

Version 2.3 Travel Model 2010 Validation

Presentation
to the
Travel Forecasting Subcommittee

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Recent staff activities

1. Refinement of the 2010 highway network
 - Arterial facility types examined, updated
 - Zonal access refined
2. Refinements to the V2.3 Travel Model
 - Added more distributed processing features
 - Relocated placement of some input files to reduce possibility of file sharing violations
3. Compilation of 2010 observed data ...

2010 observed data compiled

- Census and ACS data at jurisdiction level
 - Census: HH, HH population
 - ACS: demographic variable distributions
- HPMS VMT data at jurisdiction level
- Daily, hourly traffic counts at link level
- Metrorail daily faregate ridership counts at by station group (segment) and station level
- Daily Metrobus line ridership counts by line segment
 - Segments are single routes or a small group of routes

Most recent work: validation checks

- 2007 model scenario:
 - V2.3.36
 - Pseudo Round 8.0 land use
 - The final calibrated model
- 2010 model scenario:
 - V2.3.46 / the current *developmental* model version
 - The updated highway network
 - The latest model developmental version (#46)
 - Currently adopted Round 8.1 land activity
- Staff is now examining the 2010 model performance
- The 2010 validation checks of the model are not comprehensive
 - All four steps of the model chain are not being validated, only portions
- The validation question: Are the forecasts moving in the right direction?

How have the model inputs and outputs changed between 2007 and 2010?

Observations:

- HHs and jobs *increased* by 5.8% and 2.7%, respectively
- external trips *decreased* by 4.3%
- Non-motorized trips *increased* by 13.8%
- Total transit trips *increased* by 7.7%
- VMT *increased* by 3.7%

Comment:

- Fuel prices have been extremely volatile during the period

	2007	2010		
	Psuedo Rnd. 8.0	Rnd 8.1	Diff.	Pct. Diff.
Households	2,339,832	2,474,631	134,799	5.76%
Jobs	3,801,935	3,902,756	100,821	2.65%
External -Internal Auto Person Trips	678,204	649,259	-28,945	-4.27%
Internal-External Auto Person Trips	658,428	630,329	-28,099	-4.27%
Non-Motorized Trips	1,606,477	1,828,064	221,587	13.79%
HBWTransit Trips	716,353	783,806	67,453	9.42%
Total Transit Trips	1,077,487	1,160,278	82,791	7.68%
HBWTransit Pct.	20.33	20.61	0.00	1.38%
Total Purpose Transit Pct.	6.23	6.17	0.00	-0.96%
Metrorail Trips (Linked)	715,557	752,176	36,619	5.12%
Non-Metrorail Transit (Linked)	361,930	408,102	46,172	12.76%
Internal Mtorized Person Trips	16,215,743	17,644,890	1,429,147	8.81%
Internal Auto Driver Trips	11,599,060	12,552,406	953,346	8.22%
Internal HBWAuto Occ.	1.09	1.09	0.00	0.00%
Internal Total Purpose Auto Occ.	1.40	1.41	0.00	0.71%
Total Vehide Trips Assigned	15,261,363	16,312,891	1,051,528	6.89%
Internal Mtorized Trips per HH	7.41	7.61	0.00	2.70%
Total VMT	154,873,932	160,558,143	5,684,211	3.67%
VMTperCapita	25.90	24.23	-1.67	-6.45%

Comparison of 2010 HHs Rnd8.1 vs. CTPP: *a reasonable match at jurisdiction level*

Juris.	2010 Round 8.1			2010 Census			HH Diff.	Pop. Diff.	Size Diff.
	HHs	HH Pop.	HH Size	HHs	HH Pop.	HH Size	R81 - Cen	R81 - Cen	R81 - Cen
DC	266,707	561,702	2.11	266,707	561,702	2.11	0	0	0.00
Mtg	361,030	959,695	2.66	357,086	962,877	2.70	3,944	-3,182	-0.04
PGeo	304,042	844,092	2.78	304,042	844,092	2.78	0	0	0.00
Arl	98,050	204,735	2.09	98,050	204,735	2.09	0	0	0.00
Alx	68,131	138,131	2.03	68,082	138,139	2.03	49	-8	0.00
Ffx	399,514	1,075,041	2.69	405,075	1,106,770	2.73	-5,561	-31,729	-0.04
Ldn	104,583	311,139	2.98	104,583	311,139	2.98	0	0	0.00
PW	147,819	451,524	3.05	147,819	451,524	3.05	0	0	0.00
Frd	84,800	229,203	2.70	84,800	229,203	2.70	0	0	0.00
How	107,502	279,983	2.60	104,749	284,763	2.72	2,753	-4,780	-0.11
AnnAr	202,314	516,054	2.55	199,378	523,523	2.63	2,936	-7,469	-0.08
Chs	50,950	143,049	2.81	51,214	145,146	2.83	-264	-2,097	-0.03
Car	61,592	171,740	2.79	59,786	163,815	2.74	1,806	7,925	0.05
Calv	32,046	91,026	2.84	30,873	88,087	2.85	1,173	2,939	-0.01
StM	38,870	101,278	2.61	37,604	102,225	2.72	1,266	-947	-0.11
KGeo	8,370	23,257	2.78	8,376	23,283	2.78	-6	-26	0.00
Stf	41,769	125,355	3.00	41,769	125,368	3.00	0	-13	0.00
Spots_Fbrg	43,175	119,749	2.77	51,447	143,563	2.79	-8,272	-23,814	-0.02
Fau	26,871	74,194	2.76	23,658	64,814	2.74	3,213	9,380	0.02
Clk_Jeff	26,496	65,153	2.46	25,440	65,886	2.59	1,056	-733	-0.13
Total	2,474,631	6,486,100	2.62	2,470,538	6,540,654	2.65	4,093	-54,554	-0.03

State-level comparison

2010 HH size distribution -- estimated vs. ACS

State	Size	1 Psn HHs	2 Psn HHs	3 Psn HHs	4+Psn HHs	Sum
DC	estimated	41.1%	30.4%	13.2%	15.3%	100.0%
	observed	48.0%	27.8%	11.9%	12.3%	100.0%
	Diff.	-6.9%	2.5%	1.3%	3.0%	
MD	estimated	23.1%	30.9%	18.2%	27.8%	100.0%
	observed	24.5%	32.0%	17.3%	26.1%	100.0%
	Diff.	-1.4%	-1.2%	0.9%	1.7%	
VA	estimated	24.3%	30.0%	17.7%	28.0%	100.0%
	observed	24.1%	31.3%	16.5%	28.1%	100.0%
	Diff.	0.2%	-1.3%	1.2%	-0.1%	
Total	estimated	25.5%	30.5%	17.5%	26.5%	100.0%
	observed	26.8%	31.3%	16.4%	25.4%	100.0%
	Diff.	-1.3%	-0.8%	1.0%	1.1%	

Total HH size distribution matches well at state and regional level
 ACS data subject to sampling error

State level comparison

2010 HH income distribution-- estimated vs. ACS

State	Income	Inc. 1	Inc. 2	Inc. 3	Inc. 4	Sum
DC	estimated	47.0%	29.1%	13.4%	10.6%	100.0%
	observed	42.2%	27.3%	13.1%	17.4%	100.0%
	Diff.	4.8%	1.9%	0.3%	-6.9%	
MD	estimated	26.3%	32.1%	21.2%	20.4%	100.0%
	observed	27.8%	31.6%	20.4%	20.2%	100.0%
	Diff.	-1.5%	0.4%	0.9%	0.2%	
VA	estimated	22.1%	29.9%	22.2%	25.7%	100.0%
	observed	27.8%	31.6%	20.4%	20.2%	100.0%
	Diff.	-5.7%	-1.7%	1.8%	5.5%	
Total	estimated	27.0%	30.9%	20.7%	21.4%	100.0%
	observed	26.9%	30.1%	20.4%	22.6%	100.0%
	Diff.	0.1%	0.8%	0.3%	-1.2%	

Total HH income distribution matches extremely well
 ACS data subject to sampling error

State level comparison

2010 HH vehicles av. distribution -- estimated vs. ACS

State		0 Vehs.	1 Veh.	2 Vehs.	3+ Vehs.	Sum
DC	estimated	38.6%	39.4%	17.6%	4.4%	100.0%
	observed	35.0%	45.3%	15.7%	4.0%	100.0%
	Diff.	3.6%	-5.9%	1.9%	0.4%	
MD	estimated	4.9%	28.6%	40.9%	25.6%	100.0%
	observed	6.7%	30.3%	39.1%	23.8%	100.0%
	Diff.	-1.8%	-1.7%	1.8%	1.7%	
VA	estimated	5.3%	30.0%	40.1%	24.7%	100.0%
	observed	4.8%	30.8%	41.2%	23.2%	100.0%
	Diff.	0.5%	-0.9%	-1.1%	1.5%	
Total	estimated	8.8%	30.3%	38.0%	22.9%	100.0%
	observed	9.0%	32.1%	37.4%	21.5%	100.0%
	Diff.	-0.2%	-1.8%	0.6%	1.4%	

Total HH vehicles available distribution matches very well
 ACS data subject to sampling error

Estimated and Observed Metrorail trips (linked) 2007 and 2010

Year	2007	2010	Diff.	Pct. Diff.
Estimated	715,600	752,200	36,600	5.11%
Observed	726,000	750,600	24,600	3.39%
E/O Ratio	0.99	1.00		

- Observed trips are average weekday ridership based on WMATA faregate counts for FY 2008 and FY 2011
- System-wide e/o match is reasonable
- Simulated Metrorail growth is between '07 and '10 is slightly higher than observed counts

Linked Metrorail Trips May 2010

Faregate counts (in May) vs. estimated Trips

Metrorail Segment	WMATA Counts 2010	Estimated 2010	Est/Obs	2007 Est/Obs
1 Red Line - "A" route MD outside Beltway	32,906	34,534	1.05	0.99
2 Red Line - "A" route MD inside Beltway	25,862	34,851	1.35	1.29
3 Red Line - "A" route DC non-core	26,141	24,800	0.95	0.84
4 Red Line - DC core	149,980	114,045	0.76	0.75
5 Red Line - "B" route DC non-core	26,469	30,768	1.16	1.21
6 Red Line - "B" route MD	25,508	34,229	1.34	1.18
7 Green Line - "E" route MD	20,663	17,660	0.85	0.86
8 Green Line - "E" route DC non-core	24,631	23,309	0.95	1.18
9 Green Line - DC core	39,586	43,170	1.09	1.08
10 Green Line - "F" route DC non-core	23,607	24,387	1.03	1.44
11 Green Line - "F" route MD	22,401	19,032	0.85	0.79
12 Blue/Yellow Line - VA Fairfax	21,906	23,397	1.07	1.05
13 Blue/Yellow Line - VA Alexandria	16,098	16,945	1.05	1.08
14 Blue/Yellow Line - VA Core	56,360	59,937	1.06	0.89
15 Orange Line - VA Fairfax	29,797	30,964	1.04	1.03
16 Orange Line - VA Arlington non-core	32,289	49,549	1.53	1.33
17 Orange/Blue Line - VA/DC core	120,132	135,182	1.13	1.17
18 Orange/Blue Line - DC non-core	13,656	18,190	1.33	1.20
19 Orange Line - DC/MD	19,331	16,676	0.86	0.79
20 Blue Line - DC/MD	16,073	14,710	0.92	0.95
Total	743,396	766,330	1.03	1.01

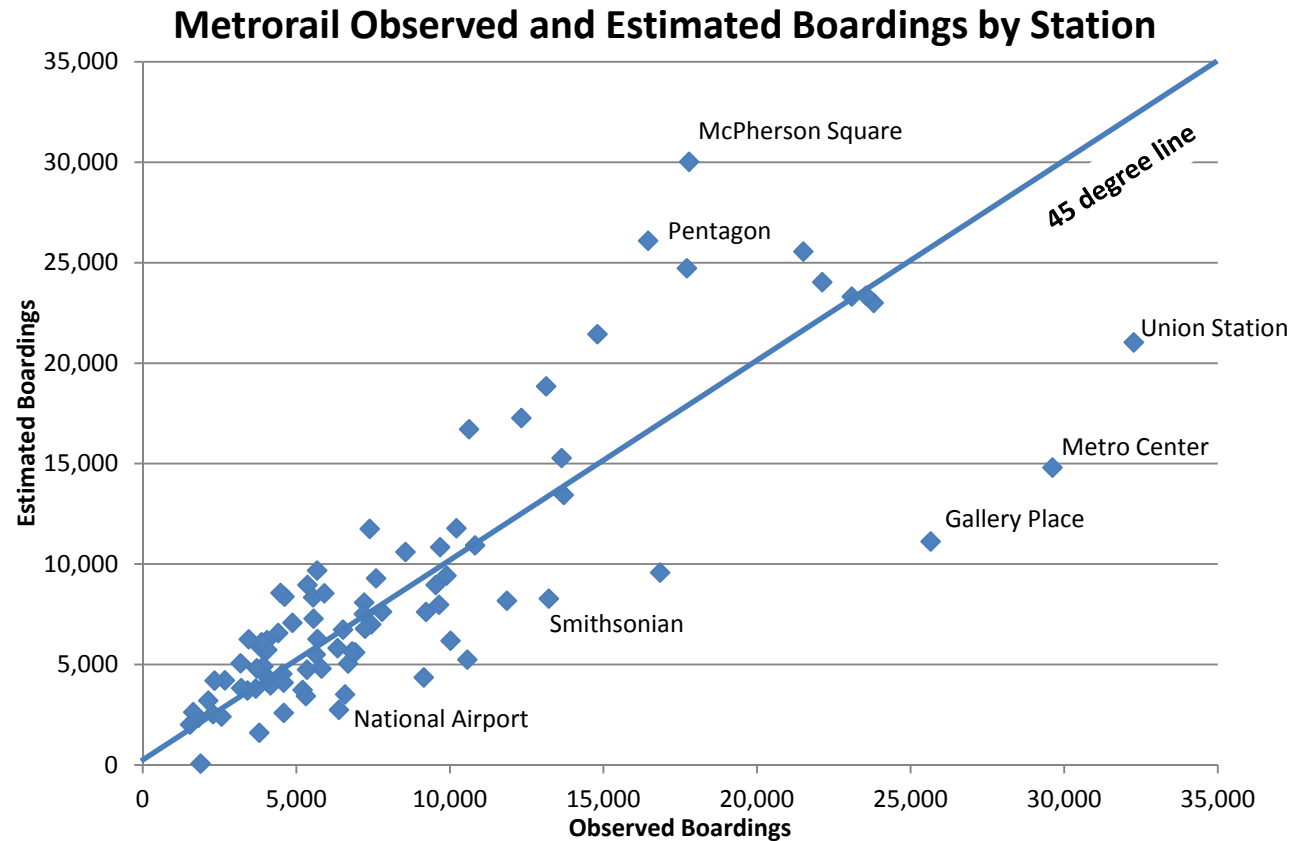
- Counts shown are the average of “ons” and “offs” at each station
- “Segments” are essentially station groups
- Overall model estimate matches observed figure well (about 3% high)
- Model matches most segments within +/-15%
- Segment level comparisons are similar to observed in the 2007 calibration effort

Estimated and observed 2010 Metrorail trips (linked)

-Some of the outlier stations are or may be associated with stations serving non-residents

-Existing model does not address this market

- staff is actively working to address

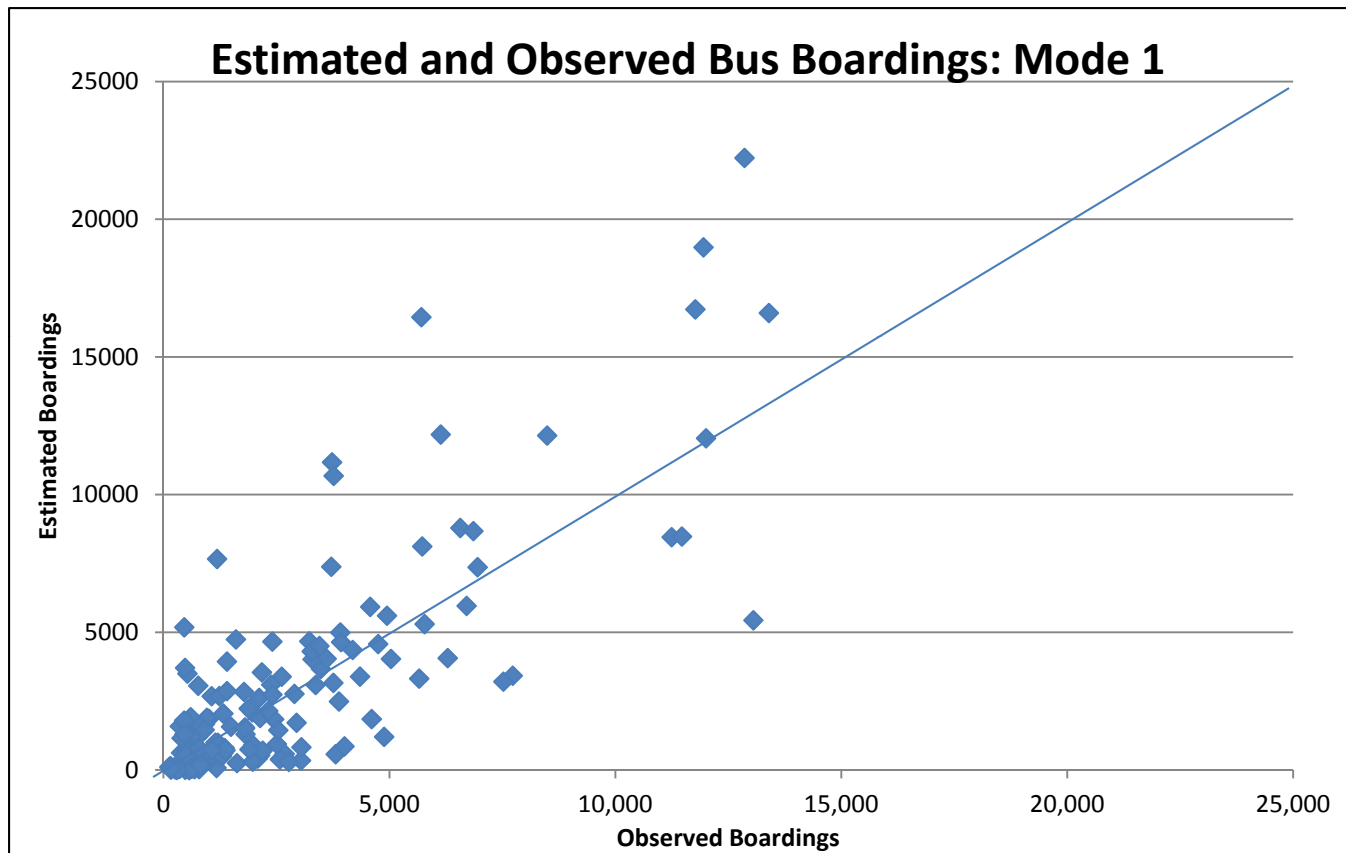


Estimated and observed 2010 Metrobus system-wide bus line counts

Mode	No. of Segments	Estimated Boardings	Observed Boardings	Diff.	Pct. Diff.
1/ Local Bus	143	443,478	401,322	42,156	10.5%
2/ Express Bus	15	32,020	17,268	14,752	85.4%
Total	158	475,498	418,590	56,908	13.6%

- Observed counts are WMATA weekday average bus counts for May 2010
- Estimated Mode 1 (local buses) loads are within 11% of observed
- Modeled bus loads are subject to “lumpiness” of an AON paths

Estimated and observed 2010 Metrobus counts at segment level



Estimated vs. Observed VMT in the Washington, D.C. MSA at the state level

State	2007			2010		
	Est.	Obs.	E/O Ratio	Est.	Obs.	E/O Ratio
DC	8,929,239	8,271,900	1.08	9,277,286	8,218,979	1.13
MD	55,859,589	56,366,301	0.99	57,852,884	55,845,616	1.04
VA	50,495,080	50,237,805	1.01	53,414,638	50,864,288	1.05
Total MSA	115,283,908	114,876,006	1.00	120,544,808	114,928,883	1.05
2007 simulation:	X:\modelRuns\fy12\Ver2.3.36\2007_pseu					
2010 simulation:	X:\modelRuns\fy13\Ver2.3.46\2010					
Obs. Source:	Reported HPMS data					
MSA Definition:	MSA Definition: DC, Mtg, PG, Arl, Alx, Ffx, Ldn, PW, Frd, Chs, Calv, Staf					

- Observed VMT is based on HPMS reports
- A precise match of est. & obs. VMT was achieved in the 2007 calibration
- 2010 VMT is currently overestimated by about 5%
- 8% over-estimation of VMT in DC found in 2007 calibration has grown to a 13% over-estimation in 2010

**Estimated vs.
Observed VMT in the
Washington, D.C.
modeled area at the
jurisdiction level**

-2010 VMT is over-
estimated by about
3% overall

- 2010 VMT is
substantially over-
estimated in DC, City
of Alexandria, and
Loudoun County

-Staff is working on
this

Jurisdiction	2007			2010		
	Est.	Obs.	E/O Ratio	Est.	Obs.	E/O Ratio
District of Columbia	8,929,239	8,271,900	1.08	9,277,286	8,218,979	1.13
Montgomery County	20,755,761	19,889,589	1.04	21,105,942	19,693,973	1.07
Prince George's County	21,733,273	23,315,753	0.93	23,118,892	23,123,014	1.00
Arlington County	4,314,948	4,391,518	0.98	4,529,161	4,256,249	1.06
City of Alexandria	2,013,028	1,957,552	1.03	2,642,544	2,122,476	1.25
Fairfax County	25,712,591	26,799,196	0.96	26,320,633	26,736,352	0.98
Loudoun County	5,910,328	5,259,907	1.12	6,802,826	5,412,448	1.26
Prince William County	8,558,940	8,000,267	1.07	8,979,517	8,416,630	1.07
Frederick County	8,630,544	7,841,918	1.10	8,630,040	7,738,356	1.12
Howard County	10,090,905	10,094,384	1.00	10,400,008	10,491,370	0.99
Anne Arundel County	14,570,489	15,330,000	0.95	14,578,753	14,984,795	0.97
Charles County	2,951,689	3,348,493	0.88	3,129,606	3,253,562	0.96
Carrol County	4,227,247	3,394,521	1.25	3,931,758	3,354,247	1.17
Calvert County	1,788,322	1,970,548	0.91	1,868,404	2,036,712	0.92
St. Mary's County	2,052,550	2,194,932	0.94	2,075,399	2,192,055	0.95
King George County	656,299	789,089	0.83	722,614	819,433	0.88
City of Fredericksburg	777,383	948,495	0.82	824,063	919,376	0.90
Stafford County	3,985,245	3,829,366	1.04	4,139,957	3,920,132	1.06
Spotsylvania County	2,013,315	3,299,537	0.61	2,202,562	3,303,754	0.67
Fauquier County	2,932,644	3,149,136	0.93	3,162,081	3,133,312	1.01
Clarke County	914,487	769,608	1.19	870,279	727,408	1.20
Jefferson County	1,354,704	1,081,763	1.25	1,245,818	1,094,762	1.14
Total	154,873,932	155,927,469	0.99	160,558,143	155,949,393	1.03

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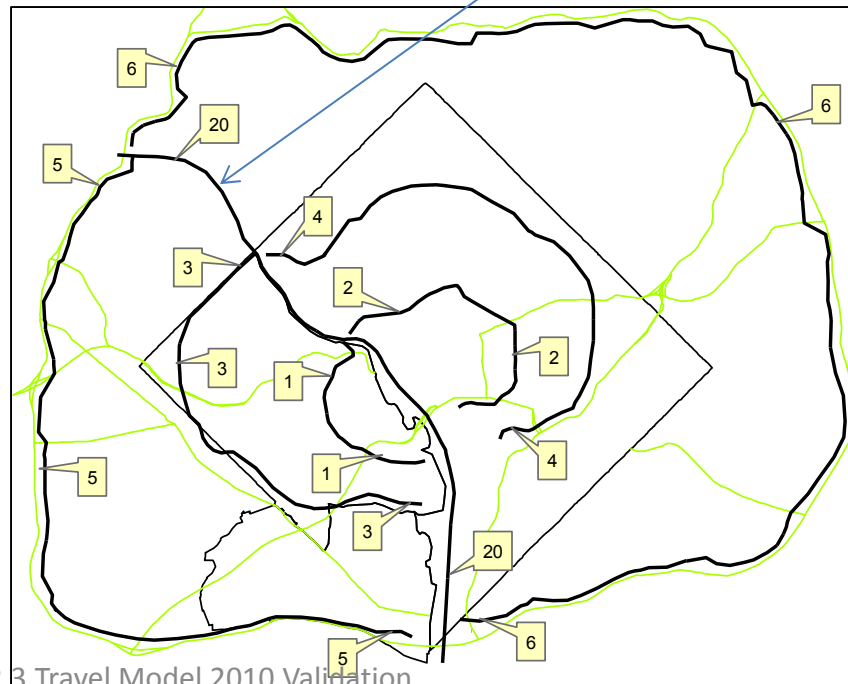
Screenline crossings (000s)– inside of the Capital Beltway

Screenline	Estimated	Observed	Difference	Ratio	Screenline links	Screenline links w/counts	Pct. links with counts
1	620	718	-98	0.86	44	33	0.75
2	1,012	695	317	1.46	64	62	0.97
3	981	1,016	-34	0.97	56	50	0.89
4	973	784	189	1.24	74	60	0.81
5	1,100	1,157	-57	0.95	64	49	0.77
6	1,616	1,485	131	1.09	108	72	0.67
20	1,206	846	360	1.42	16	14	0.88
Subtotal	7,507	6,701	806	1.12	426	340	0.80

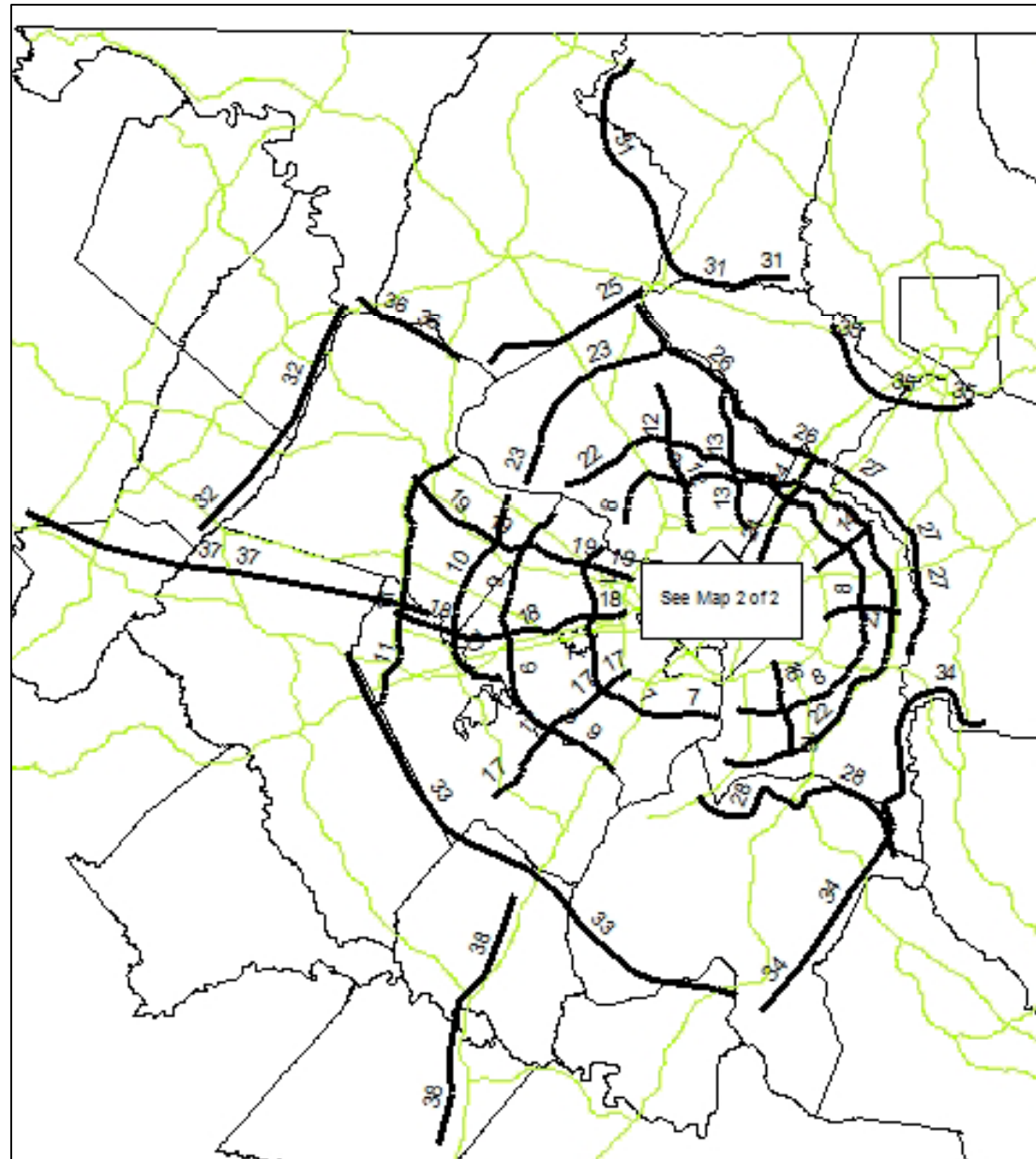
- Va. radial crossings (1,3,5) found to be underestimated

- Md. Radial crossings (2,4,6) found to be over-estimated

- Potomac River crossings (20) are **substantially** over-estimated



Highway
Screenline
crossings
outside of the
Beltway



Screenline crossings (000s)– outside of the Capital Beltway

- The “outer” screenline crossings are under analysis

- Count sample rate across all screenlines is about 70%

Screenline	Estimated	Observed	Difference	Ratio	Screenline links	Screenline links with counts	Pct. links with counts
7	1,222	1,469	-247	0.83	70	62	0.89
8	1,605	1,446	159	1.11	115	56	0.49
9	907	1,020	-113	0.89	54	46	0.85
10	488	447	42	1.09	22	18	0.82
11	291	351	-61	0.83	34	26	0.76
12	449	456	-8	0.98	32	16	0.50
13	493	386	108	1.28	20	14	0.70
14	277	333	-56	0.83	12	10	0.83
15	271	331	-60	0.82	18	8	0.44
16	146	158	-12	0.92	18	4	0.22
17	493	487	6	1.01	42	34	0.81
18	671	719	-48	0.93	44	38	0.86
19	670	727	-57	0.92	50	42	0.84
22	1,564	1,434	130	1.09	144	66	0.46
23	229	184	44	1.24	31	18	0.58
24	368	413	-45	0.89	30	14	0.47
25	135	108	27	1.25	14	6	0.43
26	73	37	35	1.94	20	6	0.30
27	291	235	55	1.24	14	10	0.71
28	140	177	-37	0.79	30	17	0.57
31	170	76	94	2.24	30	18	0.60
32	124	87	37	1.43	8	8	1.00
33	342	283	59	1.21	22	12	0.55
34	121	100	21	1.21	20	14	0.70
35	854	951	-97	0.90	36	32	0.89
36	50	22	28	2.23	10	4	0.40
37	34	24	11	1.45	16	6	0.38
38	176	264	-88	0.67	32	24	0.75
Subtotal	12,654	12,728	-73	0.99	988	629	0.64
All ScreenIns.	20,162	19,429	733	1.04	1,414	969	0.69

Conclusions

- Getting to this point has been a challenge
 - Updating the network
 - Refining the travel model
 - Compiling observed data
- Focus is now on:
 - Addressing the over-estimation of VMT in DC, and in a few other jurisdictions
 - Addressing the over-estimation of Potomac River crossings

“There’s still more work to do...”