratios > 1.0
    - Most transit service is on a 5.2 mile segment between Germantown Road (MD-118) and I-370 spur (to Shady Grove station).
- If transit ridership (and necessary service) increase, the benefit/cost ratios improve
  - However, if shoulder improvement costs increase significantly, BOS projects are unlikely to be feasible.

# Metrobus Map – Montgomery County



# Possible Options for Future Study of BOS by Member Agencies

- Contingent upon funding, SHA, Counties, and Transit Operators could continue evaluating the I-270 corridor:
  - Further refine shoulder condition information, in both directions.
    - Initial focus on segment between Germantown Road (MD-118) and I-370 spur (to Shady Grove station)?
  - Identify capital improvements and operating protocols that would be needed to implement a pilot program.
- In the long-run and for all potential corridors, member agencies could:
  - Assess results of I-66 Inside the Beltway BOS pilot project in Virginia.
  - Define necessary steps to conduct a pilot BOS project in Maryland.
  - Review long-range roadwork schedule for opportunities to upgrade shoulders for BOS operations in conjunction with rehab / re-surfacing.



# Information

<http://www.mwcog.org/bostf>