VER 2.5 TRAVEL MODEL DEVELOPMENT AND EVALUATION

Status Report

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TPB Travel Forecasting Subcommittee
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National Capital Region
Transportation Planning Board

Recap: Version 2.5 Refinements

1. Updated transit network/path-building software
   - Public Transport (PT)
2. Improved non-motorized model
3. Simplified mode choice model
   - Transit choice set reduced from 11 to 3 modes
4. Highway & transit assignment enhancements
   - Highway assignment: VOT stratification
   - Transit assignment: Transit sub-mode choice

Recap: Checklist for 2.5 adoption

1. Understanding application

2. Validation

3. Running time optimization

4. Sensitivity testing

5. Documentation

Ver 2.5 disposition

Staff has spent ~1 year in evaluation and testing

- Effort has been <u>longer</u> than anticipated

- Scripts have been scrutinized (bugs fixed, reporting enhancements made)

- Preparing "production-ready" inputs to the Ver 2.5 model has taken longer than anticipated (land activity, PT-compliant inputs)

- Forecast-year outputs from the Ver 2.5 model have only recently been evaluated

- Excessive Ver 2.5 run times are considered a challenge (27 to 33 hours per application)

Model reference names

Model Reference	Description
Ver 2.3.66SIP:	Version 2.3 travel model used for the base year, **2014**
Ver 2.3.75:	Version 2.3 travel model used in for all years **beyond 2014**
Ver 2.5_Base:	-Initial ("Pump-Prime") four-step iteration is removed to streamline the application process
	-Vehicle constants used in the Vehicle Availability sub-model were updated to match 2014 ACS data
	-Fixed bug in the highway skimming calculation (bridge penalty was not used in the impedance formulation)
	-Minor scripting edits made to fix minor bugs or to enhance reporting
Ver 2.5.9	-Builds on **Ver 2.5_Base**
	-Includes improved treament of external travel
	-Updated the PT transit skim process

Version 2.5.9 application is currently considered the "optimal" variant of the 2.5 model series from a validation standpoint

For presentation today...

- The latest year 2014 model performance results

- Regional results of the Ver 2.5 model forecasts
    (with comparisons to the latest Ver 2.3.75 model results)

Performance summaries

- All summaries correspond to the <u>year 2014</u>

- Summaries compiled:
    - Daily regional VMT by jurisdiction
    - Daily regional VMT on facilities (where link counts exist)
    - Daily screenline crossings (where link counts exist)
    - Daily regional transit boardings

Daily VMT performance (est./obs. ratio) by jurisdiction

- VMT reflects on-network facilities

- We noted excessive VMT over-estimation in Alexandria initially

- **Revised 2.5.9 ratios based on refined Alexandria boundary definition**

- V2.5.9 validation performance is comparable to that of V2.3

Jurisdiction	V2.3.66_SIP	V2.5_Base	E/O Ratio Original Jur Code V2.5.9	E/O Ratio Revised Jur Code V2.5.9
District of Columbia	1.03	1.09	1.05	1.05
Montgomery County	1.10	1.15	1.03	1.03
Prince George's County	0.98	1.04	0.93	0.93
Arlington County	0.96	0.99	0.97	0.97
City of Alexandria	1.22	1.30	1.26	1.04
Fairfax County	0.98	1.04	1.01	1.03
Loudoun County	1.12	1.16	1.01	1.01
Prince William County	1.00	1.05	1.00	1.00
Frederick County	1.12	1.18	1.12	1.12
Charles County	0.92	0.95	0.92	0.92
TPB Member Area	1.03	1.08	1.01	1.01
Non-TPB Member Area	1.01	1.06	1.01	1.01
Grand Total	1.02	1.08	1.01	1.01

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Daily VMT performance (est./obs. ratio) by facility type

	E/O Ratio		
FTYPE	**V2.3.66_SIP**	**V2.5_Base**	**V2.5.9**
Freeway	1.07	1.14	1.09
Major Arterial	1.07	1.09	1.05
Minor Arterial	1.13	1.16	1.07
Collector	0.73	0.76	0.72
Expwy	0.96	1.04	0.95
Total	**1.06**	**1.11**	**1.05**

- E/O ratio based on 6,686 directional links with daily traffic counts
- V2.5.9 performance is comparable to that of V2.3

Daily % RMSE performance by facility type

	Percent RMSE		
FTYPE	V2.3.66_SIP	V2.5_Base	V2.5.9
Freeway	21	28	25
Major Arterial	39	40	38
Minor Arterial	52	53	49
Collector	77	76	76
Expwy	34	34	33
Ramp	13	15	13
Total	**42**	**48**	**45**

- Historically, TPB model %RMSE performance has been about 20% for freeways and 40% for all links
- The V2.5.9 model performance is slightly worse than existing 2.3 model

Daily vehicular screenline crossing performance (Est./Obs. ratios)

Ver 2.5.9 model outperforms the Ver 2.3 model on 18 of 34 screenlines

The Ver 2.5 model appears to understate Potomac River screenline #20 crossings by 11%

Screenline	E/O Ratio				Screenline	E/O Ratio		
	V2.3.66_SIP	V2.5_Base	V2.5.9			V2.3.66_SIP	V2.5_Base	V2.5.9
1	0.74	0.76	0.74		20	0.92	0.98	0.89
2	1.25	1.30	1.25		22	1.06	1.13	1.01
3	0.89	0.87	0.87		23	1.61	1.65	1.24
4	1.23	1.32	1.23		24	0.90	0.96	0.89
5	0.85	0.91	0.89		25	1.32	1.45	1.28
6	1.03	1.08	1.04		26	2.16	2.17	1.64
7	0.97	0.99	0.96		27	1.48	1.63	1.29
8	1.09	1.19	1.06		28	0.75	0.79	0.77
9	0.79	0.88	0.85		31	2.22	2.23	2.00
10	0.99	1.03	0.98		32	1.76	1.87	2.15
12	1.00	1.06	0.99		33	1.08	1.09	1.00
13	1.27	1.36	1.21		34	1.18	1.24	1.12
14	1.09	1.16	1.07		35	0.93	0.98	1.03
15	0.91	0.96	0.83		36	2.09	2.11	1.41
16	0.94	1.03	0.83		37	2.00	2.04	1.82
17	0.90	0.91	0.88		38	0.69	0.72	0.72
18	0.89	0.80	0.75					
19	0.80	0.76	0.70		**Total**	**1.02**	**1.07**	**0.99**

Transit ridership performance (est./obs. boardings) by sub-mode

|	Obs	V2.3 SIP	V2.5 Base	V2.5 .9	V2.3 SIP E/O	V2.5 Base E/O	V2.5.9 E/O
Metrorail	721,804	748,657	815,304	761,077	1.04	1.13	1.05
MARC	36,051	28,285	22,997	11,389	0.78	0.64	0.32
VRE	18,166	4,747	6,731	6,492	0.26	0.37	0.36
All bus	648,083	717,757	480,304	434,327	1.11	0.74	0.67
Total	**1,424,104**	**1,499,446**	**1,325,336**	**1,213,285**	**1.05**	**0.93**	**0.85**

- V2.5 model results indicate a reasonable e/o match for Metrorail boardings, but commuter rail and bus boardings appear low

Total (linked) transit trip forecasts V2.3.75 vs. V2.5.9

Ver 2.5 transit trips are lower than the Ver 2.3 transit trips for the base year (by 11%)

Ver 2.5 transit trips are higher than the Ver 2.3 transit trips for the horizon year (by 9%)
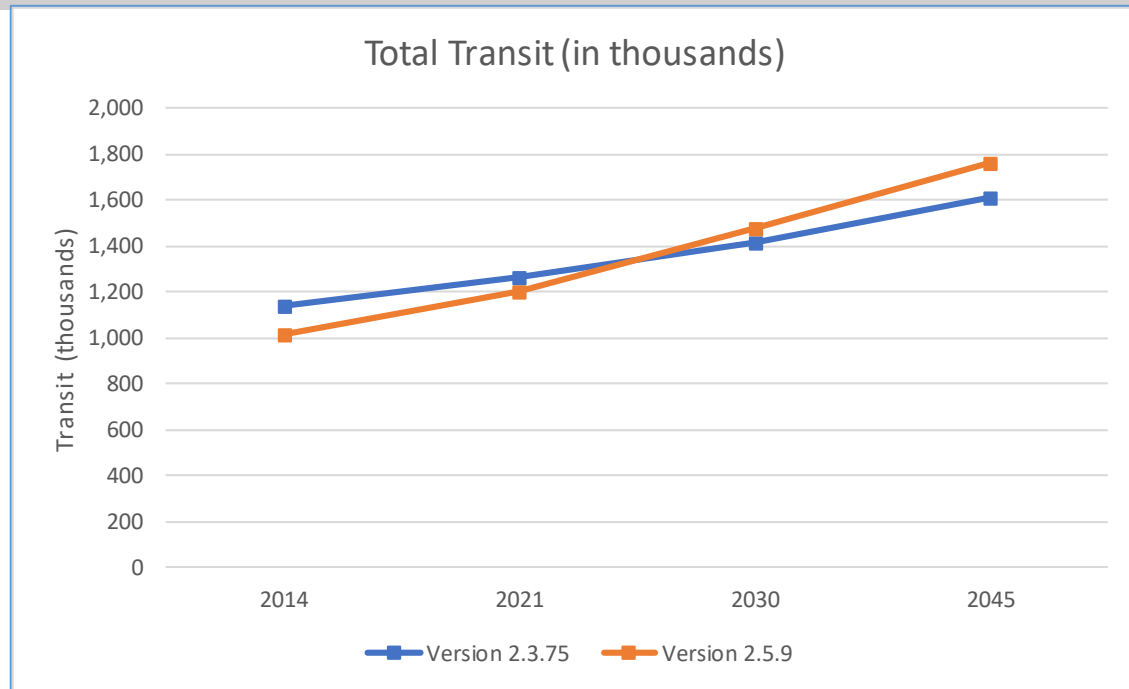
Total Transit (in thousands)				
	2014	2021	2030	2045
Version 2.3.75	1,145	1,263	1,412	1,614
Version 2.5.9	1,017	1,203	1,480	1,763

Total VMT forecasts V2.3.75 vs. V2.5.9

The magnitude and pattern of VMT growth over time appears to be consistent

Ver2.5 VMT is about 1 to 2 percentage points lower than V2.3 VMT over time

Total VMT (in thousands)
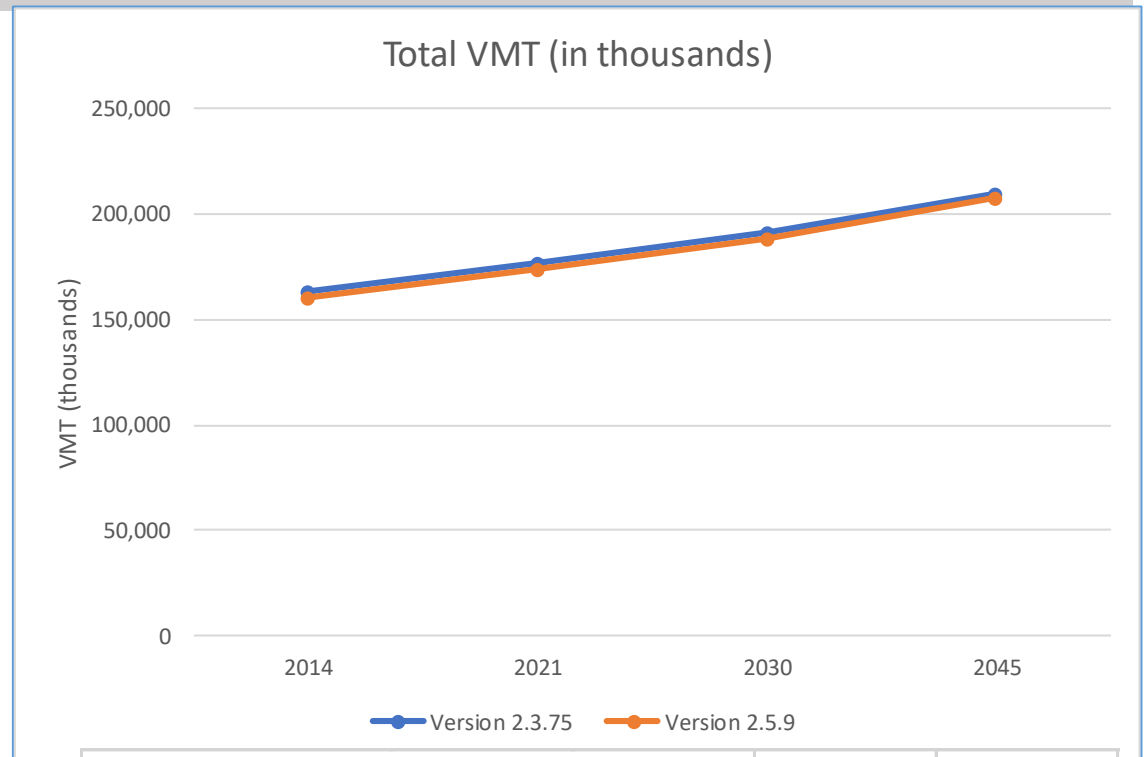
Total VMT (in thousands)

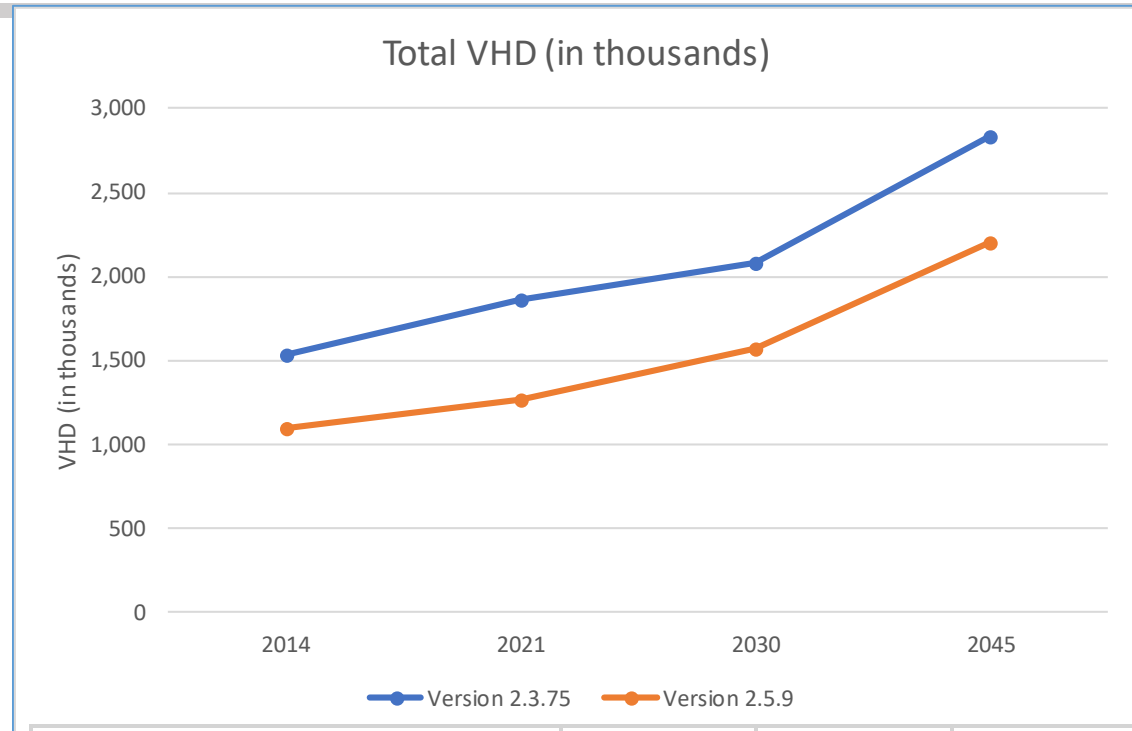|	2014	2021	2030	2045
Version 2.3.75	163,114	176,875	191,512	210,274
Version 2.5.9	160,824	173,836	188,326	207,930

Total Vehicle Hours of Delay (VHD) forecasts V2.3.75 vs. V2.5.9

Ver 2.5 model yields a **lower** VHD result

This is due to a revised volume-delay (V-D) function in the Ver 2.5 model which reflects a reduced speed decay at congested V/C levels, relative to the speed decay assumed in the Ver 2.3 model

While the V2.5 delay is lower than V2.3 delay, the rate of change over time appears consistent

Total VHD (in thousands)

Total VHD (in thousands)				
	2014	2021	2030	2045
Version 2.3.75	1,530	1,857	2,081	2,829
Version 2.5.9	1,098	1,267	1,568	2,200

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Conclusions

- Staff has spent a year evaluating and refining the V2.5 model

- From a validation perspective, Ver 2.5 model results are comparable to that of the Ver 2.3 model, except for non-Metrorail transit boardings which appear to be under-predicted; this is an issue

- From a forecasting perspective, the Ver 2.5 model produces VMT and transit trends that are generally comparable to the Ver 2.3 model; The VHD metric produced by the Ver 2.5 model is different than the VHD produced by the Ver 2.3

Conclusions, continued

- The Ver. 2.5 model running time is about double that of the Ver 2.3 model (~27 to 33 hours depending on machine and execution environment); Work on streamlining the execution process should continue.

- Documentation is on-going

- Version 2.5 model results should be tested with existing CLRP evaluation scripts to further assess its reasonability

- A determination will be made by the end of the calendar year about whether or not the Ver 2.5 model is production-ready.

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