APPENDIX A
Modeling Approach

Overview

Improvement strategies considered in the CSMP were modeled with a combination of travel demand forecasting models and a hybrid simulation model as illustrated in the diagram in **Figure 1**. The travel demand models maintained in TransCAD by the Santa Barbara Council of Associated Governments (SBCAG) and the Ventura County Transportation Commission (VCTC) were used to produce estimates of vehicular travel patterns for the AM and PM peak periods. These travel patterns were used as input to the hybrid simulation model. The travel demand models were used to produce inputs for 2008 and for two forecast years: the expected opening year for the CMIA project on US-101 (2013) and ten years after the expected opening year (2023). The travel demand model produces estimates of flows between origin-destination pairs and the volume on links in the network based on existing and projected socioeconomic and land use data. The travel demand models were used to assess any mode shifts that resulted from the improvement strategies as well as any route-choice changes to or from parallel arterials not covered in the hybrid simulation model.

Travel Demand Forecasting

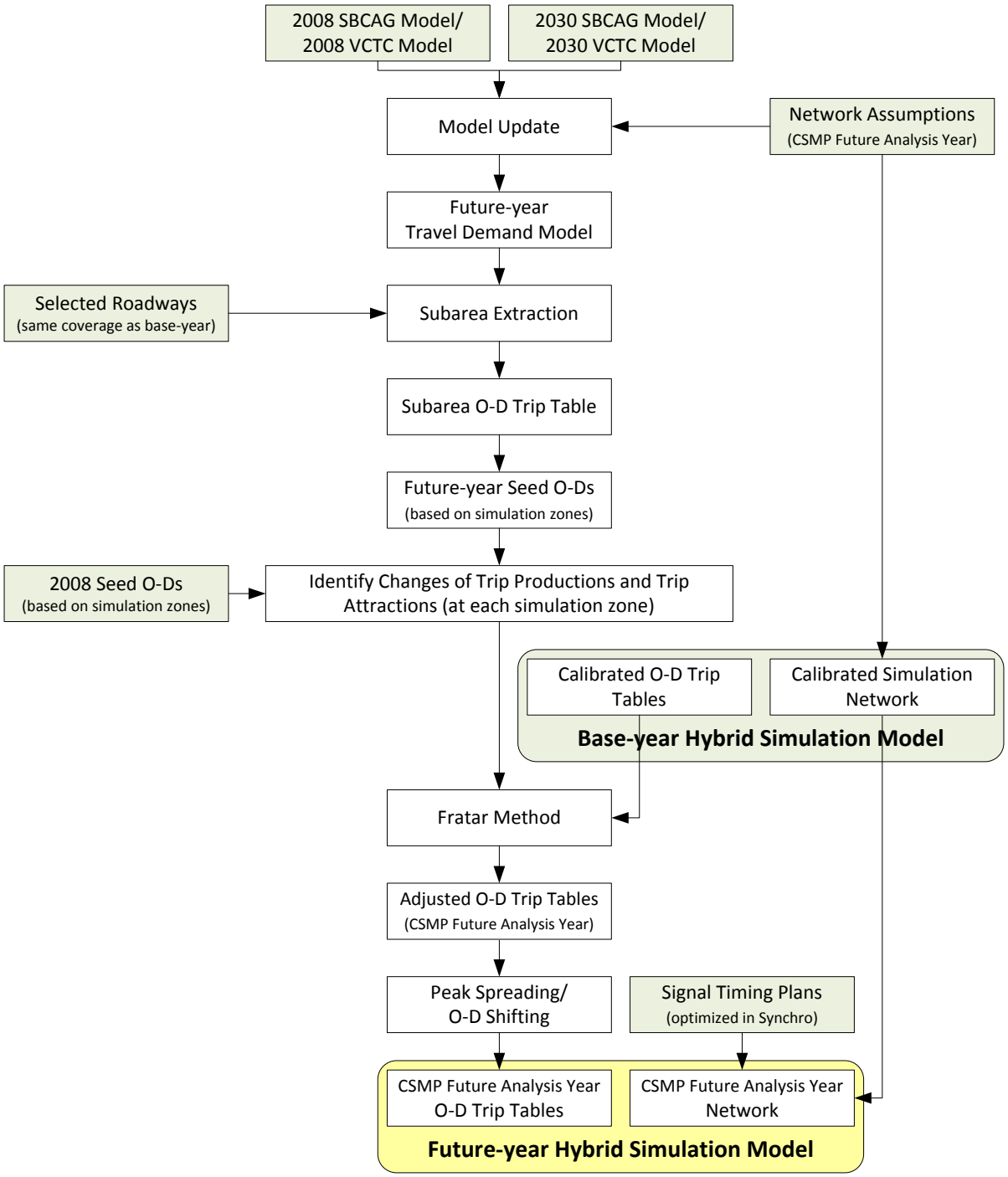
Two available travel models were used to create travel demand model inputs for the hybrid simulation models: (1) the Santa Barbara Council of Associated Governments (SBCAG) travel demand model and (2) the Ventura County Transportation Commission (VCTC) travel demand model. Each is described below. Although the regional travel demand model maintained by the Southern California Association of Governments (SCAG) was not used in creating the hybrid simulation models, it was used to aid in forecasting transit utilization and transportation demand management (TDM) benefits and it is referenced in those sections accordingly.

SBCAG Model

The SBCAG model has been available since 2004 and includes all of Santa Barbara County as well as the portion of Ventura County within the CSMP corridor. There are 281 traffic analysis zones (TAZs) and approximately 11,000 directed links and 4,000 nodes. The base-year is 2000 and the future-year is 2030. The future-year is based on the Regional Growth Forecast 2000-2030 (prepared by SBCAG in March 2002). The model is available for average daily traffic (ADT), AM peak hour (8:00-9:00 AM), PM peak hour (5:00-6:00 PM), and midday hour (1:00-2:00 PM). There is a mode-choice component that estimates the split between auto (1, 2, and 3+ persons in a car), bus, walk, and bike trips; but there is no truck component in the model. The current SBCAG model has been developed in the TransCAD software.

A specialized version of the SBCAG model was used to create the travel model inputs. Dowling Associates refined the SBCAG model for the US-101 corridor for a previous work effort focusing on the South Coast 101 HOV Study in Santa Barbara County. For clarity purposes, this refined SBCAG model will be referred to as the 101-HOV model.

Figure 1 Model Framework for the US-101 CSMP



The 101-HOV model has a refined roadway and transit network for the US-101 corridor. Freeway interchange and ramp configurations were refined to better reflect the freeway's geometry and configuration. Centroid connectors were relocated to better replicate traffic loading from minor streets and collectors onto the major arterials. Network coding reasonableness checks were performed on roadway segment and intersection network coding. No changes were made to the model's zonal structure, the zonal socioeconomic and land use data, study years modeled, time-of-day factors, or other model parameters.

While the CSMP was being prepared, SBCAG was adjusting its regional growth forecasts reflecting a slower pace of growth in the county. A new model update is planned using these new regional forecasts but was not available in time to be used in the US 101 CSMP development. To account for slowed growth rates, DKS used the SBCAG 2030 forecast to represent 2040 when interpolating to the 2008, 2013 and 2023 socioeconomic/land use data set for the SBCAG model. To illustrate this method, US-101 CSMP year 2008 input socioeconomic/land use data were interpolated as "SBCAG year 2000" plus 8/40 of the growth between the "SBCAG 2000" and the "SBCAG 2030/2040" datasets.

VCTC Model

The VCTC model was recently updated and made available in March 2009. The model is windowed from the Southern California Association of Governments (SCAG) regional model and additional detail was added to the portion of the network in Ventura County. The VCTC model does not include roadways in Santa Barbara County. The base-year is 2007 and the future-year is 2030. The future-year is based on the Southern California Association of Governments Regional Transportation Plan (SCAG RTP). The model produces a two-hour AM peak period and a three hour PM peak period, as well as a 19-hour off-peak period. The AM peak, PM peak and off-peak period volumes are combined producing average daily traffic (ADT) volume forecasts.

Although there is a mode choice component in the model, transit ridership and/or vehicle occupancy are not forecasted by the model. There is no truck or commercial freight component in the model. Vehicle trips are the only forecasted travel mode. The VCTC was developed using the TransCAD modeling software.

For both the VCTC and the SBCAG models, the socioeconomic/land use data for study year 2008 were developed using straight-line interpolation between the socioeconomic/land use data for each county model calibration year and the first forecast year after 2008 from the travel forecasting model for each county.

Additionally, cordon (or external vehicle trip) vectors were linearly interpolated to 2008 estimates. External vehicle trip data are inputs to the auto-mode trip table generation process. As such, these inputs were updated to be consistent with other model parameters and input data. The external trip data may be subsequently adjusted if the model's traffic volumes do not match actual 2008 traffic counts at the model's gateways. Likewise, special generators were straight-line interpolated to 2008.

Future Year Conditions and Forecasting

Year 2013 was selected to reflect year of CMIA opening and 2023 was selected to reflect ten years after CMIA opening. Although 2013 might be a year or two beyond the actual opening

date for the CMIA project, the timing of the CMIA project is somewhat uncertain and 2013 will be close to but after the CMIA opening.

The models networks for each year were coded to reflect the projects that are already in place (2008) and programmed for implementation by each forecast year: 2013 and 2023. Programmed projects were determined by the STIP and the RTIP, CIP, RTP and SRTP for each county. In addition, some Measure "A" projects for Santa Barbara County were included. A listing of programmed projects for the US 101 corridors for Santa Barbara and Ventura is included in Appendix E of this report.

Straight-line interpolation for the CSMP forecast years (2013 and 2023) was performed using the 2008 socioeconomic/land use data and the first model forecast year after the CSMP forecast year from the travel forecasting models. Likewise, the cordon (or external vehicle trip) vectors and special generators were linearly interpolated in the travel demand models.

As was done for the socio-economic and cordon trip data, straight-line interpolations were used to update the costs for each CSMP forecast year using the traveler costs for 2008 and the first model forecast year after the CSMP forecast year from the travel forecasting models.

The model system that was used to assess future performance in the corridor and to test improvement options was designed to represent average annual weekday conditions in the absence of any significant events that would change the demand or the operation of the facilities. The model system represented conditions without accidents or incidents that would block lanes or hinder flow. They represented reasonably good weather conditions that do not cause any reduction in system performance. Finally, the models represented a set of average forecast conditions that might influence traveler mode or route choice such as gasoline price, parking costs, or transit fares. Any seasonal fluctuations in these factors were not captured by the model system.

Fluctuation in the conditions identified above can have a significant effect on the performance of the transportation systems in the corridor. Some sensitivity testing of alternative conditions was performed to assess potential benefits of improvement options under more extreme operating conditions. The simulation model has the capability to test the impact of disruption from accidents, incidents, or adverse weather conditions on system performance. These features were used to analyze some of the more promising improvement options under these conditions. There was also some sensitivity testing of factors such as gasoline price.

One noticeable impact from the occurrence of unusual conditions in the corridor is degradation in the reliability of the system performance. This may show up in increased variation in travel times and in the amount of time a traveler must allow to ensure that trips are on time. Although the model system does not produce estimates of this variation in performance characteristics, DKS used baseline information on travel-time reliability to provide forecasts of variation and reliability for future conditions based on the expected volumes and level of service.

In the simulation model, existing traffic signalization and timing were used to represent 2008. Traffic simulation for future years was based on existing signalization and programmed signal improvements. All signal timing was assumed to be fixed-time and the timing for each signal was optimized using TransModeler.

Adjustment of the Forecasted Demands

Forecast demand cannot be used directly for simulation if it creates unrealistic gridlocks in the system. In such cases, an adjustment is needed to refine the forecasted demands to a level that can reasonably be accommodated by the network. A typical regional travel demand model, like the SBCAG and VCTC models, allows volumes greater than capacities (V/C ratio > 1). As a result, the travel demand model network can accommodate any level of demand even though the demand may be well over the capacity of the system. A simulation model, in contrast, replicates the complexity of traffic operations in a much more detailed manner and does not allow volumes greater than capacities, because individual vehicles are dynamically simulated. If the demand exceeds the capacity, vehicles will queue and can create gridlocks in the network. Once gridlocks happen, the simulation results are not meaningful. An error in approximating demands for some O-D pairs could distort the congestion pattern throughout the corridor. Because of limitations of the travel demand forecasting model, an adjustment was made to the forecasted O-D trip tables to account for temporal (peak spreading) and spatial (O-D shifting) distribution of O-D demands. In this modeling effort, the adjustments included the following:

- Capping trip productions at each simulation zone to roadway capacities at each entry point
- Shifting O-D demands to adjacent zones
- Shifting O-D demands to adjacent hours
- Shifting O-D demands outside of the peak period

The adjustments made resulted in the following overall reductions in the "Ten Year after Opening Models":

- Santa Barbara AM 0.3 %
- Santa Barbara PM 8.5 %
- Ventura AM 1.2 %
- Ventura PM 2.3 %

Simulation of Traffic Flows and Operations

The hybrid simulation methodology used in the project modeled the roadway network at different levels of fidelity in a single run. Some parts of the network were mesoscopically simulated while some were microscopically simulated simultaneously.

For the microscopic simulation part of the network, the highest detail was required to simulate complex driving behavior. Vehicle movements in this part of the network were modeled to the degree that replicates how individual vehicles react with nearby vehicles and the roadway geometry and traffic controls. The movements of individual vehicles were dictated by car-following and lane-changing logic.

For the mesoscopic simulation part of the network, less detail was required than the microscopic simulation part. That is because vehicle movements in this part of the network were modeled as platoons, sometimes called traffic cells or streams. While the mesoscopic simulation tracks the identity of individual vehicles, vehicle movements are based on aggregate speed-density relationships, not by car-following theory as on the microscopic portions of the network.

In general, all selected freeway segments and ramps were modeled using microscopic fidelity. The microscopic segments include:

- US-101
  - from Santa Barbara Post Mile 27.20 (Hollister Avenue) to Ventura Post Mile 20.76 (Rice Avenue)
- All on-/off-ramps along US-101
  - from Santa Barbara Post Mile 27.20 (Hollister Avenue) to Ventura Post Mile 20.76 (Rice Avenue)

Generally, the selected arterial segments were modeled at the mesoscopic fidelity. The mesoscopic segments include (sorted from north to south):

Segments in Santa Barbara County:

- Cathedral Oaks Road
  - from Glen Annie Road to San Marcos Pass Road
- SR-192
  - from San Marcos Pass Road to SR-150
- Casitas Pass Road
  - from Carpinteria Avenue to SR-192 (Casitas Pass Road)
- Hollister Avenue
  - from the northern end at US-101 to State Street
- State Street
  - from Calle Real (west of N La Cumbre Road) to E Gutierrez Street
- Calle Real
  - from N Los Carneros Road to N Patterson Avenue
  - from N Turnpike Road to State Street
  - from N La Cumbre Road to W Mission Street
- Castillo Street
  - from W Mission Street to W Cabrillo Boulevard
- N Milpas Street
  - from E Cabrillo Boulevard to E Ortega Street
- S Salinas Street
  - from US-101 to E Mason Street
- Cabrillo Boulevard
  - from Loma Alta Drive to US-101 (west of Hot Springs Road)
- Old Coast Highway
  - from S Salinas Street to Hot Spring Road

- Coast Village Road
    - from E Cabrillo Boulevard to Olive Mill Road
- Hot Springs Road
    - from Coast Village Road to Olive Mill Road
- Jameson Line
    - from Olive Mill Road to Sheffield Drive
- Via Real
    - from Evan Street to Santa Ynez Avenue
- Carpinteria Avenue
    - from US-101S Exit (west of Santa Monica Road) to SR-150 (Rincon Road)
- SR-150 (Rincon Road)
    - from US-101/Carpinteria Avenue to SR-192 (Casitas Pass Road)
- SR-217
    - from US-101 to S Fairview Avenue
- SR-154
    - from US-101 to San Antonio Creek Road
- SR-225 (Las Positas Road)
    - from US-101 to Cliff Drive
- Connectors between the above roadways and US-101 ramps
- Roadways connected to a ramp intersection and one intersection next to the ramp

Segments in Ventura County:

- SR-1 (Pacific Coast)
    - from Seacliff to US-101 (east of Solimar Beach Drive)
- Main Street
    - from US-101 (west of SR-33) to Telephone Road
- E Thompson Boulevard
    - from N Ventura Avenue to E Main Street/Telegraph Road
- Harbor Boulevard
    - from S California Street to S Seaward Avenue
- Frontage Road
    - from S Victoria Avenue to Johnson Drive
- SR-33 (Ojai Freeway)
    - from US-101/N Olive Street to Canada Larga Road
- SR-126
    - from US-101 to S Kimball Road
- SR-1 (Pacific Coast Highway – N Oxnard Boulevard)
    - from US-101/N Ventura Road to W Wooley Road
- SR-232 (E Vineyard Ave)
    - from SR-1 to SR-118
- Connectors between the above roadways and US-101 ramps
- Roadways connected to a ramp intersection and one intersection next to the ramp such as N Rice Avenue/Santa Clara Avenue, N Rose Avenue, etc.

TransModeler was used for hybrid simulation modeling. TransModeler is the only commercial software package in the market that can do hybrid modeling. Both microscopic and mesoscopic portions reside in the same model and results are generated from the same run.

Based on the two existing travel demand models and jurisdiction differences between the areas in Santa Barbara County and Ventura County, two hybrid simulation models were developed to model US-101 corridor: (1) US-101 Hybrid Simulation Model in Santa Barbara, and (2) US-101 Hybrid Simulation Model in Ventura. These two models were separated near the county line where there is only one link in the models. A consistency check was made during calibration to make sure that the two models are consistent.

As shown in **Figure 2**, the travel demand models were updated to the existing conditions (2008) in TransCAD. Next, the US-101 corridor study area was selected and saved as the base network for the interface models: the US-101 corridor subarea in Santa Barbara County from the SBCAG model and the US-101 corridor in Ventura County from the VCTC model. Each subarea network in the interface models was then refined in terms of roadways, zones, and intersections closely matching the level of detail necessary for simulation modeling. Along with the interface model networks, O-D trip tables matching the interface networks were extracted from the regional travel demand models. The extracted subarea O-D trip tables were then updated to more closely match observed counts. These interface models are the final product of the extraction and refinement process; as their name suggests, they serve as the interface between the travel demand models and the simulations model, functionally bridging the gap such that the simulation models can seamlessly use the forecasted travel demands from the travel demand models. Subsequently, the interface models were further refined for the purpose of simulation in TransModeler. These refinements include using temporal count profiles to account for peak spreading and O-D shifting, and adding more roadway details. The final product of this methodology is the base year hybrid simulation model. As the name suggests, the hybrid simulation model is a hybrid or blending of a mesoscopic model and a microscopic model. The methodology's individual processes were described in the Base-year Simulation Model Report.

The basic approach in the development of the hybrid simulation models was to refine the regional travel demand models, extract the interface models, and construct the simulation models. **Figure 3** shows the relationship between a travel demand model and an interface model. Grey lines indicate links in the regional travel demand model; blue lines indicate links in the subarea, which were extracted to become the interface model. The interface model and the simulation model replicate the same geographic areas; that is, the interface networks and the simulation networks share the same boundaries or cordons. A key difference is that the interface model behaves (or model traffic) like the static travel demand model. As such, the interface model is well suited to bridge the gap between the travel demand model and the simulation model.

Figure 4 illustrates the relationship between the interface model and the simulation model. The top part shows the interface model where each link is specified to be either microscopic links (in green) or mesoscopic links (in blue). These links are then imported to TransModeler to become the simulation model. As shown in the bottom part, the simulation model is laid on top of an aerial photo. Network details such as lanes and connectors are then checked to represent the network in more detailed. As shown in the magnified portion, lanes and connectors are well represented in the simulation model.

Figure 2 Development of Base-year Hybrid Simulation Model

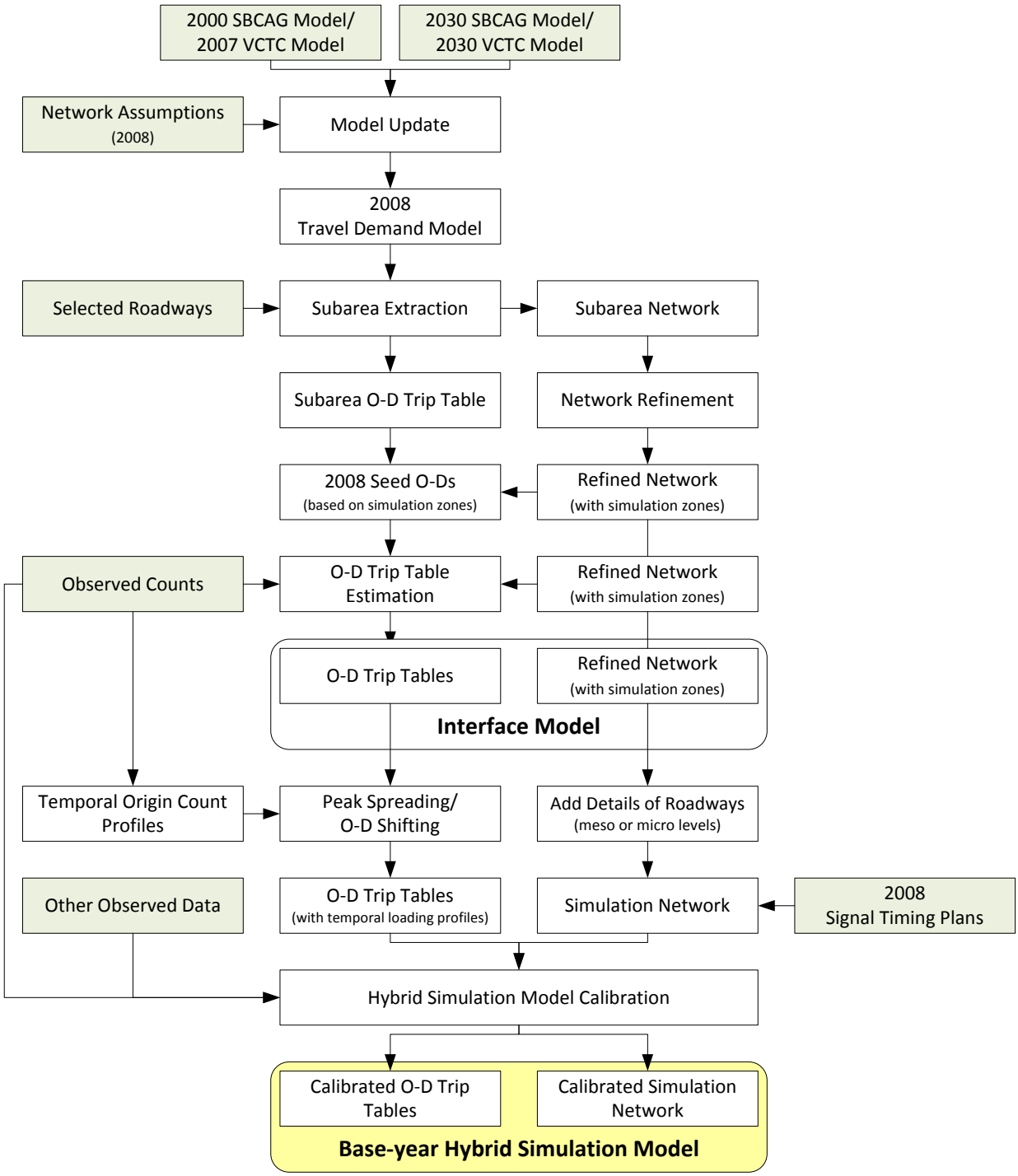
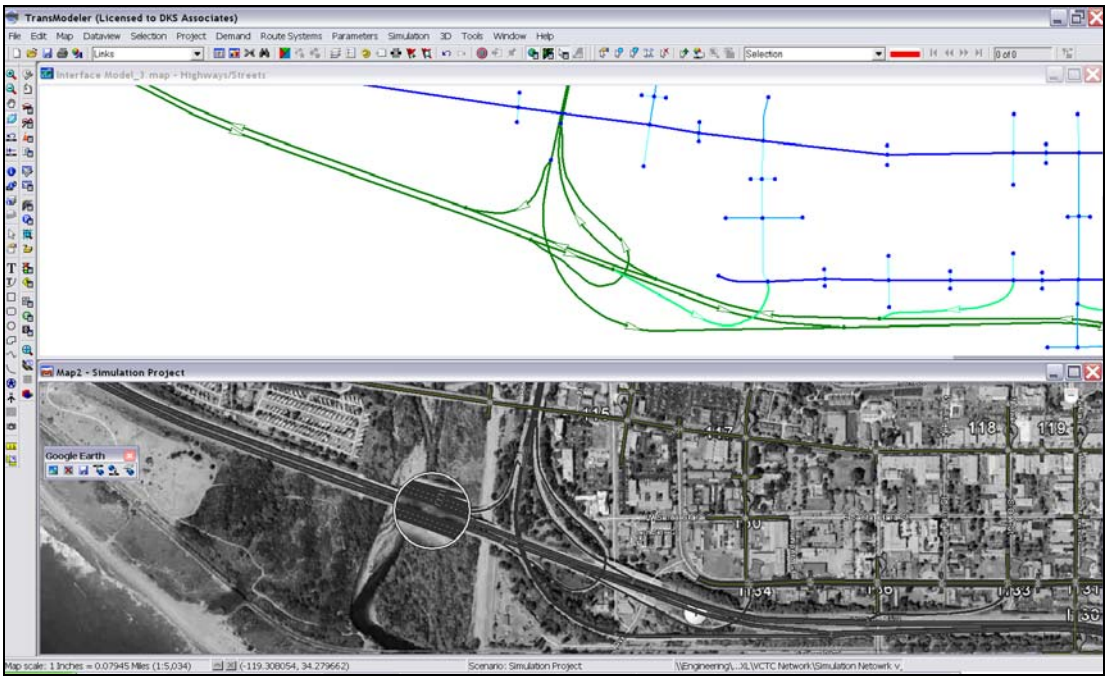


Figure 3 Relationship between Travel Demand Model and Interface Model

Figure 4 Relationship between Interface Model and Hybrid Simulation Model



Difference in Modeling Approach for the US-101 CSMP and the South Coast 101 HOV Study

There are differences between the modeling performed for the US-101 CSMP and that performed for the South Coast 101 HOV Study. The technical analysis for the CSMP is planning level and intended to provide decision makers with a long-range planning tool for future detailed analysis. The South Coast 101 HOV lane project analysis is specific to CEQA and is project specific in nature. Overall data can be shared between each analysis, however the planning level analysis of the CSMP is bigger picture with a corridor wide approach.

The level of calibration and supporting operational analysis and modeling refinement in the South Coast HOV Traffic Study is more rigorous than in the CSMP. The South Coast HOV Traffic Study analysis is a project level study and since it is within the corridor, its findings dictate and supersede over the planning level analysis of the CSMP when there are apparent differences. This planning level analysis looked at a large corridor with limited modeling refinement, where the South Coast HOV Study involved a much more focused and detailed analysis.

A major area of difference between the South Coast 101 HOV Traffic Study and this modeling effort were the projects included in the baseline model. The South Coast 101 HOV Traffic Study assumed all Measure "A" program alternative mode projects. The CSMP analysis did not assume all the projects in the Measure "A" program (such as rail, express bus, and FSP) but rather analyzed those projects as a scenario. It was determined by the TDM/Transit subcommittee that these programs would be tested in the scenario analysis since both Santa Barbara and Ventura counties have different funding sources.

Similarly, both the CSMP and South Coast 101 HOV Study used travel demand forecasts from the SBCAG regional model. Both also used consistent versions of that model for 2000 and 2030 as a starting point for developing project forecasts. Forecasts for the CSMP were developed for 2008, 2013 and 2023 by extrapolating from the SBCAG trip tables for 2000 and 2030. Because of changes in the land use and growth forecasts by SBCAG after the initiation of the CSMP project, the 2030 model output was used to represent 2040 land use and growth conditions. The South Coast101 HOV Traffic Study prepared forecasts for 2020, 2025 and 2040.

The simulation of the corridor was performed in different software packages for the two efforts. The CSMP used TransModeler, which models part of the network with microscopic simulation (freeway lanes and ramps) and part of the corridor with mesoscopic simulation (major parallel and crossing arterials and freeways). The South Coast 101 HOV Traffic Study used FREQ, to simulate mainline traffic.

The area covered by the simulation also differed. The CSMP covered roughly 25 miles in Santa Barbara County and 25 miles in Ventura County in two separate but related models. The South Coast 101 HOV Traffic Study simulated 14.5 miles for 2025 and 27.5 miles for 2020 and 2040 primarily within Santa Barbara County. The CSMP simulation covered the entire AM and PM

entire peak period (6:00 to 9:00 AM and 3:00 to 6:00 PM) whereas the SB 101 HOV Study modeled a window of time greater than six hours for each AM and PM peak period.

The CSMP simulation model calibration was based on the same set of raw data used in the SB 101 HOV Study (traffic counts, speeds, truck percentages), but supplemented with some additional data collected by DKS. Additional calibration for the CSMP was also conducted using the ODME function in TransModeler to calibrate the 2008 TransModeler model trip tables to match the ramp counts reasonably closely. The ODME function was used to revise hourly trip tables from origin zones to destination zones.

A final area of difference is that the CSMP only used a long-term forecast (2023) with the HOV lane included as proposed. There was no model run without the HOV lane. The South Coast 101 HOV Traffic Study prepared forecast for 2025 with the HOV and another forecast with the added lane being mixed-flow.

Estimation of Trip Reduction Benefits of Transit and TDM Strategies

Method for Estimating Impacts and Benefits from Transit Services

Passenger Rail Service

The effects of passenger rail service were estimated using an estimate produced as part of the *101 In Motion* study, adjusted to reflect differences between the service tested in the CSMP and that tested in the *101 In Motion* study. Adjustments were made to account for differences in service reliability and fare. Both the *101 In Motion* stud*y* and the *Santa Barbara Commuter Rail* study evaluated additional commuter-friendly passenger rail service between Oxnard and Goleta for 2030. The analysis for these reports tested two additional northbound trips in the AM peak commute period and two additional southbound trains in the PM peak commute period servicing the existing Amtrak stations located in Goleta, Santa Barbara, Carpinteria, Venture and Oxnard. For the CSMP the additional commute period service was assumed to be the result of a rescheduling of existing Amtrak service to provide better service in the commute periods with no addition of trains or daily round trips. The additional commute period trips are also assumed to be Amtrak service like that currently serving the corridor and not Metrolink-style commuter rail service as was assumed in the *101 In Motion* study. The schedule tested in the CSMP analysis assumed northbound trains arriving in Santa Barbara at 7:40 AM and 8:45 AM. Southbound trains would leave at 4:35 PM and 5:25 PM. The 2030 ridership forecasts for *101 In Motion* estimated the passenger rail would generate 460 boardings and alightings per average weekday. Based on an estimated average vehicle occupancy rate in the peak commute period of 1.2, ridership forecasts translate to a vehicle trip reduction of 385 northbound trips in the AM peak commute period and 385 southbound trips in the PM peak commute period.

The vehicle-trip reductions in the *101 In Motion* study and *Santa Barbara Commuter Rail* study were estimated based on a passenger rail service like Metrolink. The CSMP US-101 Transit and TDM scenario assumed a modified version of the Amtrak intercity rail service. Project stakeholders suggested that the *101 In Motion* study's vehicle-trip reductions be re-estimated to reflect Amtrak pricing and reliability. Existing analysis shows Amtrak pricing is approximately 15% more than Metrolink pricing for the 10-ride pass and the monthly pass. The *Journal of Public Transportation, Vol 7, No. 2, 2004* suggests a price elasticity of -0.6 to -0.9 over a five- to ten-year

period. Assuming the midpoint, a price elasticity of -0.75 would reduce the forecasted vehicle trips by 11.3%. Existing analysis also shows Metrolink trains arrive on-time more frequently than Amtrak trains. A case study in Chicago attributed a ridership increase of 16.7% to improving service reliability. Reduced cost and reliable service were combined to estimate that modified Amtrak service would generate a 285 vehicle-trip reduction (73.9% of what was assumed in the *101-In-Motion* study).

Express and Local Bus Service

The impacts and benefits of transit service in future forecast years were estimated using the SBCAG model for local bus service within Santa Barbara County and for express bus service between Ventura County and Santa Barbara County. Frequencies in the model were first updated to reflect 2009 schedules for transit express (VISTA Coastal Express) and local routes for the baseline forecast year model. Then the 2009 express service frequencies were tripled and 2009 local service was doubled for sensitivity to be included in the CSMP US-101 Transit and TDM scenario. The SBCAG travel demand model showed that an enhanced express and local bus service could reduce 200 vehicle-trips in the AM peak hour and 200 vehicle-trips in the PM peak hour. Existing vehicle counts show that the AM peak period (6:00 AM to 9:00 AM) is 281 percent of the AM peak hour. Existing vehicle counts also show that the PM peak period (4:00 AM to 7:00 AM) is 286 percent of the PM peak hour. Hence, for year "Ten Years after CMIA Opening," the CSMP US-101 Transit and TDM scenario, vehicle-trip tables were reduced by 562 trips (281 percent x 200) in the AM period and 572 trips (286 percent x 200) in the PM period

The effects of improvements in local bus service in Ventura County were estimated using a baseline forecast of transit trips in the county from the SCAG regional model and a service-frequency elasticity. Table 1 lists the trip reducing forecasting inputs, assumptions and methodology for Ventura County local transit improvements. The number of vehicle trips reduced on US-101 was estimated based on the percentage of local person trips with Ventura County that use the freeway by direction in the peak period.

Table 1 Vehicle Trip Reductions from Ventura County Local Transit Improvements

Ventura County Peak Period Transit Trips[1]	8,419
Ventura County Drive-alone Peak Period Trips[1]	637,141
Local Headway Reduction (Doubling Local Transit Service)	-50%
Out of Vehicle (Wait Time) Elasticity[2]	0.50
Increase in Peak Period Ridership	2,105
Percent of New Transit Riders from Drive-Alones[3]	50%
Drive-alone Peak Period Trip Reductions	1,052
Drive-alone Peak Period Trip Reduction Factor (%)	0.17%
Ventura "Ten Years after Opening" Drive-alone Trips (AM Peak Period)[4]	145,872
Ventura "Ten Years after Opening" Drive-alone Trips (PM Peak Period)[4]	174,941
AM Peak Period Drive-alone Vehicle Trip Reductions	241

PM Peak Period Drive-alone Vehicle Trip Reductions	289

1) Source: SCAG Travel Demand Model, CHAPTER 6 – MODE CHOICE, Table 6-6
2) Source: http://www.vtpi.org/tranelas.pdf (page 10)
3) Source: http://www.ecy.wa.gov/climatechange/2008CATdocs/091808_cat_tran_ghg_analysis.pdf
4) Source: DKS Associates, 2010
5) Factors for freeway use and direction based on simulation model trip patterns

Method for Estimating Impacts and Benefits from TDM Programs

All of the TDM programs evaluated were identified in the *101 In Motion* study for Santa Barbara County and all represented Santa Barbara County-based programs. No Ventura-based programs were evaluated, but all of the Santa Barbara County-based programs will affect commuters from Ventura County to Santa Barbara County and these effects were taken into account. The effects of the *101 In Motion* TDM programs had already been estimated as part of that study and these effects were used directly in the CSMP.

A combination of three TDM strategies was recommended in the *101* In Motion study: ridesharing incentives, individualized marketing, and flexible work schedules. The method used to translate the results from the *101 In Motion* study to the CSMP corridor is described below for each strategy.

Ridesharing Incentives

This strategy reduces trips by offering financial incentives to carpoolers and vanpoolers. As documented in the *101 In Motion Report*, this strategy would reduce 185 peak hour vehicle trips entering the major generators in the AM and 185 peak hour vehicle trips exiting in the PM. As described in the Local and Express Bus section; peak period vehicle trip reductions were calculated based on the existing peak-period to peak-hour percentages. This translates into 520 trips in the AM period and 529 trips in the PM period.

Individualized Marketing

This strategy reduces trips by working with individual commuters to understand current travel behavior and to develop personalized advice on how to use alternative modes, make better chain trips, change timing of trips to avoid congested periods, etc. This strategy also reduces trips by targeted marketing campaigns to build or increase ridership on specific transit improvements. As documented the *101 In Motion* study, this strategy would reduce 150 peak hour vehicle trips entering the employment areas in the AM and 150 peak hour vehicle trips exiting in the PM. Using the peak hour to peak period conversion; this strategy would reduce 422 vehicle trips in the AM peak period and 430 vehicle trips in the PM peak period.

Flexible Work Schedule

This strategy reduces trips by implementation of compressed work weeks (3/36, 4/40, and 9/80), "telecommuting" part-time, and flex-time commuting. Flexible schedules have the benefit of moving peak commute trips to off-peak times and also eliminating commute trips. The *Flex Work Santa Barbara Phase 2 Report* projects that 1,421 commute trips per day will be eliminated from the peak periods for the South 101 analysis. This translates to a vehicle trip reduction of 711 northbound trips in the AM peak period and a vehicle trip reduction of 711 southbound trips in the PM peak period.

The TDM strategies' vehicle trip reductions reported in the *101 In Motion* study are evaluated for 2030. The combined 2030 vehicle trip reductions will be applied to the CSMP US-101 Transit and TDM scenario for the "Ten Years after CMIA Opening" model runs.

Estimation of the Effects of Transit and TDM Strategies on Roadway System Performance

Once the effects of the transit service improvements and TDM programs had been estimated, they were translated into changes in vehicle trips in the simulation model for each county. The simulation model was then run with the modified hourly trip tables to identify the effects of the transit service improvements and TDM programs on roadway system performance. The AM and PM peak period vehicle trip reductions were converted into three one-hour blocks, based on existing vehicle count data. Also, the associated network TAZs were index into one of four districts: CBD, South of CBD, North of CBD, and Other; the same districts used in the *101 In Motion* study**.** The index process provided a method to select specific trips from the trip tables based on district to district (row to column) travel. **Table 1** shows the hourly vehicle trip reductions for each strategy categorized by row (origin) and column (destination) district for each strategy. The vehicle-trip reductions shown in **Table 2** were applied to each hour block using the same algorithm as used in the *101 In Motion* study. Because the trip reduction would be primarily from converting single occupancy drivers to other alternative modes, the vehicle trip reductions were subtracted from the SOV volumes in the model.

Table 2 Vehicle Trip Reductions for the Santa Barbara Microsimulation Model

Strategy	Peak Period	Vehicle-Trip Reductions					
		Total	Hour 1	Hour 2	Hour 3	Row	Column
Passenger Rail Service	AM	285	0	140	145	South	CBD
	PM	285	0	157	128	CBD	South
Local and Express Bus Service	AM	562	155	200	208	All	All
	PM	572	209	200	163	All	All
Ridesharing Incentives	AM	520	143	185	192	South	CBD
	PM	529	193	185	151	CBD	South
Individualized Marketing	AM	422	116	151	155	South	CBD
	PM	430	157	151	122	CBD	South
Flexible Work Schedule	AM	711	196	252	263	South	CBD
	PM	711	196	252	263	CBD	South
Source: DKS Associates, 2010							

Method for Modeling Ramp Metering

To quantify the impact of ramp metering, the future-year baseline (2023) hybrid simulation models were modified by adding a ramp metering feature. As agreed by the Project Coordination Team, a ramp metering system called SATMS (Semi-Actuated Traffic Management System) was used in this study. Unfortunately, a default TransModeler version could not be used to model this specific ramp metering system. A special plug-in was developed by CLR Analytics and Caliper and provided by Caltrans Headquarters to link with the default TransModeler version.

The control logic inside SATMS can be described as a local traffic responsive control operated according to real-time detector data at the upstream of the metered on-ramp. The control logic is based on demand capacity control. Every 30 seconds, SATMS determines an appropriate metering rate. If the freeway is not congested, the metering rate will be adaptively determined. If the freeway is congested, the pre-defined rate will be used. In addition, the queue override control logic was enabled at every metered ramp. If there was a queue at the queue detector, the metering rate that was determined by the SATMS would be overridden by the maximum rate (for example, 900 vph for a one-lane on-ramp that is operated under the one-car per green rule). For more detailed information, please refer to the TransModeler Plug-in User Manual SATMS Ramp Metering Control.

Ramp metering was only modeled if it provided a benefit and did not result in the ramp queue extending beyond the end into the intersection of the ramp and the nearest street. The simulation model was coded with a queue spillback detector that automatically discontinued the metering of the ramp if the queue reached the detector. Metering was not tested at some ramps because it would not affect a bottleneck point and at other ramps because the ramp flow rate was too great to ever allow metering in the peak period without spillback. **Table 3** identifies which ramps were never tested because they would not affect bottlenecks (A), which ramps were beneficial and had adequate capacity for the period (B), which ramps were beneficial but had queue spillback to the ramp intersection during some part of the period (C), and which ramps were not tested because they did not have adequate storage capacity to be effective.

Table 3a Summary of Ramp Metering Limitations in 2023 Simulation – Southbound Santa Barbara County

On-ramps	Post Mile	Period	
		AM Peak	PM Peak
Santa Barbara County			
SB on from Hollister Ave	26.720	A	A
SB on from Storke Rd	24.570	A	A
SB on from Los Carneros Rd	23.450	A	A
SB on from Fairview Ave	22.360	A	A
SB on from SR-217	21.193	A	A
SB on from Patterson Ave	20.850	A	A
SB on from Turn Pike Rd	19.870	A	A
SB on from San Marcos Pass Rd	18.175	A	D
SB on from Las Palmas Dr	17.533	B	B
SB on from Las Positas Rd	16.320	C	D
SB on from W Mission St	15.640	D	C
SB on from W Carrillo St	14.640	C	C
SB on from Castillo St	14.080	B	B
SB on from Garden St	13.357	B	B
SB on from S Milpas St	12.410	A	A
SB on from Olive Mill Rd	10.340	B	A
SB on from S Jameson Ln	9.640	A	A
SB on from Sheffield Dr (Left Ramp)	8.850	A	A
SB on from Wallace Ave/Evans St	7.870	A	A

SB on from N Padaro Ln	7.000	A	A
SB on from Santa Claus Ln/S Padaro Ln	4.700	A	A
SB on from Reynolds Ave	3.480	A	A
SB on from SR-224	2.457	A	A
SB on from Bailard Ave	1.510	A	A
SB on from SR-150	0.480	A	A

A = Not metered because of light traffic on mainline
B = Metered and the queue spillback control is not active
C = Metered and the queue spillback control is active at some points of time
D = Not metered because the existing ramp capacity is not sufficient (or too long queue)

Table 3b Summary of Ramp Metering Limitations in 2023 Simulation – Southbound Ventura County

On-ramps	Post Mile	Period	
		AM Peak	PM Peak
Ventura County			
SB on from Bates Rd	43.421	A	A
SB on from Seacliff (SR-1)	39.044	A	A
SB on from Solimar (SR-1)	32.592	B	B
SB on from SR-33s	30.548	A	D
SB on from E Thompson Blvd/Chestnut St/Harbor Blvd	29.838	C	C
SB on from SB Seaward/WB Harbor	28.643	C	C
SB on from Seaward Ave	28.322	C	D
SB on from Telephone Rd	25.860	D	D
SB on from SB Victoria Ave	24.782	B	D
SB on from NB Victoria Ave	24.509	B	D
SB on from Johnson Dr	23.501	B	D
SB on from Oxnard Blvd	22.323	B	B
SB on from SB Vineyard Ave	22.031	C	B
SB on from NB Vineyard Ave	21.780	C	D
SB on from SB Rose Avenue	21.055	B	B
SB on from NB Rose Ave	20.941	B	B
SB on from Rice Ave	20.032	D	D

A = Not metered because of light traffic on mainline
B = Metered and the queue spillback control is not active
C = Metered and the queue spillback control is active at some points of time
D = Not metered because the existing ramp capacity is not sufficient (or too long queue)

Table 3c Summary of Ramp Metering Limitations in 2023 Simulation – Northbound Ventura County

On-ramps	Post Mile	Period	
		AM Peak	PM Peak
Ventura County			
NB on from NB Rice Ave	20.047	B	C
NB on from SB Rice Ave	20.150	B	B
NB on from NB Rose Ave	20.979	D	C
NB on from SB Rose Ave	21.080	B	C
NB on from NB Vineyard Ave	21.966	C	A
NB on from SB Vineyard Ave	22.179	C	A
NB on from Oxnard Blvd	22.918	D	A
NB on from Johnson Dr / North Bank Dr	23.712	C	A
NB on from Victoria Ave	24.797	C	A
NB on from SR-126W	26.597	A	A
NB on from E Main St	26.925	C	A
NB on from Seaward Ave	28.604	A	A
NB on from S Oak St	30.329	B	A
NB on from SR-33S	30.998	A	A
NB on from W Main St	31.646	A	A
NB on from Seacliff (SR-1)	39.340	B	A

A = Not metered because of light traffic on mainline
B = Metered and the queue spillback control is not active
C = Metered and the queue spillback control is active at some points of time
D = Not metered because the existing ramp capacity is not sufficient (or too long queue)

Table 3d Summary of Ramp Metering Limitations in 2023 Simulation – Northbound Santa Barbara County

On-ramps	Post Mile	Period	
		AM Peak	PM Peak
Santa Barbara County			
NB on from Bates Rd	0.390	B	B
NB on from Rincon Rd (Rte 150)	1.180	B	B
NB on from Bailard Ave	1.810	C	B
NB on from Casitas Pass Rd	2.940	B	B
NB on from Linden Ave/ Ogan Rd	3.040	C	B
NB on from Santa Monica Rd	3.930	B	B
NB on from S Padaro Ln	5.500	B	B
NB on from N Padaro Ln	7.300	B	B
NB on from Ortega Hill Rd/ Evans Ave	8.440	B	B
NB on from N Jameson Ln/ Sheffield Dr	9.110	B	B
NB on from San Ysidro Rd/Eucalyptus Ln	10.150	B	B
NB on from Coast Village Rd/ E Cabrillo Blvd	11.520	B	B
NB on from S Salinas St	12.120	C	B
NB on from S Milpas St	12.865	C	D
NB on from Garden St	13.611	B	D
NB on from Castillo St (SR-225)	14.280	B	C
NB on from W Carrillo St	14.890	C	C
NB on from W Arrellaga St	15.400	B	D
NB on from W Mission St	15.757	D	D
NB on from Calle Real/ Las Positas Rd	16.710	B	D
NB on from S Hope Ave	17.500	B	B
NB on from State St (SR-154)	18.230	A	A
NB on from El Sueno Rd	18.990	A	A
NB on from Turnpike Rd	20.207	A	A
NB on from Patterson Ave	21.261	A	A
NB on from Fairview Ave	22.480	A	A
NB on from Los Carneros Rd	23.900	A	A
NB on from Storke Rd	24.900	A	A
NB on from Calle Real/ Hollister Ave	27.100	A	A

A = Not metered because of light traffic on mainline
B = Metered and the queue spillback control is not active
C = Metered and the queue spillback control is active at some points of time
D = Not metered because the existing ramp capacity is not sufficient (or too long queue)

Modeling the Benefits of Minor Physical Capacity Enhancements to Improve Roadway Flow and Throughput

A set of minor physical capacity enhancements was modeled using the hybrid simulation model. The enhancements were added to the baseline simulation network for 2023. The minor physical enhancements tested in this improvement scenario were for projects that are not already programmed and that could directly affect the operation of US-101. These plans are the combination of suggestions from US-101 CSMP Traffic Operations Subcommittee (which includes Caltrans District 5, Caltrans District 7, SBCAG, and VCTC) and from DKS and are based on results of the baseline simulation models. The improvements that were tested are identified below.

Santa Barbara

US-101 Northbound

- SB-NB-2: Add an auxiliary lane from W Arrellaga Street on-ramp to W Mission Street off-ramp
- SB-NB-3: Add an auxiliary lane from Las Positas Road/Calle Real on-ramp to S Hope Avenue off-ramp
- SB-NB-4: Add an auxiliary lane from Fairview Avenue on-ramp to Los Carneros Road off-ramp
- SB-NB-5: Add an auxiliary lane from Los Carneros Road on-ramp to Storke Road off-ramp

US-101 Southbound

- SB-SB-1: Add an auxiliary lane from Las Palmas Drive on-ramp to Las Positas Road off-ramp
- SB-SB-2: Add an auxiliary lane from Las Positas Road on-ramp to W Mission Street off-ramp

Arterials

- SB-SB-5: Expand State Street/Hollister Avenue from San Marcos Pass Road to Turnpike Road to be 4 lanes all the way

Ventura County

US-101 Northbound

- VEN-NB-1: Add an auxiliary lane from SB Rose Avenue on-ramp to Vineyard Avenue off-ramp
- VEN-NB-2: Add a lane from the lane-drop at Johnson Drive to Victoria Avenue off-ramp
- VEN-NB-3: Extend the acceleration lane from Main Street on-ramp

US-101 Southbound

- VEN-SB-1: Add an auxiliary lane from Seaward Avenue on-ramp to SR-126 off-ramp

- VEN-SB-2: Add a lane from SB Victoria Avenue on-ramp to Auto Center Drive/Johnson Drive off-ramp
- VEN-SB-3: Add a lane from the lane-drop at Vineyard Avenue to Rose Avenue off-ramp