

To: MOITS Technical subcommittee

From: Daivamani Sivasailam
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Subject: Vehicle Probe Project (VPP) Analysis Suite

Background

Staff has been experimenting with the VPP analysis suite developed by the University of Maryland's CATT laboratory and funded through the I-95 Corridor Coalition. The lab has been adding new features to the suite on a periodic basis and staff wanted to test the use of the tool for congestion monitoring in the region. CATT lab is also undertaking extending validation of the VPP data on both freeways and arterial highways using other data sources.

The suite uses the VPP probe data supplied by INRIX along with other data sources such as reported incidents, volume data from roadside detectors, etc. This memorandum presents our observation of tools in the analysis suite and its capabilities. We also used the suite and produced the "Top Ten Bottleneck Locations" on the freeway system for the three jurisdictions in our region. Staff proposes to use the VPP suite as the primary tool in the preparation of the biannual congestion management process technical report.

All the analysis that are presented in this memorandum are of a draft nature and has not been validated for publication and are presented to illustrate the capabilities of the VPP suite tools.

Current Staff Approach

Currently and in the past, staff has been downloading raw data from INRIX and performing analysis using statistical analysis system (SAS) software and developing freeway and arterial highway system performance. All the graphics are generated using Excel spread sheet program. During FY 2012 staff used the INRIX raw data to analyze and report on the arterial highway system performance in the region. This approach works well, however is very time consuming, and switching over to the use of VPP suite tools will save time.

VPP Analysis Suite Tools.

- I. **VPP Dashboard:** "Explore the impacts of and relationships between bottlenecks and traffic events in real-time and at previous points in the past."

This provides a snapshot in time of the bottlenecks in a geographic area and facilities that the user selects. The time you can select is a time point in a day and cannot cover multiple hours

like AM and PM peak periods as well as multiple days. This is useful for analyzing the regional impact of special events or special days. I picked January 3rd, 2012 at 8 AM and showing the bottleneck locations on interstate highways, expressways and parkways in our region. The data is available in an excel spreadsheet which can be exported for further analysis. The following page shows the graphic of the bottleneck snapshot and the excel table of the locations by order of the severity of the bottleneck. We can also get additional details of each bottleneck as shown by the insert.

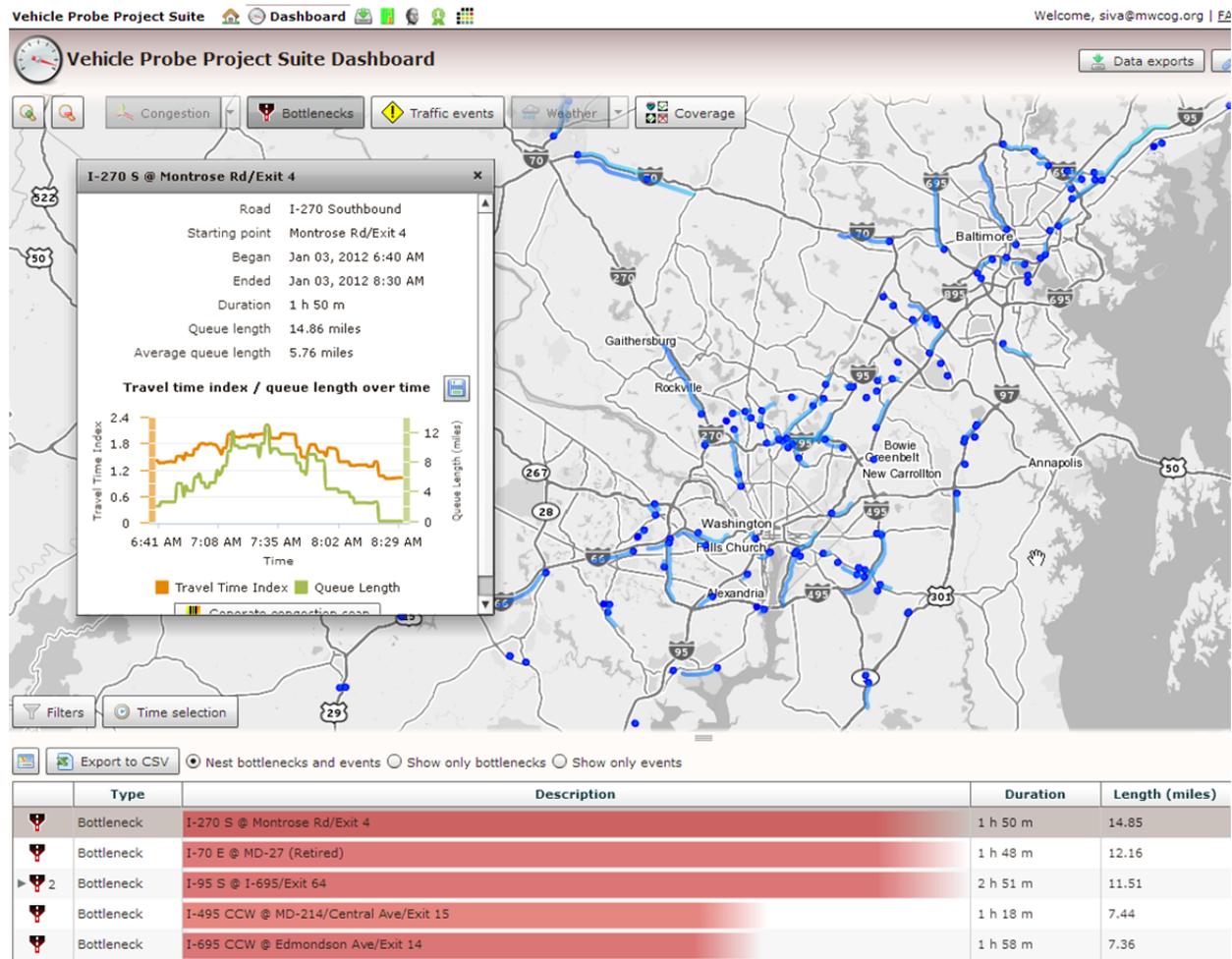


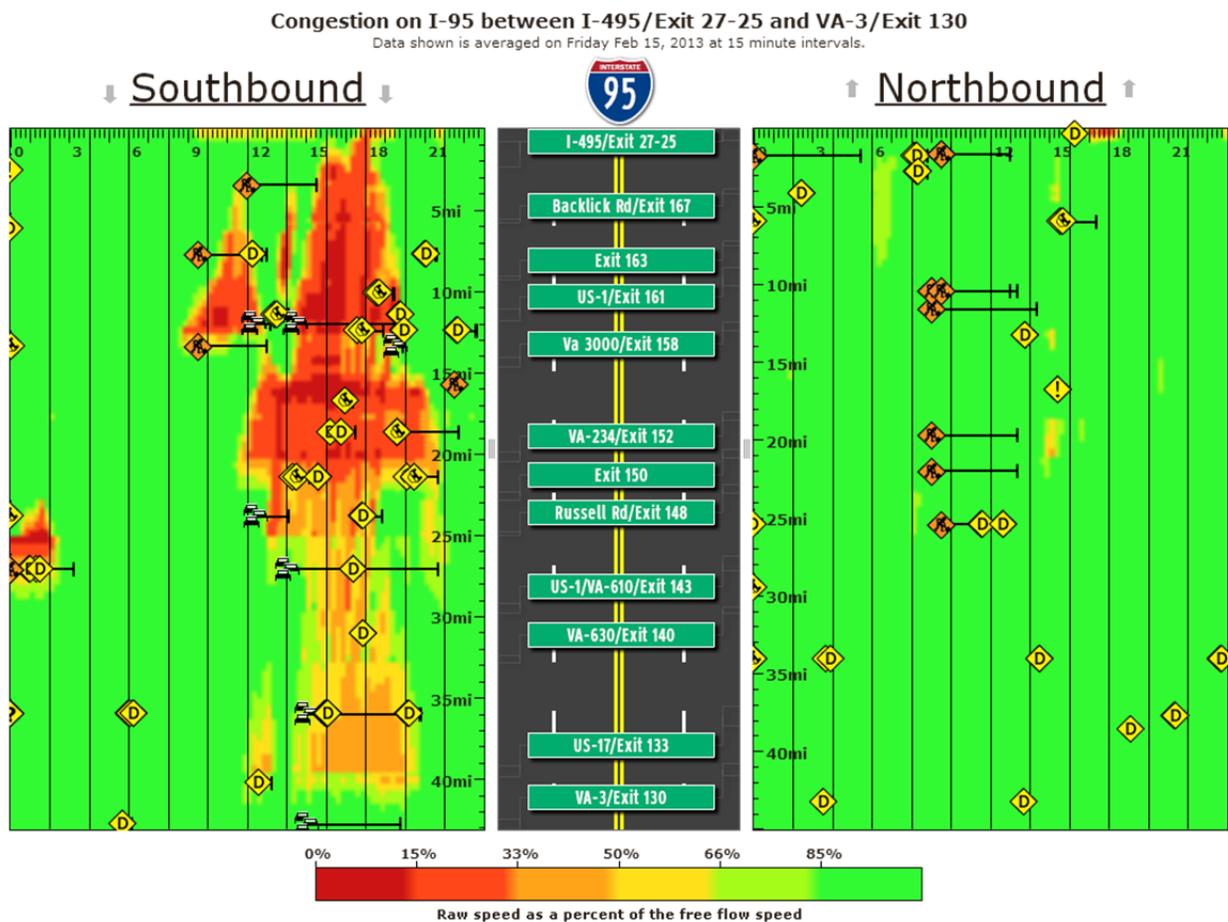
Table of Bottleneck Locations

Type	Description	Duration	Length (miles)	State
Bottleneck	I-270 S @ Montrose Rd/Exit 4	1 h 50 m	14.85	MD
Bottleneck	I-495 CCW @ MD-214/Central Ave/Exit 15	1 h 18 m	7.44	MD
Bottleneck	I-495 CCW @ MD-97/Georgia Ave/Exit 31	3 h 27 m	6.41	MD
Bottleneck	I-66 E @ VA-28/Exit 53	2 h 48 m	5.68	VA
Bottleneck	I-495 CW @ I-66/Exit 9	3 h 36 m	5.44	VA
Bottleneck	I-295 N @ I-295	1 h 29 m	5.06	DC
Bottleneck	US-29 S @ I-495	1 h 23 m	4.48	MD
Bottleneck	I-66 E @ Vaden Dr/Exit 62	1 h 47 m	4.06	VA

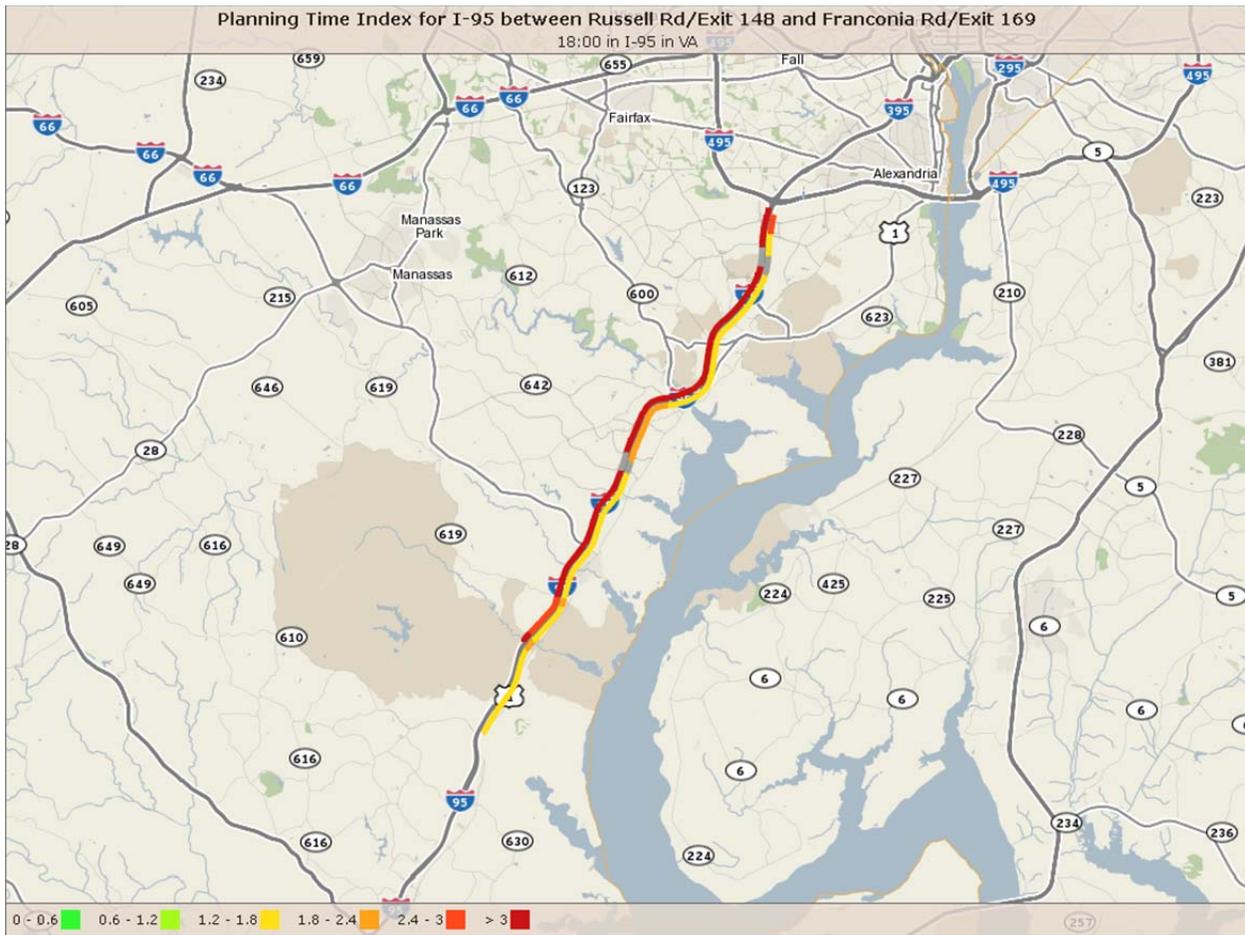
Bottleneck	I-66 W @ 25th St	2 h 10 m	3.44	VA
Bottleneck	US-1 N @ VA-235/Mount Vernon Memorial Hwy	1 h 20 m	3.41	VA

II. Congestion Scan: “The Congestion Scan tool lets you analyze traffic conditions on a single stretch of road. If you choose to analyze a single day, traffic events and incidents will be plotted on the road, each spanning the time range when it was active. If you choose more than one day, the readings displayed will be averaged across the date range, and traffic events will not be shown.”

The following is a sample of I-95 between I-495 and Stafford County Line showing southbound congestion including incidents. The day was the Friday before the Presidents day holiday weekend and southbound congestion existed for a long period between 9 AM and 7 PM in the evening.



III. Historic Probe Data Analyzer: “The Historic Probe Data Explorer tool application is a collection of visualizations that provide some insight into traffic conditions and patterns over a period of time. It allows you to explore probe data averaged over large date ranges and gauge the performance on stretches of road.”



The tool offers different visualization techniques, such as the one shown above or the line graph shown below and additional options such as bar graphs and scatter plots. The range of the indexes can also be changed by the user. In other words a user can adjust the travel time index as to what value represents congestion and levels of congestion represented by color codes. (This tool has been replaced by Trend Map, Performance Charts, and Performance Summary in the latest release of the VPP suite)

IV. Massive Raw Data Downloader

This tool lets the user download raw data collected by INRIX for interstates, expressways, parkways and arterial highways. The user can obtain speed, average speed, reference speed, travel time, confidence score, and c-value in 1(non-averaged), 5, 10, 15 or higher time ranges for 90 days at a time. INRIX can provide the data in smaller time increment as low as 1 minute but up to 30 days in one file. The INRIX data format is UTC time and file structure/data format are different. If a user wants to download the raw data and analyze the data, one has to consider the time required to download the data and then have to use tools such as SAS or other data base programs (raw data file size big for excel to handle) to analyze the data and prepare the reports which VPP suite does for the user.

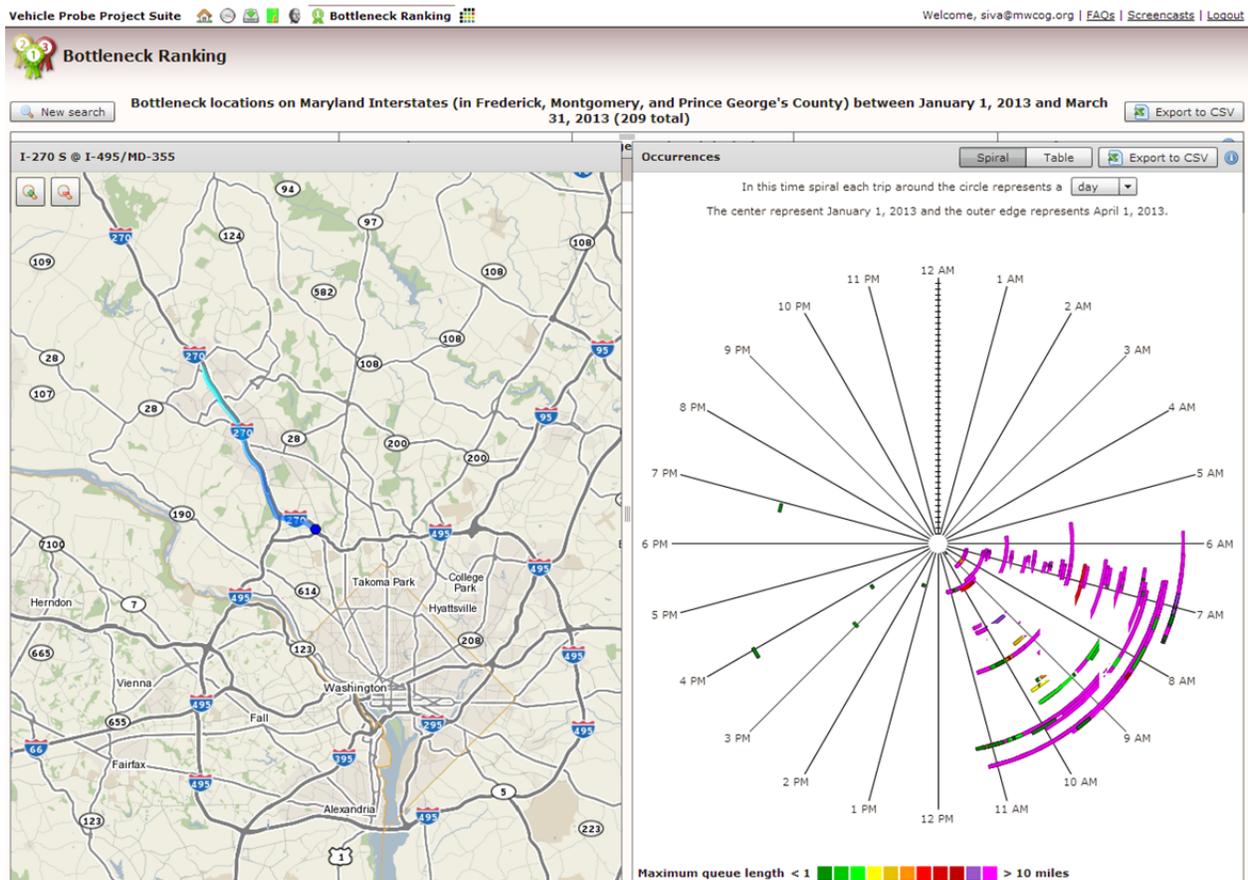
IV. Bottleneck Ranking

This is another tool which staff has used to develop the top 10 bottlenecks in Maryland, Virginia and the District of Columbia. The tool does identify bottlenecks with origins outside the region but which affect the region if the tail of the queue extends in to our region. At this time the tool does not permit the user to pick a multistate region in a single analysis, therefore staff embarked on a manual exercise to develop a regional top 10 bottleneck ranking list by combining the three state data namely District of Columbia, Maryland and Virginia. Shown below is a table of the top 10 bottleneck locations on Maryland Freeways in the region based on impact factor which is the product of average duration of congestion, length of the congestion, and the number of times (frequency) the congestion occurs.

Baltimore Metropolitan Council (BMC) has been publishing a quarterly snapshot of the “Top 10 Freeway Bottleneck Locations” in the Baltimore region based on impact factor and another list based on the length of the queue. We are attempting to do a similar report for the first quarter of 2013 and the tables and the graphics in the accompanying pages capture that effort. Two visualization techniques are available in this tool which depicts the exact location of the bottleneck on a map, and the second is a spiral graph which depicts the same information on a daily basis by the time of occurrence. Each segment in the spiral graph is a bottleneck episode on I-270 and represents the day when it occurred and the time when it occurred. Examples of these products are also shown on the following pages.

Top 10 Bottleneck Locations on Maryland Interstate Highways by Impact Factor

Location	Direction	Average duration	Average max length (miles)	Occurrences	Impact factor
I-270 S @ I-495/MD-355	SOUTHBOUND	2 h 3 m	18.17	74	165,339
I-270 N @ Middlebrook Rd/Exit 13	NORTHBOUND	1 h 50 m	6.74	141	104,557
I-95 N @ MD-100/Exit 43	NORTHBOUND	2 h 20 m	13.41	50	93,862
I-495 CCW @ MD-185/Connecticut Ave/Exit 33	COUNTERCLOCKWISE	2 h 23 m	6.24	79	70,444
I-270 N @ I-70/US-40	NORTHBOUND	1 h 27 m	7.34	87	55,564
I-495 CCW @ VA-193/Georgetown Pike/Exit 13	COUNTERCLOCKWISE	2 h 27 m	5.46	69	55,332
I-270 N @ MD-80/Exit 26	NORTHBOUND	1 h 29 m	7.82	66	45,940
I-495 CW @ Exit 27	CLOCKWISE	1 h 42 m	5.54	68	38,432
I-495 CW @ MD-202/Landover Rd/Exit 17	CLOCKWISE	1 h 58 m	9.67	32	36,506
US-50 W @ 7th St/Mount Vernon PI	WESTBOUND	6 h 33 m	15.02	6	35,406



Regional Top 10 Bottlenecks by Impact Factor

Rank	Location	Direction	Average duration	Average max length (miles)	Occurrences	Impact factor	State
1	I-95 S @ Fredericksburg/Stafford Co Line	SOUTHBOUND	5 h 36 m	33.6	24	270,972	VA
2	I-270 S @ I-495/MD-355	SOUTHBOUND	2 h 3 m	18.17	74	165,339	MD
3	I-395 N @ 2nd St	NORTHBOUND	2 h 30 m	6.62	156	154,793	VA
4	I-95 S @ VA-630/Exit 140	SOUTHBOUND	3 h 46 m	22.36	30	151,575	VA
5	I-95 S @ VA-3/Exit 130	SOUTHBOUND	4 h 48 m	36.23	13	135,657	VA
6	I-95 S @ VA-606/Exit 118	SOUTHBOUND	7 h 57 m	50.08	5	119,430	VA
7	I-66 W @ VA-7/Leesburg Pike/Exit 66	WESTBOUND	1 h 7 m	1.18	1410	111,572	VA
8	I-95 S @ Russell Rd/Exit 148	SOUTHBOUND	2 h 18 m	6.38	126	110,853	VA
9	I-270 N @ Middlebrook Rd/Exit 13	NORTHBOUND	1 h 49 m	6.8	138	102,357	MD
10	I-395 N @ 2nd St	NORTHBOUND	1 h 29 m	3.32	318	94,077	DC

Regional Top 10 Bottlenecks by Queue Length

Rank	Location	Direction	Average duration	Average max length (miles)	Occurrences	Impact factor	State
1	I-95 S @ Fredericksburg/Stafford Co Line	SOUTHBOUND	5 h 36 m	33.6	24	270,972	VA
2	I-95 S @ US-17/US-1/Exit 126	SOUTHBOUND	3 h 17 m	31.09	2	12,250	VA
3	I-95 S @ US-17/Exit 133	SOUTHBOUND	4 h 25 m	25.1	3	19,957	VA
4	I-95 S @ VA-630/Exit 140	SOUTHBOUND	3 h 46 m	22.36	30	151,575	VA
5	I-70 W @ MD-65/Exit 29	WESTBOUND	2 h 13 m	20.37	2	5,417	MD
6	I-270 S @ I-495/MD-355	SOUTHBOUND	2 h 3 m	18.17	74	165,339	MD
7	US-50 E @ MD-450/Exit 23	EASTBOUND	1 h 16 m	17.27	3	3,939	MD
8	US-50 W @ 7th St/Mount Vernon Pl	WESTBOUND	6 h 33 m	15.02	6	35,406	MD
9	US-50 W @ 7th St/Mount Vernon Pl	WESTBOUND	4 h 48 m	14.81	8	34,130	MD
10	US-50 W @ 9th St	WESTBOUND	4 h 49 m	14.71	2	8,503	MD

VI. User Delay Cost

This is the latest tool introduced in the VPP suite and combines volume, unit vehicle delay cost for passenger cars, and commercial vehicles, and duration of delay calculates user delay cost from bottlenecks. The user can use local data to supplant default cost used in the program.

November 18th VPP Suite Enhancements:

UMD CATT lab continues to make enhancements to the VPP analysis suite and some major enhancements were released on November 18, 2013 subsequent to the development of the November 4, 2013 memorandum. The November 4, 2013 memorandum was revised to include a few paragraphs on the enhancements. The enhancements in staff opinion will be beneficial to our multistate region.

1. TMC selection: Facilities or TMC's can be selected for multiple jurisdictions at the same time enhancing our ability to select road segments across the region for comparison purposes.
2. Congestion Scan: A number of enhanced graphical interfaces have been added to the congestion scan including the contour plots. The ability to include performance measures such as travel time index, planning time index are available.
3. Performance Charts: The advanced road search available allows for multi-road and regional analysis and higher temporal resolution, significantly improving the usefulness of the application. There are additional style changes and graph customization features that have been added to the resulting charts.
4. Trend Maps: The Trend Map allows you to create animated maps of metrics derived from raw speed data and performance metrics. You can choose to analyze multiple time periods at once, displaying them side-by-side or one at a time. The resulting animations can be exported to animated GIFs, allowing you to easily embed them on other webpages or presentations.
5. Mapping Multiple Ranked Bottlenecks: Each row in the table of ranked bottlenecks now includes a checkbox that controls whether or not the bottleneck shown in that row should be plotted on the map. The bottleneck in the highlighted row is always shown on the map. Checkboxes on the map panel, allow you to disable the "highlighting" of the selected bottleneck and turn on or off the ranking numbers next to each map icon.
6. Local Volume Data for User Delay Cost Calculation: Local volume can be used to substitute default national average data provided by Texas Transportation Institute in the user delay cost calculation.

Next Steps

Staff proposes to use the VPP suite as the primary tool to develop arterial highway congestion information, work with UMD CATT lab as they prepare validation reports of VPP data on arterial highways, and use the visualization tools to prepare exhibits for the CMP technical report.