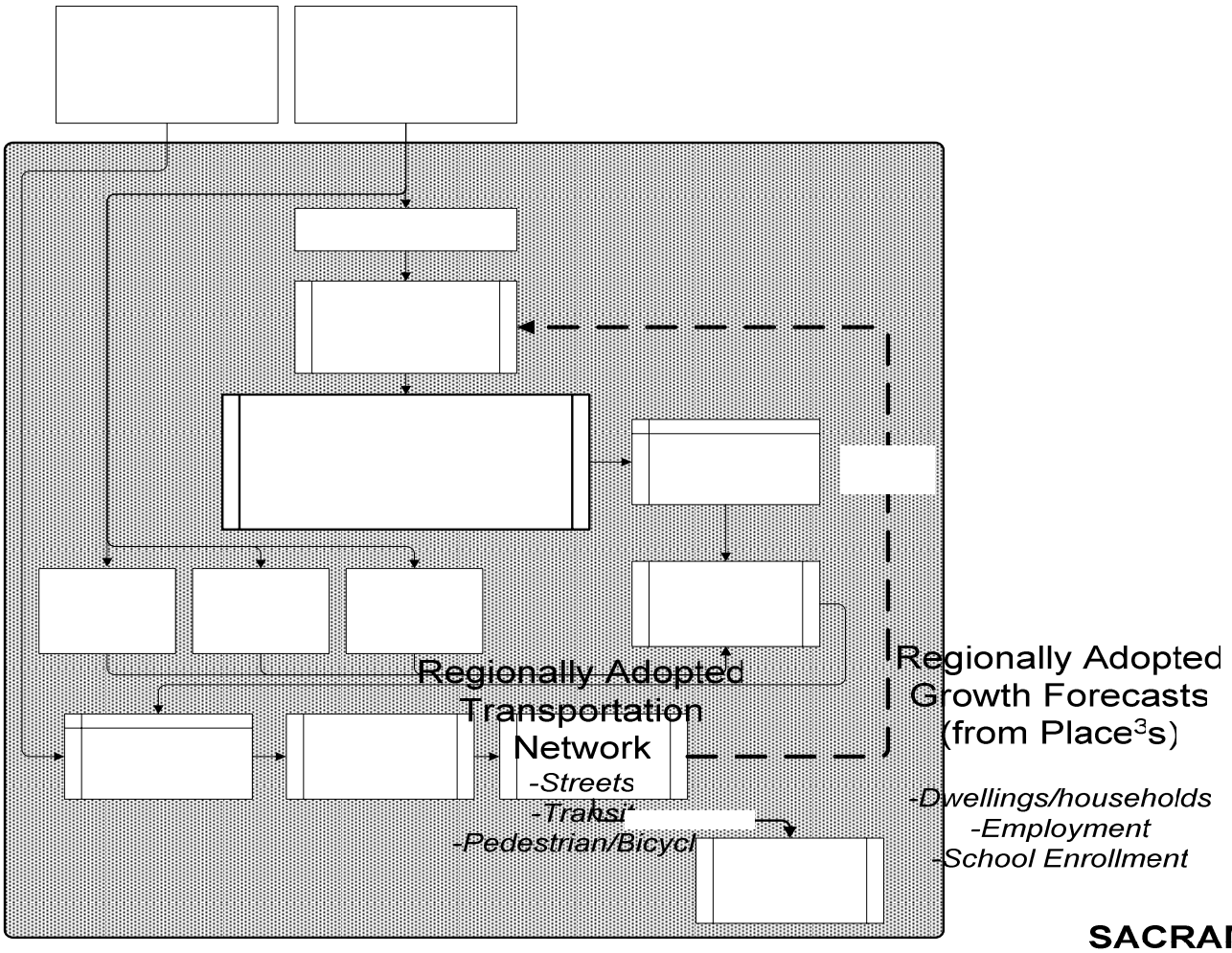
APPENDIX H - TRANSPORTATION

SACSIM Overview

The travel demand model used in the preparation of the MTP analysis is the latest regional model, known as the Sacramento Regional Travel Simulation Model (SACSIM)[1]. Figure 1 shows the major components of the model. This model is fundamentally different from past models in that household travel is modeled from a set of activities undertaken by the household that require travel, and implemented at the parcel level rather than the traditional zone level.

Figure 1. Sacramento Regional Travel Simulation Model



Source: SACOG, May 2007.

[1] The "simulation" should not be confused with a traffic operations simulation. The simulation is of the activities and travel behavior of a population database of individual persons (or "synthetic" population), fully consistent with the regionally adopted growth forecasts and Blueprint land use vision.

The major components from Figure 1 are summarized below.

A population synthesizer (PopSyn) creates a population database which is used later in the model. The database is comprised of person record, drawn from actual Census PUMS households from the Sacramento Region. The population dataset is consistent with regional residential, employment and school enrollment forecasts in quantity, location, and key demographic variables like age and income. Population datasets are generated for each forecast land use alternative, and are treated as inputs files for testing transportation network alternatives. The population dataset can be directly modified (e.g. changing locations of specific households, changing income or age characteristics, etc.) to test the effects of different land use forecasts or demographic trend assumptions.

Long term choices (work location, school location and auto ownership) are simulated for all members of the population. The Person Day Activity and Travel Simulator (DaySim) creates a one-day activity and travel schedule for each person in the population, including a list of their tours and the trips on each tour.

The trips predicted by DaySim are aggregated into trip matrices and combined with predicted trips for airport passenger ground access, external trips and commercial traffic into time- and mode-specific trip matrices. The network traffic assignment models load the trips onto the network.

The model iterates until convergence is achieved. Convergence is defined as a model's internal consistency of major data items (i.e. trip tables, traffic volumes, and level-of-service matrices) used throughout the model process. The feedback process that maindates this convergence step is required by Federal regulations for transportation and air quality planning.

As shown here, the regional population and employment forecasts, as well as future transportation networks, are treated as exogenous inputs. Currently, these land use forecasts datasets are generated as scenarios within the Place^{3}s land use model. Place^{3}s builds up the regional forecast datasets from parcel-level land use data. For each forecast year, regional control totals are established by SACOG Board-adopted growth allocations and demographic trend assumptions[2,3].

[2] The SACOG Board adopted Year 2005 to Year 2035 growth allocations in September 2007 for use in updating the region's Metropolitan Transportation Plan.

[3] The SACOG Board adopted long range economic and demographic forecasts in September 2005 for use in regional transportation planning.

SACSIM Land Use Data

SACSIM was developed and estimated using parcel/point[4] land use input data rather than aggregating data to Travel Analysis Zones (TAZs). It is the first regional travel demand model which uses this level of input data. The parcel-level land use data, combined with the population synthesis approach, provides an unprecedented level of model sensitivity and detail regarding representation of land use and its effects on travel behavior. The model was designed and developed with the full intention of capturing land use and transportation inter-relationships which are masked or missed altogether in models based on traffic analysis zones (TAZ's).

Some unique variables included in SACSIM at parcel or point level are:

- Households and population
- Employment by sector (retail, office, manufacturing, medical, service, government, etc.)
- K – 12 school enrollment
- University enrollment
- Street pattern / connectivity
- Distance to nearest transit station/stop
- Number of paid, off-street parking spaces

These variables are utilized in SACSIM as parcel/point values (i.e. quantity and type of use on that parcel). The variables are also utilized as "buffered" parcel/point values (e.g. the quantity and type of a use within ¼ or ½ mile of a parcel).

SACSIM Comparison to SACMET

SACMET (Sacramento Regional Transportation Demand Model) is the so-called "4-step", TAZ-based travel demand model developed by SACOG in 1994, and used for metropolitan transportation planning and analysis since that date. SACMET has been used for several Metropolitan Transportation Plan (MTP) updates, New Starts rail project evaluations, and major corridor studies. Additionally, cities and counties within the SACOG region have based their local travel demand models to a large extent on SACMET.

Key differences are:

- Level of detail in land use input data
    - SACSIM = parcel level (650,000 parcels, average size = 0.8 acres)
    - SACMET = zones (1528 zones, median zone size = 390 acres)

[4] Parcels (which include an outline of a specific property) are converted to "points" for use in SACSIM, with one point per parcel, for computational efficiency.

- Representation of proximity of land uses
    - SACSIM = parcel-to-parcel distances;
    - SACMET = zone-to-zone averages for all parcels within a zone
- Demographic variables for input data
    - SACSIM includes household size, age, income, gender, employment status, education status, at person level.
    - SACMET includes a cross-classification of households by # persons, # workers, and income class at zone level
- Treatment of travel
    - In SACSIM, travel is treated as an outcome of activities (work, school, shopping, etc.). Activity patterns are generated at person-level, with all activities internally consistent (e.g. if someone takes transit to work, they take transit home, etc.). Shifts in time of travel
    - In SACMET, travel is equivalent with trips, and trips are generated directly by land uses by zone. There is no guarantee of internal consistency.
- Level of detail on model output data
    - SACSIM allows for isolation of all travel generated by households in a given area, regardless of where that travel occurs. Travel characteristics can be correlated to area types, and the effects of demographics (e.g. household size, income, etc.) explicitly controlled.
    - SACMET allows for isolation only of number of trips generated by zones, without reference to who generates the travel (e.g. trips from a particular zone might be generated by residents, employees, or both, with no means of identifying the actual "source" of the travel).

Validation of SACSIM Model

The long term models, tour frequency, time-of-travel and vehicle assignment models of SACSIM have been validated against the best observed data sources. Table 1 provides a partial reporting of current validation statistics for the SACMET travel demand model, and comparable statistics for the SACSIM model. Note that the reported validation statistics for SACSIM are drafts, and that final model calibration and validation is still being performed.

In terms of overall validation on measures which can be directly compared between the two models, SACSIM outperforms SACMET on the following:

- *Daily vehicle miles of travel.* SACSIM is 3 percent high compared to observed HPMS data, SACMET is 9 percent low.
- Auto ownership. SACSIM error on prediction of zero-auto households is significantly less than SACMET (38 percent, compared to 61 percent). Total

zero-auto households are predicted almost exactly by SACSIM, compared to 11 percent high by SACMET.

- Worker flows (i.e. the number of workers with residence in regional analysis district (RAD) “A” and place of work in RAD “B” for all non-zero RAD pairs) are marginally better predicted by SACSIM.
- Highway link assignment (i.e. daily and time-period vehicle volumes on specific roadway links) are comparably predicted by both models. SACSIM link error measured by root mean squared error (RMSE) is marginally higher (34 percent, compared to 33 percent for SACMET).

Table 1. Key Validation Statistics, SACMET and SACSIM Travel Models

Validation Variable	SACMET	SACSIM
Auto Ownership (vs. Census)/1/		
Number of Zero-Auto Households Per RAD (Model/Census Ratio)	1.11	1.00
(RMSE) /5/	61%	38%
Worker Flows (RAD to RAD, vs. Census)/2/		
Adj. R-squared	0.93	0.96
Beta	0.97	1.04
Highway Assignment (vs. Yr.2000 Counts)/3/		
Daily Link Volumes (Model/Count Ratio)	0.97	0.94
(RMSE)	33%	34%
AM Peak Period--3 hours (Model/Count Ratio)	0.97	0.91
(RMSE)	33%	36%
PM Peak Period--3 hours (Model/Count Ratio)	0.99	1.11
(RMSE)	25%	34%
Midday Period--5 hours (Model/Count Ratio)	0.91	0.91
(RMSE)	24%	31%
Evening/Early AM Period--13 hours (Model/Count Ratio)	0.77	0.92
(RMSE)	38%	34%
Total Weekday Vehicle Miles of Travel (vs. 2005 HPMS Data) /4/		
Total Weekday VMT (millions)	48.4	54.7
Validation Ratio (Model / HPMS)	0.91	1.03

Source: SACOG, May 2007.

Notes:

/1/ US Census Bureau, Census Transportation Planning Package Data.

/2/ US Census Bureau, Journey-to-Work Data.

/3/ Traffic counts collected by Caltrans, cities and counties. Data assembled by SACOG.

/4/ 2005 California Public Road Data, derived from Highway Performance Monitoring System.

/5/ RMSE = root mean squared error. Key measure of total error.

Figures 2 and 3 provide some validation illustrations which are possible to produce with SACSIM, but not for SACMET, due to the nature of the model outputs. These figures compared SACSIM model output to information on travel behavior from the *Year 2000 Household Travel Survey*[5]. The comparisons to the Household Travel Survey were prepared in order to validate the sensitivity and reasonable-ness of SACSIM in predicting differences in travel behavior correlated to land use characteristics at a persons place of residence.

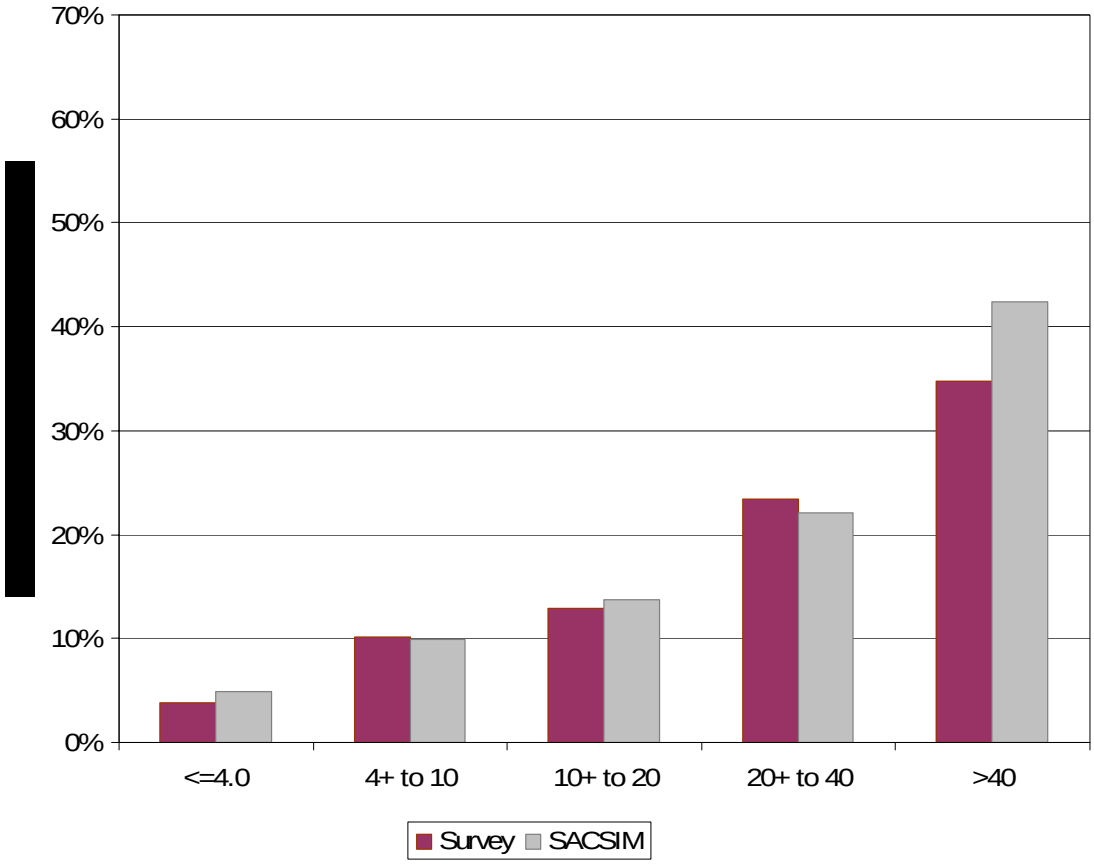
Figure 2 shows the relationship between mode of travel and density at place of residence. The survey data show the expected relationship, with propensity for non-auto travel means (i.e. walking, bicycling, or walking to transit) increasing as the density at place of residence increases. SACSIM captures this correlation. At the lowest density range (less than 4 jobs+dwellings per acre at place of residence) non-auto trips make up less than 5 percent of all trips. For households residing in areas with 40 or more jobs+dwellings per acre at place of residence, non-auto trips make up more than 30 percent of all trips.

Figure 3 shows a similar relationship between vehicle miles of travel and density at place of residence. The survey data show that as density at place of residence increases, the vehicle mileage generated by a household decreases sharply. Households at the lowest density range (less than 4 jobs+dwellings per acre) generate more than 50 vehicle miles of travel per weekday. Households in areas with 40 or more jobs+dwellings per acre generate 10 vehicle miles or less per day.

[5] This survey was conducted by SACOG in Year 2000. Results are reported in "2000 Sacramento Area Household Travel Survey" (NuStats, November 2000) and "Pre-Census Travel Behavior Report: Analysis of the 2000 SACOG Household Travel Survey" (DKS Associates, July 2001). SACOG has prepared a "post-Census" analysis of the survey, which has not yet been documented; this post-Census analysis re-weighted/expanded the Household Survey to match key Census control totals by county within the SACOG region. All figures in this Appendix are based on the "post-Census" weighting of the Household Survey.

Figure 2. Propensity for Non-Auto Travel and Density at Place of Residence

Year 2000 Household Travel Survey and SACSIM Model Output



Source: SACOG, May 2007.

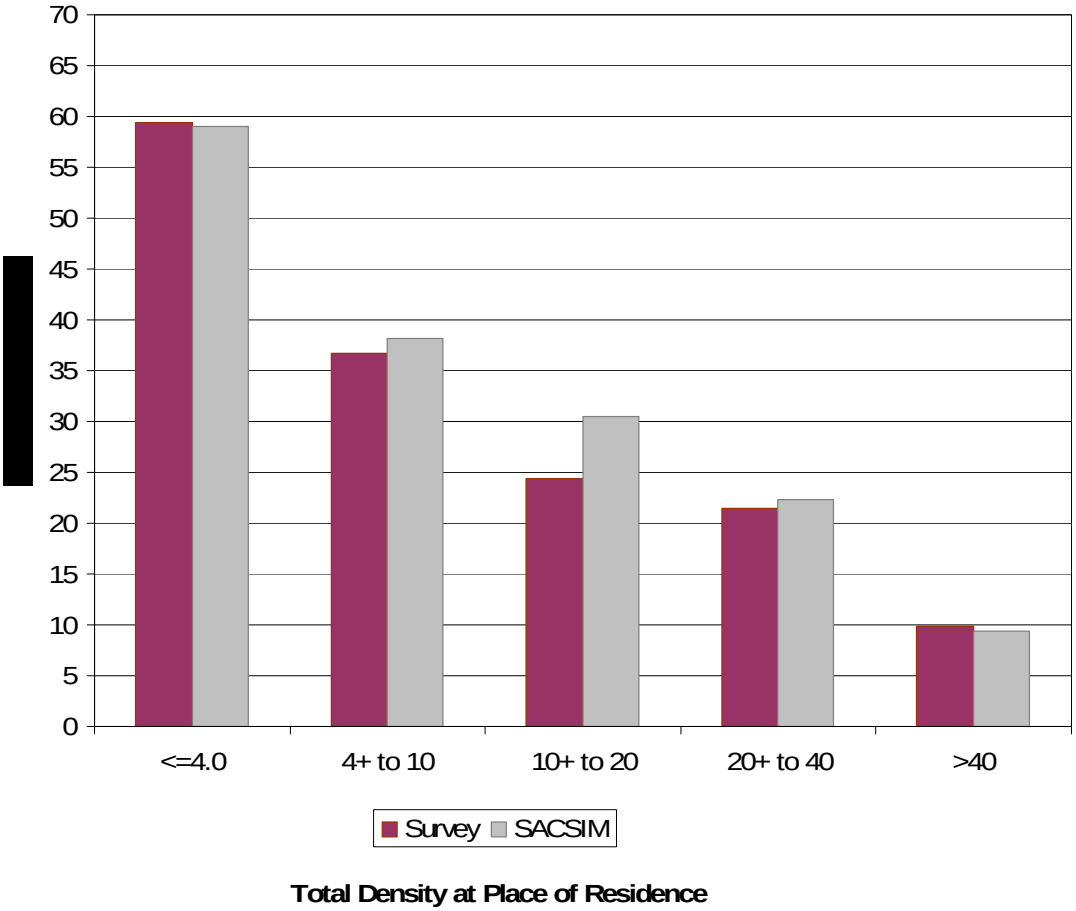
Notes:

/1/ "Total Density at Place of Residence" = (Jobs w/in ¼ mi + Dwellings w/in ¼ mi) / Acres w/in ¼ mi.

/2/ "% of Trips by Bike, Walk or Transit" = all trips not requiring private automobile. Transit includes only walk-access (i.e. no park-and-ride or kiss-and-ride). Includes all trips by residents of households, even those not based from the household.

Figure 3. VMT per Household and Density at Place of Residence

Year 2000 Household Travel Survey and SACSIM Model Output



Source: SACOG, May 2007.

Notes:

/1/ "Total Density at Place of Residence" = (Jobs w/in ¼ mi + Dwellings w/in ¼ mi) / Acres w/in ¼ mi.

/2/ "VMT Per Household" = estimate of total miles of vehicle travel by all household members for an average weekday, based on density range at the place of residence.