Version 2.2 Travel Demand Model Update

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September 21, 2007

Presentation

to the

Travel Forecasting Subcommittee

Version 2.2 Timeline Milestones

Fall 2005	Development of individual model refinements commenced
Fall 2006	Refinements combined into a unified application
January 2007	Draft Version 2.2 documentation released
Spring 2007	Sensitivity work undertaken. Model refined further as a result
Summer 2007	Testing on increased assignment iteration undertaken; model refined further as a result
September 2007	Model is being applied in support of air quality work (2007 CLRP / 2008-2013 TIP)
Late Fall 2007	Version 2.2 model envisioned to be formally adopted

Ver. 2.2 & Ver. 2.1D Similarities

- General form and structure
  - Pump-prime, and six ‘standard’ iterations
- Traffic assignment involves three time periods
  - AM, PM, Off-Peak
- Transit networks reflect peak and off-peak periods
- Modeled purposes
  - Four: HBW, HBS, HBO, NHB

  …but NHB definition is modified & new commercial vehicle (CV) purpose is added
- Highway/transit networks
  - …but minor format changes introduced
- Application process
  - Rigid subdirectory structure and file naming
  - Execution via batch files

Version 2.2 Primary Changes

- New commercial vehicle model
  - Formerly subsumed in the NHB travel market
- External traffic forecasts moderated
  - Traffic growth previously assumed to be 3% annually
  - Growth now assumed to be 1.1 to 3%
- Traffic assignment
  - Volume delay functions updated (no ‘floors’)
  - Queuing delay function added to speed-flow relationship
- Other numerous updates/refinements added

‘Late-Breaking’ Refinement

…based on model testing undertaken in August

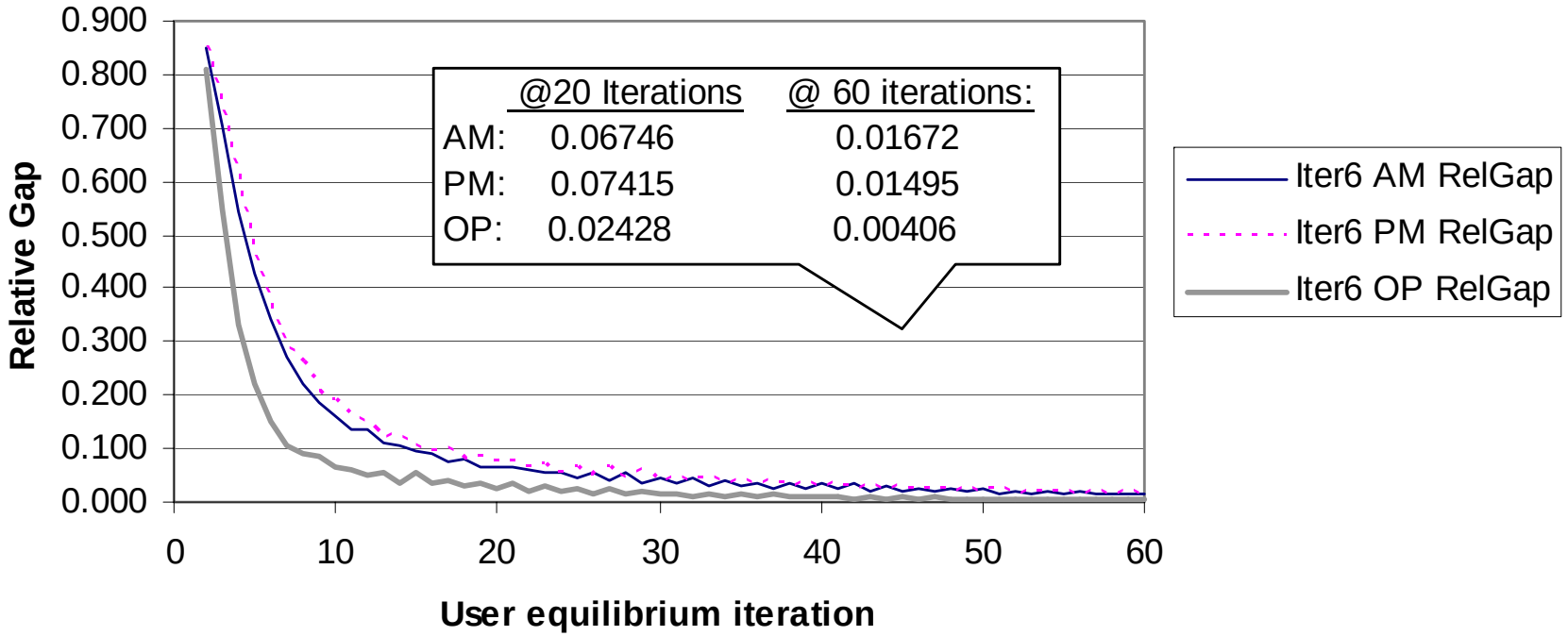
- The number of user equilibrium iterations (UEIs) in the traffic assignment increased from 20 to 60
- Assignment loadings per model execution increased from 420 to 1,260
- Implication of increased UEIs
  - Run time increases from ~12 to ~20-30 hours

Why are increased UEI's important?

- Increased user equilibrium iterations better reflect optimal (or 'well converged') paths…

- …tighter convergence minimizes noise when comparing highway alternatives

Traffic Assignment Relative Gap
by Time Period and User Equilibrium Iteration
(from iteration 6 of speed feedback loop)
Version 2.2 travel model, 2030 modeled year



2005 Estimated/Observed (HPMS) VMT for the Washington, DC MSA

State	Est(000s)	Obs(000s)	Est./Obs.
DC	8,995	8,619	1.04
MD	55,941	56,806	0.98
VA	51,021	50,733	1.01
MSA Total	115,957	116,158	1.00

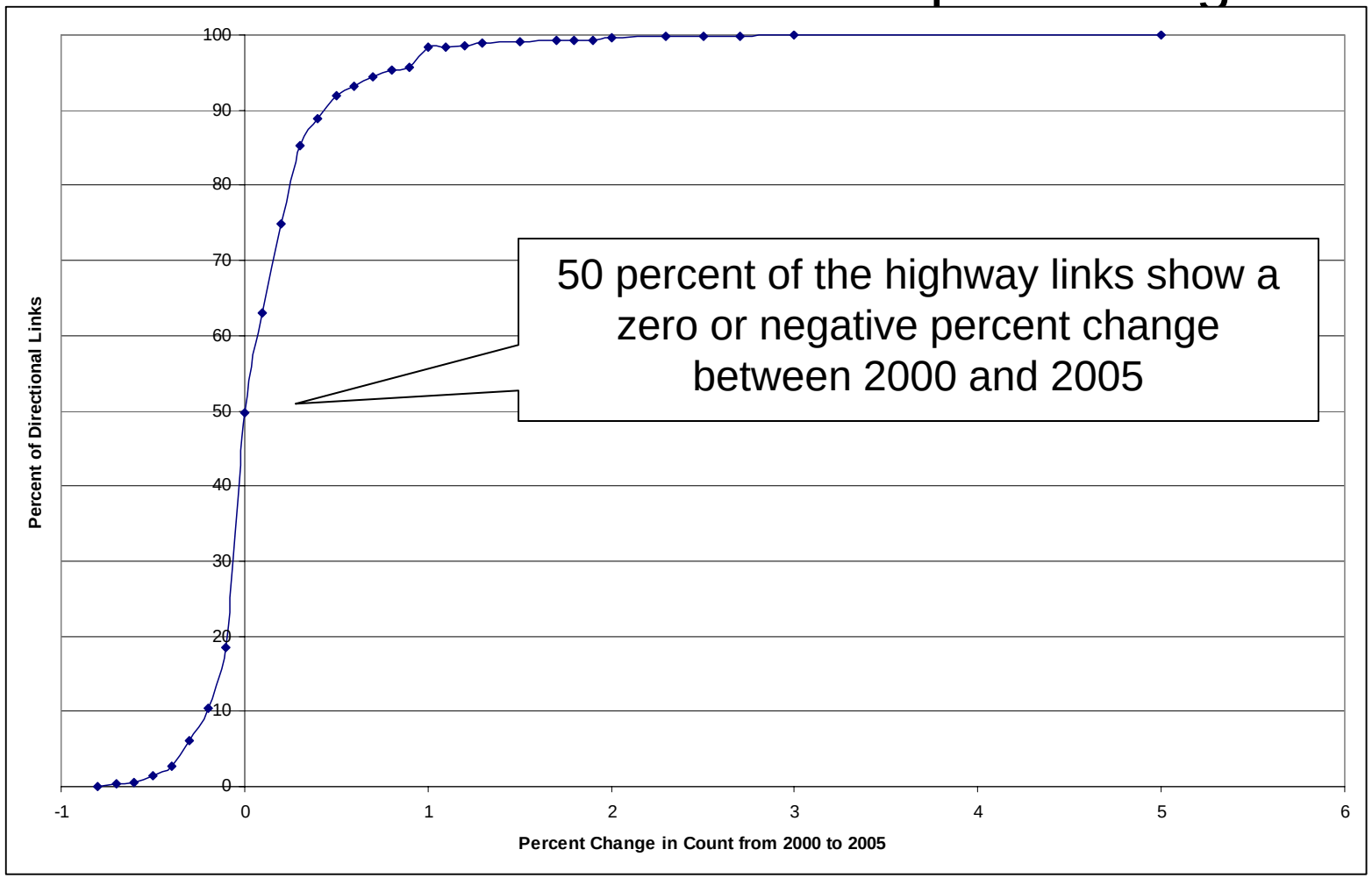
Jurisdictions in the MSA are:
District of Columbia, Montgomery County, Prince George's County,
Arlington County, City of Alexandria, Fairfax County,
Loudoun County, Prince William County, Frederick County,
Charles County, Calvert County, Stafford County

VMT shown excludes local traffic

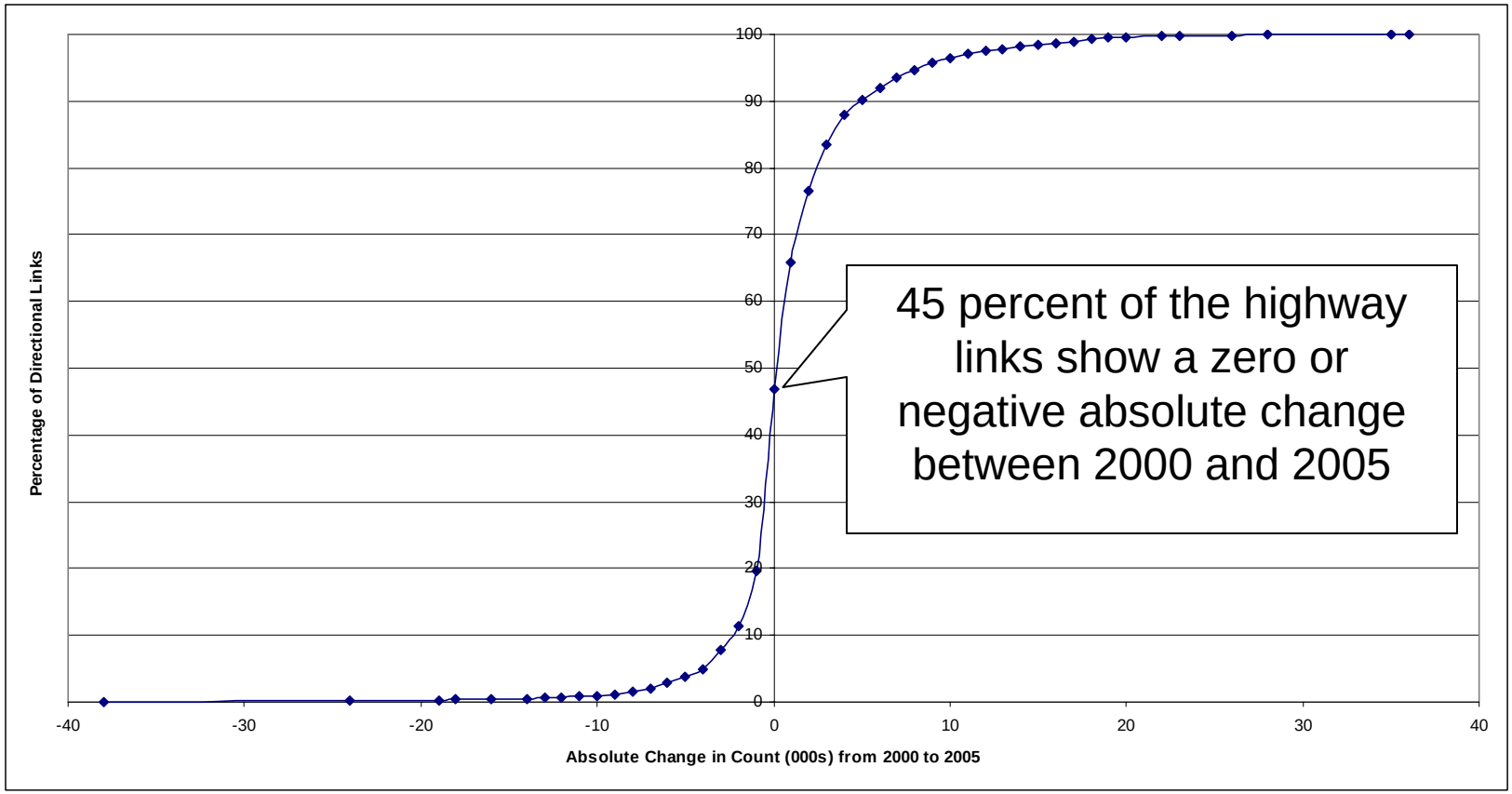
Ground Counts

- Coded in 2 networks: 2000, 2005
- Units: Avg. Annual Weekday Travel (AAWDT)
  - 2000: AAWDT provided by DC, VA; AADT provided by MD and factored by 1.05 to arrive at AAWDT
  - 2005: AAWDT provided by DC, VA, & MD
- Counts coded directionally: AAWDT / 2.0
- Counts coded in thousands (e.g., ’10’ = 10,000)
- Counts are linked to permanent or program counting locations
- The number of directional links with counts:
  - 2000: 3,900 (20%)
  - 2005: 5,600 (28%)
  - No. of links with BOTH 2000 and 2005 counts: 3,400
    (17% of year 2000 highway links and 17% of 2005 highway links)

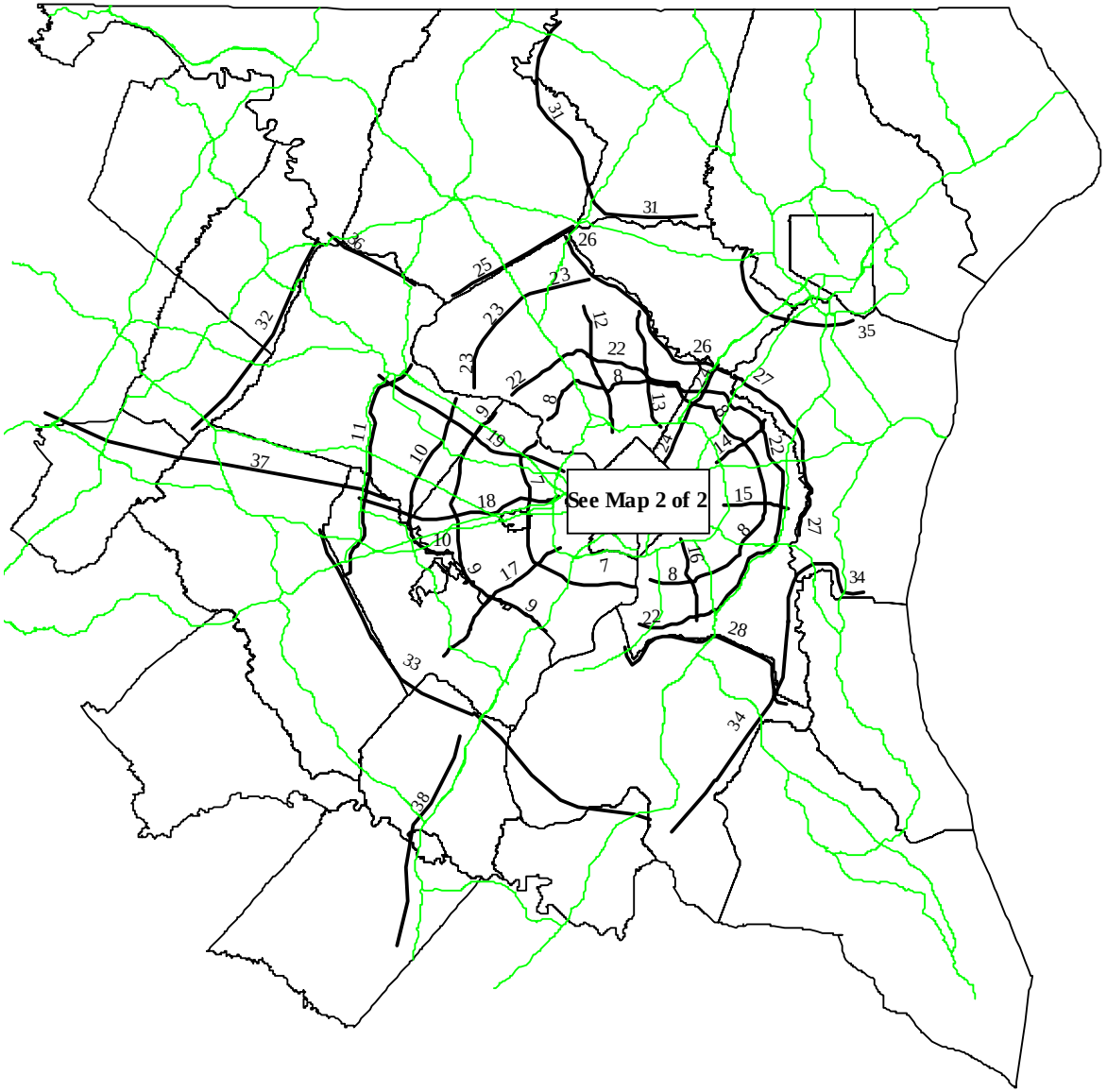
Observation regarding links with both 2000 & 2005 counts (n=3,400): cumulative distribution of pct. change



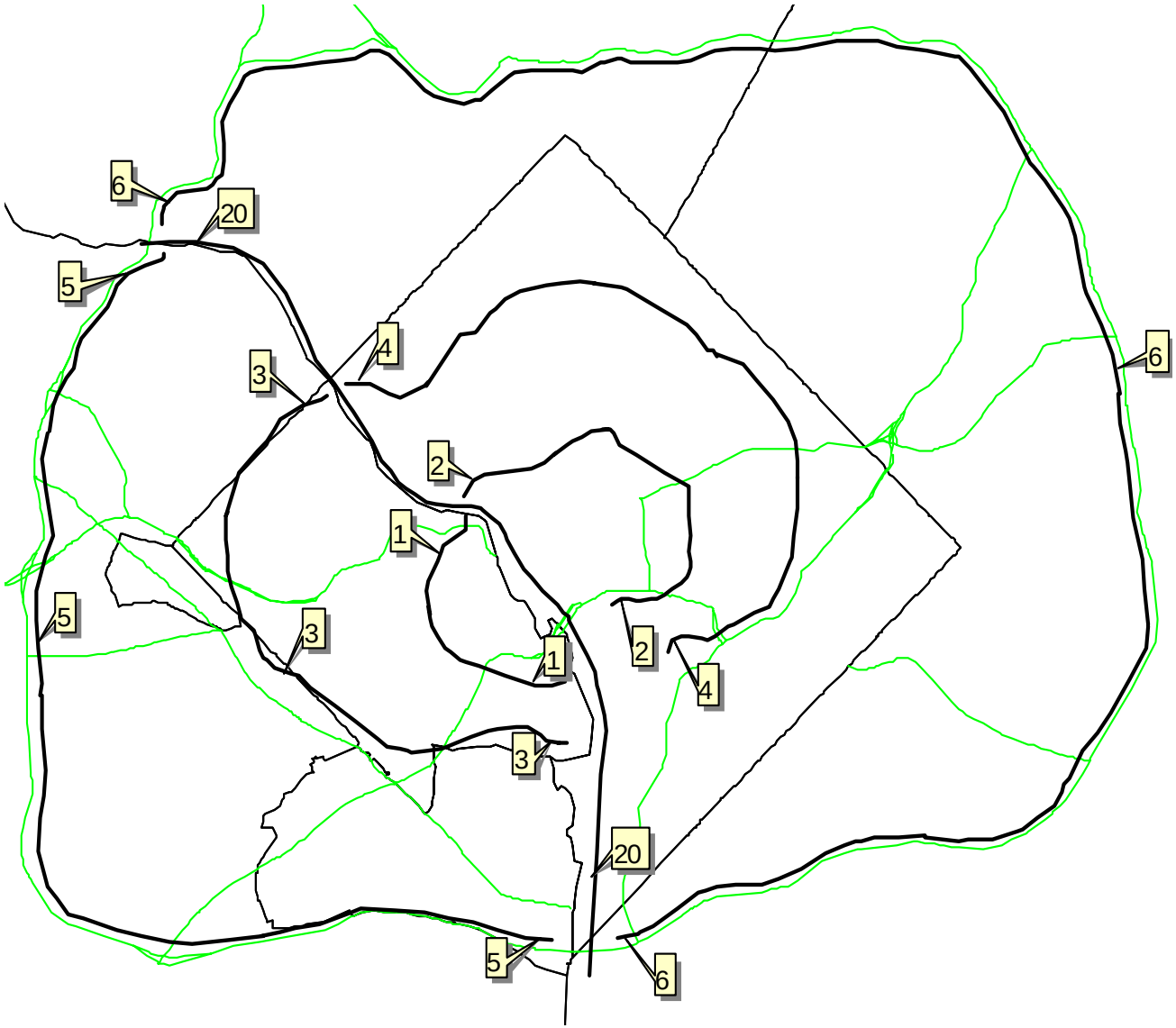
Observation regarding links with both 2000 & 2005 counts (n=3,400): cumulative distribution of absolute change



Screenline Map (1 of 2)



Screenline Map (2 of 2)



Estimated and Observed Daily Screenline Crossings

Crossings are in thousands

	Year 2000						Year 2005					
Screenline No.	Est	Obs	Ratio Est / Obs	No. of links w/ Screenline Code	No. of links w/ Counts	% of links w/ Counts	Est	Obs	Ratio Est / Obs	No. of links w/ Screenline Code	No. of links w/ Counts	% of links w/ Counts
1	570	412	1.38	40	16	40.0%	325	304	1.07	40	18	45.0%
2	637	483	1.32	74	27	36.5%	395	294	1.34	74	14	18.9%
3	646	496	1.30	56	24	42.9%	381	356	1.07	56	22	39.3%
4	851	734	1.16	68	38	55.9%	482	366	1.32	66	22	33.3%
5	1,104	898	1.23	50	40	80.0%	393	378	1.04	52	14	26.9%
6	1,398	1,210	1.16	103	52	50.5%	1,045	992	1.05	100	40	40.0%
7	960	978	0.98	66	48	72.7%	667	720	0.93	66	30	45.5%
8	1,128	870	1.30	108	42	38.9%	522	494	1.06	102	22	21.6%
9	610	566	1.08	44	26	59.1%	687	664	1.03	46	26	56.5%
10	333	278	1.20	20	14	70.0%	77	122	0.63	20	8	40.0%
11	219	188	1.16	18	16	88.9%	6	12	0.50	18	4	22.2%
12	231	290	0.80	32	6	18.8%	235	272	0.86	32	6	18.8%
13	319	302	1.06	18	8	44.4%	234	240	0.98	18	4	22.2%
14	246	246	1.00	16	6	37.5%	188	244	0.77	16	2	12.5%
15	263	282	0.93	12	8	66.7%	173	216	0.80	12	2	16.7%
16	130	142	0.92	16	2	12.5%	135	162	0.83	16	2	12.5%
17	395	354	1.12	28	24	85.7%	84	92	0.91	30	10	33.3%
18	541	440	1.23	35	32	91.4%	248	306	0.81	35	18	51.4%
19	533	490	1.09	42	32	76.2%	396	442	0.90	42	20	47.6%
20	1,020	898	1.14	14	14	100.0%	1,036	958	1.08	14	14	100.0%
22	966	794	1.22	118	36	30.5%	558	558	1.00	118	26	22.0%
23	152	100	1.52	24	8	33.3%	157	140	1.12	24	8	33.3%
24	340	310	1.10	28	8	28.6%	253	296	0.85	28	4	14.3%
25	141	88	1.60	8	8	100.0%	14	10	1.40	8	2	25.0%
26	392	324	1.21	20	14	70.0%	372	318	1.17	20	12	60.0%
27	428	342	1.25	16	14	87.5%	176	154	1.14	16	8	50.0%
28	98	106	0.92	10	4	40.0%	32	28	1.14	10	2	20.0%
31	125	78	1.60	20	16	80.0%	111	72	1.54	20	12	60.0%
32	43	32	1.34	8	4	50.0%	76	40	1.90	8	4	50.0%
33	277	138	2.01	14	14	100.0%	104	80	1.30	14	6	42.9%
34	67	60	1.12	14	10	71.4%	74	84	0.88	14	10	71.4%
35	892	844	1.06	42	36	85.7%	793	854	0.93	42	30	71.4%
36	43	20	2.15	6	4	66.7%	48	24	2.00	6	4	66.7%
37	38	30	1.27	10	8	80.0%	49	38	1.29	10	8	80.0%
38	200	180	1.11	18	16	88.9%	153	168	0.91	18	14	77.8%
Total	**16,336**	**14,003**	**1.17**	**1,216**	**675**	**55.5%**	**10,679**	**10,498**	**1.02**	**1,211**	**448**	**37.0%**

Regional RMSE Performance

Facility Type	2000		2005	
	Pct_RMSE	Lnk_Cnt	Pct_RMSE	Lnk_Cnt
Freeway	27.47	460	21.05	539
Major Arterial	43.99	1,818	42.23	2,376
Minor Arterial	59.74	851	60.59	1,338
Collector	76.53	669	77.45	972
Expressway	52.28	96	34.52	136
Total	**46.3**	**3,894**	**41.13**	**5,361**

Household & Job Forecasts

	2000	2005	2030	05/'00 Ratio	30/05 Ratio
Households	2,143,500	2,357,200	3,200,000	1.10	1.36
Employment	3,441,400	3,709,500	5,156,600	1.08	1.39
HH Population	5,632,000	6,160,500	8,133,600	1.09	1.32
HH & GQ Population	5,748,100	6,294,500	8,282,400	1.10	1.32

Source: Round 7.1 Cooperative Forecasts, 7/28/07
Note: CTPP based employment adjustments have been applied to some non-COG member jurisdictions

HH Demographic Forecasts

	2000	2005	2030	05/'00 Ratio	30/05 Ratio
Inc. Grp 1 HHs	511,200	552,100	756,700	1.08	1.37
Inc. Grp 2 HHs	491,400	538,100	732,600	1.10	1.36
Inc. Grp 3 HHs	590,700	653,800	888,300	1.11	1.36
Inc. Grp 4 HHs	550,200	613,000	821,100	1.11	1.34
1- person HHs	538,000	599,100	872,900	1.11	1.46
2- person HHs	658,200	723,000	985,700	1.10	1.36
3- person HHs	378,200	413,900	546,500	1.09	1.32
4+ person HHs	569,000	621,100	793,600	1.09	1.28
0 Vehicle HHs	204,000	223,600	343,600	1.10	1.54
1 Vehicle HHs	707,200	780,200	1,100,000	1.10	1.41
2 Vehicle HHs	832,300	914,300	1,198,900	1.10	1.31
3+ Vehicle HHs	400,000	439,000	556,200	1.10	1.27
HHs Total	2,143,500	2,357,200	3,200,000	1.10	1.36

Households summed over subgroups may not match the total households shown exactly due to rounding

Based on Round 7.1 Cooperative Forecast

Travel Forecasts by Mode

	2000	2005	2030	05/'00 Ratio	30/05 Ratio
Non-Motorized HBW Trips	171,200	187,600	292,400	1.10	1.56
HBW Auto Driver Trips	3,104,500	3,433,500	4,571,000	1.11	1.33
HBS Auto Driver Trips	2,463,400	2,707,500	3,659,900	1.10	1.35
HBO Auto Driver Trips	7,024,300	7,730,200	10,205,600	1.10	1.32
NHB Auto Driver Trips	4,009,400	4,431,600	5,940,500	1.11	1.34
Total Auto Driver Trips	16,601,600	18,302,800	24,377,100	1.10	1.33
HBW Auto Passenger Trips	389,000	423,300	587,600	1.09	1.39
HBS Auto Passenger Trips	603,500	661,600	828,300	1.10	1.25
HBO Auto Passenger Trips	2,361,600	2,568,700	3,312,500	1.09	1.29
NHB Auto Passenger Trips	1,133,100	1,231,300	1,556,200	1.09	1.26
Total Auto Passenger Trips	4,487,300	4,884,800	6,284,600	1.09	1.29
HBW Auto Occupancies	1.13	1.12	1.13	0.99	1.01
HBS Auto Occupancies	1.25	1.24	1.23	0.99	0.99
HBO Auto Occupancies	1.34	1.33	1.32	0.99	0.99
NHB Auto Occupancies	1.28	1.28	1.26	1.00	0.98
Total Auto Occupancies	1.27	1.27	1.26	1.00	0.99
HBW Transit Trips	548,900	596,200	840,100	1.09	1.41
HBS Transit Trips	48,200	55,500	85,100	1.15	1.53
HBO Transit Trips	231,100	240,300	368,100	1.04	1.53
NHB Transit Trips	145,900	158,900	236,600	1.09	1.49
Total Transit Trips	974,100	1,050,800	1,529,800	1.08	1.46
HBW Transit Percentage	13.58	13.39	14.01	0.99	1.05
HBS Transit Percentage	1.55	1.62	1.86	1.05	1.15
HBO Transit Percentage	2.4	2.28	2.65	0.95	1.16
NHB Transit Percentage	2.76	2.73	3.06	0.99	1.12
Total Transit Percentage	4.42	4.34	4.75	0.98	1.09

Vehicle Trip/VMT Forecasts

	2000	2005	2030	05/'00 Ratio	30/05 Ratio
Households	2,143,500	2,357,200	3,200,000	1.10	1.36
Employment	3,441,400	3,709,500	5,156,600	1.08	1.39
HH Population	5,632,000	6,160,500	8,133,600	1.09	1.32
Total Vehicle Trips	18,866,700	20,757,400	27,732,300	1.10	1.34
Total VMT	144,150,400	152,970,300	198,890,400	1.06	1.30
VMT per Capita	25.08	24.3	24.01	0.97	0.99
VMT per HH	67.25	64.89	62.15	0.96	0.96
VMT per Vehicle Trip	7.64	7.37	7.17	0.96	0.97

Land use source: Round 7.1 Cooperative Forecasts, 7/28/07

Version 2.2 Screenline Summary

Screen No.	2000		2005		2030		05/'00	'30/,05
	Volume	Count	Volume	Count	Volume	Count	Ratio	Ratio
1	784	40	813	40	857	40	1.04	1.05
2	975	74	981	74	1,077	74	1.01	1.10
3	1,017	56	1,044	56	1,068	56	1.03	1.02
4	1,071	68	1,015	66	1,169	70	0.95	1.15
5	1,135	50	1,160	52	1,301	56	1.02	1.12
6	1,839	103	1,733	100	1,965	105	0.94	1.13
7	1,126	66	1,180	66	1,406	68	1.05	1.19
8	1,989	108	1,778	102	2,007	105	0.89	1.13
9	852	44	933	46	1,235	52	1.10	1.32
10	375	20	446	20	721	24	1.19	1.62
11	222	18	261	18	455	20	1.18	1.74
12	511	32	527	32	650	34	1.03	1.23
13	447	18	447	18	604	22	1.00	1.35
14	311	16	307	16	343	16	0.99	1.12
15	273	12	277	12	308	12	1.01	1.11
16	225	16	234	16	296	16	1.04	1.26
17	442	28	460	30	605	30	1.04	1.32
18	647	35	658	35	964	46	1.02	1.47
19	581	42	616	42	869	46	1.06	1.41
20	1,020	14	1,036	14	1,153	18	1.02	1.11
22	1,544	118	1,604	118	1,978	121	1.04	1.23
23	215	24	228	24	321	28	1.06	1.41
24	496	28	501	28	692	28	1.01	1.38
25	141	8	148	8	193	10	1.05	1.30
26	421	20	432	20	559	20	1.03	1.29
27	430	16	448	16	543	16	1.04	1.21
28	145	10	164	10	222	10	1.13	1.35
31	139	20	147	20	205	20	1.06	1.39
32	111	8	122	8	180	8	1.10	1.48
33	277	14	307	14	443	14	1.11	1.44
34	109	14	119	14	149	14	1.09	1.25
35	949	42	974	42	1,202	42	1.03	1.23
36	95	6	102	6	136	6	1.07	1.33
37	40	10	51	10	85	10	1.28	1.67
38	200	18	231	18	351	20	1.16	1.52
Total	**21,154**	**1,216**	**21,484**	**1,211**	**26,312**	**1,277**	**1.02**	**1.22**

Note: Volumes shown are in thousands; Count is the number of directional links that constitute the screenline

Conclusions

- Version 2.2 is now in production
- The Version 2.2 model reflects improved travel forecasting practice as recommended by the TRB review panel in 2004
  - There are fewer adjustments than ever
  - commercial travel market is explicitly addressed
- There are built-in ‘checks’ on link overloading
- Traffic count quality needs to be improved
- Version 2.2 represents ongoing, incremental improvement to TPB’s travel forecasting practice

Looking Ahead: Version 2.3

- Refinements will include:
  - Revised Medium & Heavy Truck Models
    - in progress (Bill Allen)
  - Nested Logit Mode Choice Model Implementation
    - in progress (TPB/AECOM Consult, Inc.)