



Technical Memorandum

Date: May 3, 2018

To: Ryan Niblock
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San Joaquin Council of Governments

From: Lawrence Liao, TJKM

Subject: **Revised Draft Technical Memorandum for VMIP2 TCM 2015 Update**

INTRODUCTION

The objective of the San Joaquin Valley Model Improvement Plan, Phase 2 ("VMIP2") Three-County Model (TCM) 2015 Update project is to create a 2015 base year model to support the development of 2018 regional transportation plans for San Joaquin Council of Governments (SJCOG), Stanislaus Council of Governments (StanCOG), and Merced County Association of Governments (MCAG).

The starting point of the TCM 2015 Update project was the TCM 2008 Model delivered by Fehr and Peers on March 3, 2017. The model development report can be found on StanCOG's website. This TCM_Base08_20170303 Model was a work-in-progress which was not fully calibrated and validated to 2008 conditions. The assumptions and methodologies of the TCM_Base08_20170303 Model and the validation statistics can be found in the following Appendices.

- Appendix A-- SJV MIP - Highway Validation - TCM_SanJoaquin_20170224.pdf
- Appendix B -- SJV MIP - Highway Validation - TCM_Stanslaus_20170224.pdf
- Appendix C -- SJV MIP - Highway Validation - TCM_Merced_20170224.pdf

An initial review was conducted to identify any issues with the input data and model scripts of the TCM_Base08_20170303 Model. After identified issues were addressed in 2008 Model, the calibration/validation efforts were focused on the 2015 Model. The identified issues and 2015 validation performance results are provided below.

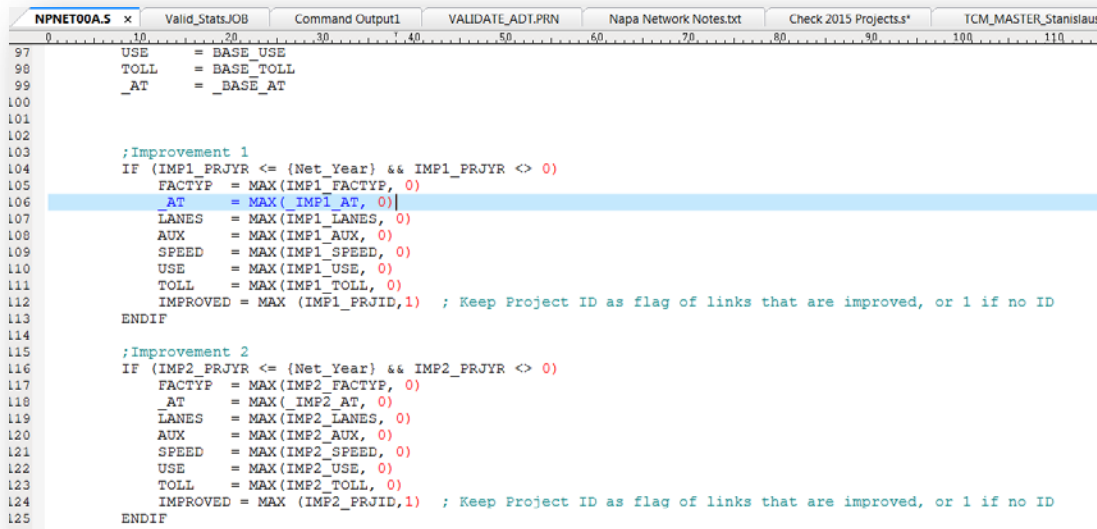
ISSUES IDENTIFIED IN TCM_BASE08_20170303 MODEL

The input data and model scripts were reviewed extensively before model calibration/validation began. Some of the issues identified in the *TCM_Base08_20170303 Model* are described below:

1. Future project links with FACTYP=0 due to scripting and project coding

Based on the current logic in the master network processing script ("NPNET00A.S"), some future project links will have FACTYP=0, when

- IMP2_PRJYR>0 AND IMP2_FACTYP=0



```

NPNET00A.S x Valid_Stats.JOB Command Output1 VALIDATE_ADJ.PRN Napa Network Notes.txt Check 2015 Projects.s* TCM_MASTER_StaniusC
0 10 20 30 40 50 60 70 80 90 100 110
97 USE = BASE_USE
98 TOLL = BASE_TOLL
99 _AT = _BASE_AT
100
101
102
103 ;Improvement 1
104 IF (IMP1_PRJYR <= {Net_Year} && IMP1_PRJYR <> 0)
105 FACTYP = MAX (IMP1_FACTYP, 0)
106 AT = MAX (IMP1_AT, 0)
107 LANES = MAX (IMP1_LANES, 0)
108 AUX = MAX (IMP1_AUX, 0)
109 SPEED = MAX (IMP1_SPEED, 0)
110 USE = MAX (IMP1_USE, 0)
111 TOLL = MAX (IMP1_TOLL, 0)
112 IMPROVED = MAX (IMP1_PRJID,1) ; Keep Project ID as flag of links that are improved, or 1 if no ID
113 ENDIF
114
115 ;Improvement 2
116 IF (IMP2_PRJYR <= {Net_Year} && IMP2_PRJYR <> 0)
117 FACTYP = MAX (IMP2_FACTYP, 0)
118 AT = MAX (IMP2_AT, 0)
119 LANES = MAX (IMP2_LANES, 0)
120 AUX = MAX (IMP2_AUX, 0)
121 SPEED = MAX (IMP2_SPEED, 0)
122 USE = MAX (IMP2_USE, 0)
123 TOLL = MAX (IMP2_TOLL, 0)
124 IMPROVED = MAX (IMP2_PRJID,1) ; Keep Project ID as flag of links that are improved, or 1 if no ID
125 ENDIF

```

Facility Type is a key variable in determining the BPR function parameters for each link, and is used in the vehicle-miles traveled (VMT) classification. This issue was causing problems in future year traffic assignment, as well as classification of VMT by facility type for air quality conformity.

2. VMT Reporting was incorrect because no Airbasin defined in TAZ data

The VMT reporting script assumes Airbasin is in the second field of the TCM08_Base_TAZData.csv file



```
; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Application Manager.
RUN PGM=MATRIX MSG='Intrazonal VMT'
FILEO PRINTO[1] = "{SCENARIO_DIR}\10_Reporting\{Scenario_ShortName}_VMT_Conformity_Intrazonal.CSV"
FILEI ZDATI[1] = "{TAZ_Data}",
Z=#1,Airbasin=#2
FILEI MATI[4] = "{SCENARIO_DIR}\09_ASSIGNMENT\{SCENARIO_SHORTNAME}_VEHTRIPS_MD.mat"
FILEI MATI[1] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_PK_Dl.mat"
FILEI MATI[2] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_OK_Dl.mat"
FILEI MATI[3] = "{SCENARIO_DIR}\09_ASSIGNMENT\{SCENARIO_SHORTNAME}_VEHTRIPS_AM.mat"
FILEI MATI[5] = "{SCENARIO_DIR}\09_ASSIGNMENT\{SCENARIO_SHORTNAME}_VEHTRIPS_PM.mat"
FILEI MATI[6] = "{SCENARIO_DIR}\09_ASSIGNMENT\{SCENARIO_SHORTNAME}_VEHTRIPS_NT.mat"
```

However, the second field in the TAZ data file contains a different data.

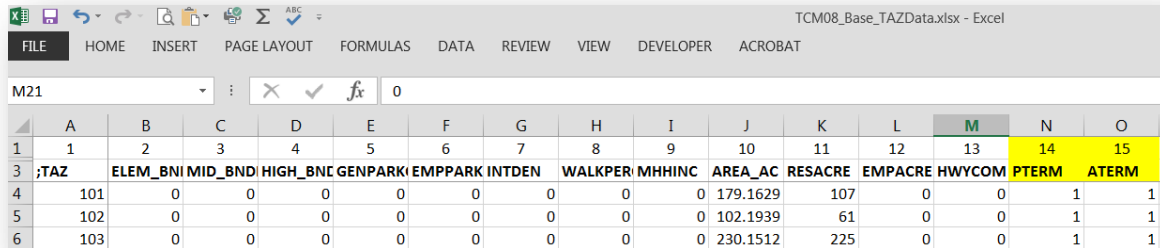
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	;TAZ	ELEM_BNDY	MID_BNDY	HIGH_BNDY	GENPARK	EMPPARK	INTDEN	WALKPER	MHHINC	AREA_AC	RESACRE	EMPACRE	HWYCOM	PTERM
2	101	0	0	0	0	0	0	0	0	179.1629	107	0	0	
3	102	0	0	0	0	0	0	0	0	102.1939	61	0	0	
4	103	0	0	0	0	0	0	0	0	230.1512	225	0	0	
5	104	0	0	0	0	0	0	0	0	164.0724	112	0	0	
6	105	0	0	0	0	0	0	0	0	148.3393	148	0	0	
7	106	0	0	0	0	0	0	0	0	82.30646	81	0	0	

3. Terminal Time variables were referenced incorrectly in various scripts

The scripts assume PTERM and ATERM are in fields #13 and #14, e.g.,

```
STMAT00C.S x
1 ; Do not change filenames or add or remove FILEI/FILEO statements using an editor. Use Cube/Applic
2 RUN PGM=MATRIX
3 FILEO MATO[8] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_OK_TDR.mat",
4 MO=66-76, NAME = IVTT, DRV_P, DRVDIST_P, WLK_P, WLK_A, WLK_X, IWAIT, XWAIT, FARE, BRDS
5 FILEO MATO[7] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_OK_TWR.mat",
6 MO=58-65, NAME = IVTT, WLK_P, WLK_A, WLK_X, IWAIT, XWAIT, FARE, BRDS
7 FILEO MATO[6] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_PK_TDR.mat",
8 MO=47-57, NAME = IVTT, DRV_P, DRVDIST_P, WLK_P, WLK_A, WLK_X, IWAIT, XWAIT, FARE, BRDS
9 FILEO MATO[5] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_PK_TWR.mat",
10 MO=39-46, NAME = IVTT, WLK_P, WLK_A, WLK_X, IWAIT, XWAIT, FARE, BRDS
11
12 FILEI MATI[1] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_PK_S3.mat"
13 FILEI MATI[2] = "{SCENARIO_DIR}\01_SKIMS\{SCENARIO_SHORTNAME}_SKM_OK_S3.mat"
14 ;TAZ detail
15 FILEI DBI[1] = "{TAZ_DATA}",
16 AUTOARRAY=ALLFIELDS
17 FILEI ZDATI[1] = "{TAZ_DATA}",
18
19 Z=#1,
20 ELEM_BNDRY=#2,
21 MID_BNDRY=#3,
22 HIGH_BNDRY=#4,
23 PARKINGCOST=#5,
24 SHORTWALK=#6,
25 MEDWALK=#7,
26 LONGWALK=#8,
27 MHHINC=#9,
28 RESACRE=#10,
29 EMPACRE=#11,
30 HWYCOM=#12,
31 PTERM=#13,
32 ATERM=#14,
33 PKFREQ=#15,
34 OPFREQ=#16
```

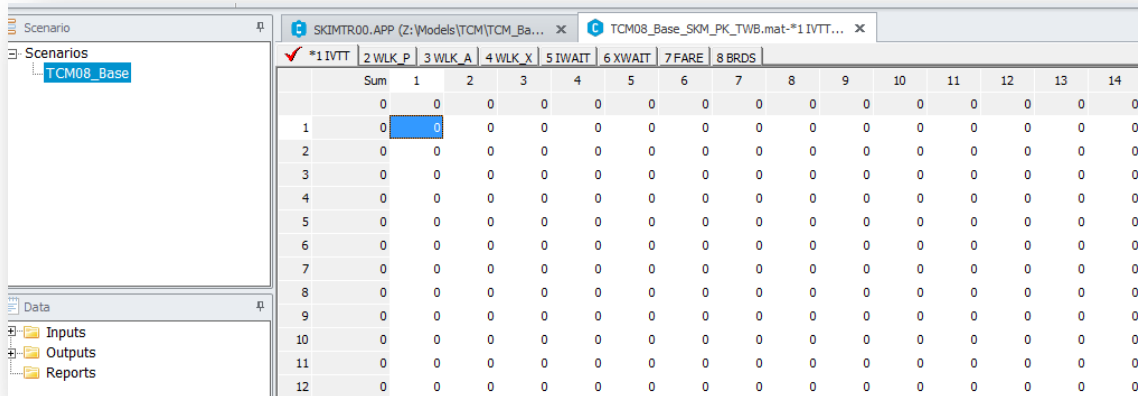
But, they are in fields #14 and #15, respectively.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
3	;TAZ	ELEM_BNI	MID_BND	HIGH_BNE	GENPARK	EMP	PARK	INTDEN	WALKPER	MHHINC	AREA_AC	RESACRE	EMPACRE	HWYCOM	PTERM	ATERM
4	101	0	0	0	0	0	0	0	0	0	179.1629	107	0	0	1	1
5	102	0	0	0	0	0	0	0	0	0	102.1939	61	0	0	1	1
6	103	0	0	0	0	0	0	0	0	0	230.1512	225	0	0	1	1

4. Transit skimming scripting error for BUS only mode

The BUS only mode has zero In-Vehicle Travel Time due to a scripting error.



	Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

All the issues identified in the input data and mode scripts have been addressed in the VMIP2 TCM 2015 update, accordingly.

2015 MODEL CALIBRATION/VALIDATION

No assumptions nor methodologies in the original VMIP2 TCM development were modified in this project. The main goal of the 2015 model update effort was to calibrate the model VMT to the 2015 HMPS VMT by resolving the issues found in input data and scripting. The 2015 model has been validated up to the Mode Choice step, currently.

The 2008 non-highway validation workbooks were updated for 2015 model calibration and validation. Each non-highway validation workbook includes the following checks:



- Vehicle availability was validated using Census vehicle ownership cross-classified by household size and income.
- Trip generation was validated for trip productions, attractions, and trip balancing.
 - Trip production: A comparison of model total trips by purpose and observed totals from the expanded 2012 CHTS data. A secondary comparison, if needed, can be HBW trips from more aggregate sources such as the CTPP or NHTS. These sources are used with caution since they report 'usual' workplace locations and are not directly comparable to model generated workplace locations. Convert person trip rates to ITE rates using Ave Veh Occ by purpose.
 - Trip attraction: Compare HBW attractions to total jobs in zone, range of 1.2-1.5 HBW attractions per employee in zone (source TFResource.org)
 - Trip balancing: PA totals within +/-10% of totals and totals by purpose
- For trip distribution models: The gravity model and any associated friction factors (k-factors) were calibrated iteratively to match average trip lengths by purpose and trip length frequencies by purpose are compared with the household travel survey. As a secondary method, the model volumes are compared to observed traffic volumes or observed survey data of vehicle volumes.
- For mode choice models, observed transit ridership (when available) can be compared against trip tables and the model mode shares for validation. As a secondary method, the mode shares, developed by pooling all SJV households is compared to the local mode shares observed in the CHTS.

The 2015 non-highway validation summaries and highlights can be found in the next section.

For Trip Generation, the average person trips per household was compared to the target from 2012 CHTS for each county. The 2015 average person trips per household are consistent with the 2008 model results. For example, the 2015 average person trips per household for SJCOG is 8.9 compared to 9.0 in the TCM_Base08_20170303 Model.

The 2015 average person trips per household for each county is shown below:

Table 12-1.3:
Weekday Person Trips per Household (SJCOG)

CHTS	Model
11.0	8.9

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P

Table 12-1.3:
Weekday Person Trips per Household (STANCOG)

CHTS	Model
10.6	7.4

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P

Table 12-1.3:
Weekday Person Trips per Household (MCAG)

CHTS	Model
11.1	7.9

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P



The Trip Distribution validation improved significantly compared to the TCM_Base08_20170303 Model. For example, the following graphic shows a comparison of SJCOG Trip Distribution results between TCM_Base08_20170303 and 2015 models.

Table 12-5.1: Trip Distribution - By Purpose (TCM)

Trip Type	Total		HBW		HBO		NHB	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
II	87%	96%	74%	89%	90%	97%	89%	98%
IX	8%	2%	18%	6%	7%	1%	6%	2%
XI	4%	2%	8%	5%	3%	2%	5%	1%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes.

Table 12.3-6a: Trip Distribution - By Purpose (STANCOG)

Trip Type	Total		HBW		HBO		NHB	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
II	84%	86%	70%	74%	86%	88%	89%	88%
IX	8%	9%	17%	19%	6%	8%	6%	6%
XI	8%	5%	13%	7%	8%	4%	5%	6%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes.

The Trip Distribution validation results for StanCOG and MCAG are shown below:

Table 12.3-6a: Trip Distribution - By Purpose (STANCOG)

Trip Type	Total		HBW		HBO		NHB	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
II	84%	86%	70%	74%	86%	88%	89%	88%
IX	8%	9%	17%	19%	6%	8%	6%	6%
XI	8%	5%	13%	7%	8%	4%	5%	6%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes.



**Table 12-5.1:
Trip Distribution - By Purpose (MCAG)**

Trip Type	Trip Purpose							
	Total		HBW		HBO		NHB	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
II	83%	86%	73%	74%	83%	88%	86%	88%
IX	9%	9%	13%	19%	9%	8%	6%	6%
XI	9%	5%	14%	7%	7%	4%	8%	6%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes.

The mode share validation, especially for Walk, improved significantly compared to the TCM_Base08_20170303 Model. For example, the following graphic shows a comparison of SJCOG mode choice by purpose results between TCM_Base08_20170303 and 2015 models.

TABLE 12-2.2
MODE SPLIT BY PURPOSE (SJCOG)

Purpose	Total (All Modes)		Drove Alone		Shared Ride 2		Shared Ride 3+		Transit		Walk		Bike		Other	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
HBW	13%	13%	76%	79%	16%	17%	2%	2%	1.1%	0.8%	3.6%	0.5%	2.0%	0.5%	0%	0%
HBO	55%	56%	29%	38%	23%	25%	35%	30%	1.4%	2.6%	11.1%	3.2%	0.7%	0.5%	1%	1%
NHB	32%	31%	32%	35%	27%	28%	36%	34%	1.2%	0.7%	3.3%	1.3%	0.2%	0.1%	0%	0%
Total (All Purposes)	100%	100%	35.8%	42%	23.3%	25%	30.9%	28%	1.3%	1.8%	7.6%	2.3%	0.7%	0.4%	0.4%	0%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes. School bus trips are categorized as Other.

SJCOG_15ValidationSummary_V3_010618.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER ACROBAT

2

A B C D E F G H I J K L M N O P Q

TABLE 12-2.2
MODE SPLIT BY PURPOSE (STANCOG)

Purpose	Total (All Modes)		Drove Alone		Shared Ride 2		Shared Ride 3+		Transit		Walk		Bike		Other	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
HBW	13%	13%	76%	76%	16%	17%	2%	1%	1.1%	0.3%	3.6%	6.3%	2.0%	0.7%	0%	0%
HBO	55%	56%	29%	33%	23%	20%	35%	26%	1.4%	3.7%	11.1%	13.4%	0.7%	1.8%	1%	2%
NHB	32%	31%	32%	31%	27%	22%	36%	45%	1.2%	0.1%	3.3%	1.1%	0.2%	0.3%	0%	0%
Total (All Purposes)	100%	100%	35.8%	38%	23.3%	20%	30.9%	28%	1.3%	2.2%	7.6%	8.7%	0.7%	1.2%	0.4%	1%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes. School bus trips are categorized as Other.

The mode share validation results for StanCOG and MCAG are shown below:

TABLE 12-2.2
MODE SPLIT BY PURPOSE (STANCOG)

Purpose	Total (All Modes)		Drove Alone		Shared Ride 2		Shared Ride 3+		Transit		Walk		Bike		Other	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
HBW	13%	13%	85%	76%	6%	17%	2%	1%	1%	0%	3%	6%	2%	1%	2%	0%
HBO	59%	56%	29%	33%	32%	20%	21%	26%	2%	4%	14%	13%	1%	2%	1%	2%
NHB	28%	31%	42%	31%	24%	22%	26%	45%	2%	0%	6%	1%	0%	0%	0%	0%
Total (All Purposes)	100%	100%	40%	38%	27%	20%	20%	28%	2%	2%	10%	9%	1%	1%	1%	1%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes. School bus trips are categorized as Other.



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**TABLE 12-2.2
MODE SPLIT BY PURPOSE (MCAG)**

Purpose	Total (All Modes)		Drove Alone		Shared Ride 2		Shared Ride 3+		Transit		Walk		Bike		Other	
	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model	CHTS	Model
HBW	11%	13%	73%	75%	10%	17%	11%	1%	0%	0%	2%	6%	5%	1%	0%	0%
HBO	57%	56%	26%	33%	23%	20%	29%	26%	2%	4%	16%	14%	1%	2%	3%	2%
NHB	32%	31%	29%	31%	35%	22%	27%	45%	1%	0%	6%	1%	0%	0%	1%	0%
Total (All Purposes)	100%	100%	32%	38%	26%	20%	27%	29%	1%	2%	11%	9%	1%	1%	2%	1%

Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes. School bus trips are categorized as Other.

The Caltrans 2015 HPMS VMT used as the validation target is shown below:

**Table 9
2015 Miles, Lane-Miles and Daily Vehicle Miles of Travel
by Metropolitan Planning Organization**

MPO	Miles	Lane Miles	DVMT (thousands)
AMBAG	4760.944	10094.899	17043.974
BCAG	2288.685	4705.555	4694.765
COFCG	6673.775	14501.996	22557.334
KCOG	9600.957	20490.576	23614.006
MCAG	2960.573	6261.485	7811.404
MTC	23834.892	53601.363	171971.015
SAAG	3081.396	6565.27	11373.869
SACOG	12665.264	27763.021	59277.155
SANDAG	9903.251	23676.373	77951.052
SBCAG	2187.052	4868.194	9801.497
SCAG	66586.882	155925.191	441962.059
SJCOG	3613.417	8043.247	17991.591
SLOCOG	2618.787	5523.65	8311.4
SRTA	3542.845	7370.764	5260.266
TCAG	4903.197	10131.259	10100.162
TMPO	518.461	1058.393	961.852
Not in any MPO	36093.013	73996.182	40393.436
STATEWIDE TOTAL	195,833.39	434,577.42	931,076.84

Note: StanCOG was referred to as SAAG (Stanislaus Area Association of Governments) in the HPMS table

The 2015 VMT validation results for all three counties are shown below:

Table 12.3-6a:
Trip Assignment – 2015 VMT vs Model (SJCOG)

Evaluation n Criterion	2015 HPMS	Model	% Deviation	XX % of VMT
+3%	17,991,591	17,843,263	-1%	9%

Notes: Daily Vehicle Miles Traveled. Highway Performance Management System – 2015 California Public Road Data, Table 9.

Table 12.3-6a:
Trip Assignment – 2015 VMT vs Model (STANCOG)

Evaluation n Criterion	HPMS	Model	% Deviation	XX % of VMT
+3%	11,373,869	10,979,189	-3%	14%

Notes: Daily Vehicle Miles Traveled. Highway Performance Management System – 2015 California Public Road Data, Table 9

Table 12.3-6a:
Trip Assignment – 2015 VMT vs Model (MCAG)

Evaluation n Criterion	HPMS	Model	% Deviation	XX % of VMT
+3%	7,811,404	7,727,533	-1%	20%

Notes: Daily Vehicle Miles Traveled. Highway Performance Management System – 2015 California Public Road Data, Table 9.

As presented, the static validation for 2015 Trip Generation, Trip Distribution and Mode Choice models have all improved significantly compared to the previous 2008 model validation results. And, the 2015 model VMT for all three counties are within 3% of the 2015 HMPS VMT.



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