Summary of updates to the Kern COG VMIP-3 travel demand model

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For Kern Council of Governments

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This document was prepared by or under the supervision of the following registered professional engineers.

Updates to the Kern COG travel demand model

March 2026

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Summary

This report documents updates to the Kern COG MIP-3 travel demand model, for purposes to:

- Update the base year to 2023 conditions, including its socioeconomic and network input data and gateway auto and truck volumes,
- Parameterize telecommuting's effect on work travel,
- Incorporate a congestion-sensitive accessibility measure as an independent variable in trip generation,
- Improve the calibration of the truck/commercial vehicle model using KernCOG and Caltrans classification counts and available applicable studies.
- Correct the mode choice model's calculations involving monetary costs.
- Recalibrate the model to recent traffic and transit count data and the Central California Travel Survey of 2022-23 (hereafter the CCTS),
- Provide additional analysis summaries:
    - A zonal crash prediction model based on one developed for the Southern California Association of Governments (SCAG),
    - A secondary district for environmental justice (EJ) analysis.

Background

The Kern COG MIP-3travel demand model updates and calibrates the Kern COG MIP-II model to a new 2023 base year, and a refined zone structure, with many parameters updated using the Central California Travel Survey of 2022-23 (CCTS). The basis of this model is the 2021 (pre-COVID) calibration by DKS Associates, with subsequent enhancements enabling tolling and managed lane modeling. This was developed from the San Joaquin Valley models of 2010 and of early 2017, originally prepared by Fehr and Peers and Kittleson and Associates for the Metropolitan Planning Organizations (MPOs) of the San Joaquin Valley. Kern COG MIP-3 retains minor adjustments to the MIP-II model by DKS Associates in 2019 in review of its level-of-service estimates, and features added for truck trip diversion and VMT analysis by trip purpose and land use.

Through its evolution, the Kern COG MIP model has been an advanced four-step travel demand model system of trip generation, trip distribution, mode choice, and traffic assignment, with nearly all stages applied in user-classes distinguished in some combination of household demographics and auto availability. This model includes multiple modes including walk, bike, and transit, explicit models of truck travel demand, and feedback approaching consistency between travel times used by and resulting from its component models.

Both the new and previous models are advanced four-step travel demand model systems of trip generation, trip distribution, mode choice, and traffic assignment, with nearly all stages recognizing household demographics, auto availability, multiple modes including walk, bike, and transit by walk and by auto access, and explicit models of truck travel demand. Advanced practice features included cross-classified household trip generation, an auto availability model, multi-modal logsum composite travel impedance used in trip distribution and auto availability models, auto-availability user-classes in trip distribution and mode choice, and iteration of the model system with feedback of peak and off-peak travel times due to congestion. Additional features include income-stratification to the Home-Work trip generation and distribution, control of internal-external trip generation by zone, purpose, and scenario. The highway network was derived from a "big data" source. Travel choice parameters were updated by regional travel survey data, and household cross-classification distributions were updated from the US Census.

The model is structured so that when run upon alternative future scenarios, travel choices and demand at all four model steps are determined not only by the specific scenario's provision of roads and transit services, but by feedback of the congested travel times – the entire system iterated toward equilibrium. The travel demand model is also structured to enable feedback to KernCOG's models of land use allocation, as transportation infrastructure provides accessibility and opens buildable lands.

Background documents:

- Fehr & Peers, *Kern COG – VMIP 2 Model Development Report*, April 2017
- DKS Associates, *Summary of peer review and revisions to the KernCOG VMIP-2 travel demand model*, December 2017
- RSG, *San Joaquin Valley Model Improvement Program Freight Forecasting Models*
- DKS Associates, *Summary of updates to the Kern COG VMIP-3 travel demand model*, February 2023
- DKS Associates, *Toll and transit access enhancements to the Kern COG MIP-3 travel demand model*, February 10, 2022
- RSG, *Central California Travel Study – Findings Report*, June 2023
- Hamilton, Himes, Tanzen (VHB), *Safety data & analysis technical assistance program final memo* (to Southern California Association of Governments), July 9, 2021

Data updates for 2023 base year

Socioeconomic data

- Cross-classification of households and population were updated according to applicable 2022 ACS 5-year and 1-year tabulations. Cross-classification distributions were synthesized from PUMS records for 2022 and 2023 (all that are given in 2020 PUMA geography) using iterative proportional fitting (IPF) methods, controlling to census-tract marginal distributions of unit type (3 categories), persons per household (5 categories), income (5 categories), and age group of householder (4 categories). Results updated the "cross class rates" table in the "scenario prep" Excel workbook, which serve as the proportional basis for splitting the households given by Kern COG into cross-classifications, and for inferring populations.
- Two new fields were introduced to the Socioeconomic Detail (SED) file, X_WRK_30AUT and X_EMP_30AUT, taking the places of unused fields EMPSPARE7 and EMPSPARE8. The

accessibility variables WRK_30AUT, EMP_30AUT, and ACT_30AUT are computed from workers and employees within 30 minutes by auto which are within Kern County. The two new fields provide exogenous input of additional workers and employees outside of Kern County that are within 30 minutes drive time of model zones. Tentative estimates have been entered for Delano zones based on the workforce in Tulare (approx. 30,000), and for Rosamond zones based on the workforce in Lancaster (approx. 60,000). As described below, the trip generation model has been updated to use these accessibility variables.

- Bakersfield College (BC) main campus was revised according to published enrollment for fall 2023 of 31,021 students. Table BC gives an estimated apportionment among its main and satellite campuses.

Table BC
Bakersfield College estimated enrollment by campus

Campus	TAZ	Given	Revised
Main (Panorama Dr)	533	8,984	29,394
Arvin	115	520	520
Southwest*	254	214	214
Delano	1568	657	657
Weill Inst. (Downtown)	762	236	236
Total		10,611	31,021

* Southwest campus is in the same TAZ as CSU Bakersfield (CSUB). The whole TAZ was given as 9,613 students. CSUB enrollment was 9,399, leaving the difference 214 estimated for BC.

Sources: California Community Colleges Chancellor's Office,
https://datamart.cccco.edu/Students/Student_Term_Annual_Count.aspx;
Bakersfield College, https://www.bakersfieldcollege.edu/about/locations/index.html;
The California State University,
https://www.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment.

TAZ data

Updated income splits by employment category were derived from the CCTS, made possible by a question of each employed person's industry of work, in 17 NAICS-aligned categories. (Unlike the surveys used for precedents of this model, this particular survey was the first to ask this question. Previously, the industry-income relationship could only be inferred indirectly by the LODES surveys, which relate industries to wage categories.) Table SE-2 lists these splits. Surveyed workers in all central valley counties were included, since Kern County appeared undersampled (overly skewed in some industries, and excessively different from a LODES analysis). The income breaks were selected to agree in regional split with the work trips generated by the corresponding household categories in the model:

- Low, under $50k
- Medium, $50k to $100k, and 40% of the $100k to $150k category
- High, 60% of the $100k to $150k category, and all of higher incomes

Table SE-1
Household income distributions estimated for workers in each modeled employment category

Modeled employment category	Low-Income (HWL)	Medium-Income (HWM)	High-Income (HWH)
EMPEDU	18.0%	42.8%	39.2%
EMPFOO	46.7%	35.9%	17.4%
EMPGOV	10.7%	57.7%	31.6%
EMPIND	32.6%	48.6%	18.7%
EMPMED	21.7%	35.1%	43.2%
EMPOFC	20.6%	43.8%	35.7%
EMPOTH	26.2%	42.8%	31.0%
EMPRET	38.3%	45.8%	15.9%
EMPAGR	42.7%	38.6%	18.7%

Gateway data

An updated factoring of trips in the 2017 California Statewide Travel Demand Model (CSTDM) was created for a coordinated update of

- Zonal (in 13 districts) IX and XI shares of trip generation
- Gateway IX and XI trip generation
- Through trips

The basis trips from the CSTDM were those person-trips identified as beginning, ending, or passing through Kern County. These trips, weighted as vehicle-trips, were summed by trip purpose in production-attraction directionality, through Kern County gateways and 13 subarea districts in Kern County.

These trips were then factored to fit updated gateway traffic volumes by autos, single-unit trucks, and multi-unit trucks (each productions plus attractions, IX + XI + through), and trip generation by purpose from the Kern MIP3 model in the 13 subarea districts. The factoring method was a generalized form of iterative proportional fitting (IPF). This generalization accounts for the gateway constraints not being distinctly row sums and column sums, but the total of both without regard to trip purpose or directionality. The subarea district constraints, on the other hand, were distinctly productions (row sums) and attractions (column sums) for each trip purpose, as in typical IPF usage. This modified IPF solved for the minimum relative-entropy adjustment of the given matrix that satisfies the linear constraints, the same underlying objective as conventional IPF. The method of solution was based on Darroch & Ratcliff, "Generalized Iterative Scaling for Log-Linear Models" (*Annals of Mathematical Statistics* 43.5, 1972).

Table GW-1 compiles gateway traffic counts, and where available, truck volumes classified by single-unit (SU) and multi-unit (MU) configurations. Model gateway data preparation uses the "Targets" selected from the data sources. Classification counts were available for few gateways other than state highways;

targets for the remaining gateways are the previous model's targets factored in proportion to total counted volume changes.

Table GW-1
Gateway Traffic Counts

		Targets				Sources								
Kern MIP Gate-way	Location	Veh	SU	MU	Autos	Cal-trans FY 2023-2024 TWTh	Cal-trans 2022 Census	Cal-trans 2022 SU	Cal-trans 2022 MU	Kern COG 2020-2023	SLO 2015 Mode l	TCA G c. 2020	SCAG 2024 RTP Model	TCAG & SCAG c. 2015
61	SR 33 (N)	2521	154	293	2075	2521	1450	154	293					
62	Barker (Baker)	48	3	3	42					48				
63	King Rd	831	100	100	631					831				
64	I-5 (N)	31244	2382	11627	17234	31244	39500	2382	11627					
65	Corcoran/Dairy	1744	90	90	1564					1744				
66	Road 80	95	1	1	93					50				
67	SR 43	2935	204	377	2355	2935	2850	204	377					
68	Roads 128 + 136	1800	33	33	1734									1741
69	SR 99	52597	2537	10948	39113	52597	56000	2537	10948					
82	Road 144 (Girard)	3500	45	45	3410									2764
70	Roads 152 + 156	1000	6	6	988									859
83	Rd 160 (Veneto/Bowman)	2000	44	44	1912									786
85	Road 192	3500	84	84	3332									1470
71	Famoso-Porterville (Richgrove)	4219	136	136	3947							4219		4790
72	SR 65	8384	910	1119	6354	8384	8000	910	1119					
73	Jack Ranch	249	9	9	231					249				
74	Sierra Way	945	33	33	879					945				
29	SR 395 (N)	5700	239	834	4626		5700	239	834					
30	SR 178	2600	131	130	2340		2400	131	130				2695	
75	Searles Sta. Cutoff	424	20	20	384					424				
31	US 395 (S)	4567	163	615	3787	4567	4500	163	615				4192	
76	Randsburg Cutoff + 20 M.T.Pkwy	73	2	2	69					73				
32	SR 58 (E)	16294	914	5177	10202	16294	15200	914	5177				12691	
77	20 Mule Team Rd in Boron	1099	18	18	1063					1099				
81	Edwards AFB south gate (Redman)	1352	14	4	1334					1352			3176	
33	Sierra Hwy	4080	78	78	3924								1621	3030
84	(unused, next to SR 14)	0	0	0	0									
34	SR 14	39392	724	1434	37234	39392	38000	724	1434				43765	
35	60th St West	997	24	24	949								2174	
36	90th St West	841	20	20	801								1941	
78	170th St West	528	12	12	504					528				
37	I-5 (S)	72319	5433	17706	49181	72319	81000	5433	17706				72504	
38	Lockwood Valley Rd (Mt Pinos)	1303	125	125	1053					1303			1891	
39	SR 33 (S)	3261	239	653	2367	3261	4050	239	653		2045		525	
79	Soda Lake	24	1	1	22					24				
40	SR 58 (W)	152	27	6	118	152	140	27	6		160			
80	Bitterwater Valley Rd	133	5	5	123					133				
41	SR 46	8194	633	1558	6002	8194	8400	633	1558		6994			

Telecommute model

The Central California Travel Survey (CCTS) conducted in late 2022 and early 2023 asked working persons in the San Joaquin Valley counties how many hours per week they telecommute, and how many they recall they telecommuted before covid. Table TC1 gives the weighted frequencies. (The actual sample sizes were 7712 working persons for telecommute frequency, and 7935 for pre-covid frequency, both excluding non-workers.)

Table TC1
Telecommute frequencies in the CCTS (all surveyed counties)

Value	Label	telework_freq How often telecommutes Weighted Sum	Percent	telework_freq_pre_covid How often telecommuted before covid Weighted Sum	Percent
1	6-7 days a week	52,495	3.20%	80,211	4.70%
2	5 days a week	162,560	9.80%	224,183	13.30%
3	4 days a week	50,686	3.10%	46,256	2.70%
4	2-3 days a week	140,702	8.50%	66,006	3.90%
5	1 day a week	68,306	4.10%	48,898	2.90%
6	1-3 days a month	54,766	3.30%	41,246	2.40%
7	Less than monthly	110,911	6.70%	69,473	4.10%
996	Never	1,011,151	61.20%	1,048,732	62.10%
998	Unsure			64,449	3.80%
	Total valid	1,651,577	100.00%	1,689,455	100.00%

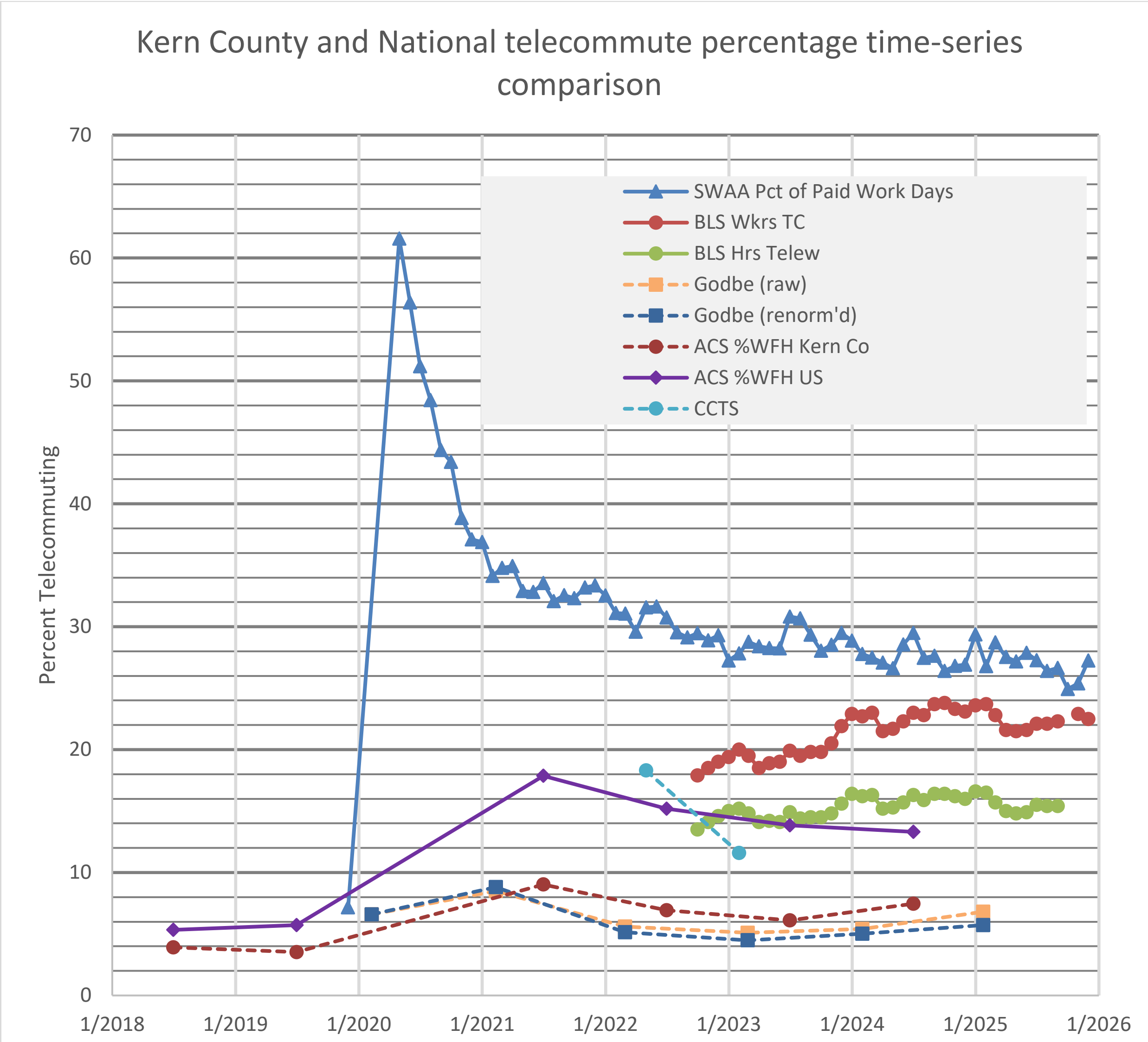
Interpreting 5 or more days a week as 100% telecommuting, and lesser frequencies in proportion, the post-covid effective telecommuting rate by CCTS respondents was 14.7%.

The “pre covid” survey responses are deemed doubtful and are not used, since they show more telecommuting than at the time of survey. Instead, pre- and post-covid telecommuting trends are obtained from both Kern County and national sources:

- Kern County
    - Godbe Research, 2019 through 2025 Community Surveys for Kern COG, Primary Type of Transportation Used Traveling to Work or School
    - US Census American Community Survey (ACS) tabulations of Means of Transportation to Work (from Table B08006, 1-year), Work at Home, of Workers 16 Years and Over
- National
    - Bureau of Labor Statistics (BLS), percentage of workers who telecommuted (Specific tables https://data.bls.gov/timeseries/LNU0201B46B and https://data.bls.gov/timeseries/LNU0201B8A1, via https://www.bls.gov/cps/telework.htm)
    - Survey of Working Arrangements and Attitudes (SWAA), www.wfhresearch.com, percentage of paid full days worked from home. (Barrero, Jose Maria, Bloom, Nick and Davis, Steven J., Work from Home Rate: retrieved from ALFRED, Federal Reserve Bank of St. Louis; https://alfred.stlouisfed.org, January 23, 2026. The pre-COVID figure is from the 2017-2018 American Time Use Survey.)
    - ACS Means of Transportation to Work (from Table B08006, 1-year), Work at Home, of Workers 16 Years and Over

Figure TC1 compares telecommuting rates from the cited sources, from pre-covid to recently-released data.

Figure TC1
Telecommuting as share of working, sources cited



Many of the differences among the various sources in Figure TC1 are due to different definitions of percent telecommuting. The ACS and the Godbe surveys report it in terms of a worker's primary means of transportation to work, likely understating partial or hybrid telecommuting, and are the lowest rates shown. The SWAA reports percentage of paid full days worked from home. The BLS provides two definitions: workers who telecommute, and the percentage of working hours worked from home. The CCTS (all San Joaquin Valley) rates are distinguished by the two waves of data collection, around April-May 2022, and January-February 2023. (Two plots for the Godbe surveys are shown, one raw as reported, the other excluding retired and other non-workers, and re-normalized.)

From the one source available both nationally and locally (ACS), Kern County shows significantly lower overall telecommute rated than nationally. This is partially due to the distribution of industries in Kern County versus the US, and the distinct telecommute rates by industry.

Nationwide compilations from the Bureau of Labor Statistics (BLS) provide a trend by industry since before covid through the present. Table TC2 presents the trend of percentage of usually telecommuting workers by workplace industry, aggregated into the employment categories of the KernCOG model. (Agriculture and Government are not available for earlier years.) A row is inserted for the CCTS for percent of days teleworked, the respondents similarly grouped by workplace industry.

Table TC2
By-Industry National Telecommute Rate Trends, and CCTS Rates

	Agri	Educ	Food	Gov't	Indust	Med	Office	Other	Retail
2019 [1]		8.8%	2.0%		4.6%	5.5%	12.8%	6.1%	3.7%
2021 [1]		23.1%	6.0%		12.9%	12.5%	37.5%	9.7%	10.4%
2022 [1]		17.8%	5.3%		10.8%	11.7%	33.2%	9.6%	9.4%
CCTS (22-23)	*15.9%*	*14.3%*	*4.7%*	*21.6%*	*12.0%*	*15.4%*	*29.2%*	*16.9%*	*3.8%*
2022/10 [2]	5.2%	12.9%	6.4%	14.5%	11.1%	12.1%	41.3%	11.7%	9.4%
2023/04 [2]	7.4%	15.0%	6.2%	15.6%	12.1%	12.7%	41.9%	12.8%	9.8%
2023/10 [2]	9.9%	13.9%	7.4%	16.7%	13.0%	14.0%	44.6%	12.6%	9.8%
2024/04 [2]	10.1%	16.9%	7.6%	19.1%	13.8%	16.0%	47.2%	17.3%	11.3%
2024/10 [2]	12.9%	18.4%	8.6%	19.9%	15.5%	19.0%	50.8%	20.1%	11.7%
2025/01 [2]	15.1%	19.1%	8.7%	19.5%	16.2%	18.2%	49.4%	18.6%	11.6%

Sources: [1] Sabrina Wulff Pabilonia and Jill Janocha Redmond, "The rise in remote work since the pandemic and its impact on productivity," Beyond the Numbers: Productivity, vol. 13, no. 8 (U.S. Bureau of Labor Statistics, October 2024), https://www.bls.gov/opub/btn/volume-13/remote-work-productivity.htm accessed February 2025; [2] https://www.bls.gov/cps/telework.htm, accessed February 2025.

Comparisons between the three sources must be made cautiously due to different definitions of percentage telecommuting, but the fair level of consistency between rates among those for 2022 and after nonetheless indicate we can use the 2019 and CCTS rates as "before" and "after" for the sake of model application. Thereby, the pre-covid telecommute rate is taken as the baseline minimum. (An exception is assumed of no telecommute change for agriculture.)

The telecommute parameter for model application is defined so that 0 corresponds to "before" (2019 national), and 1 corresponds to "after" (CCTS), and any other number specifies a linear combination of the two. If trends of increasing telecommuting from 2022 through 2024 continue, the telecommute parameter for years thereafter could be set to something greater than 1, representing even more of the difference between "before" and "after," while if rates reverse to something between 2019 and 2023 rates, the parameter should be set to something less than 1. For the base calibration model, it is set to 1. For any back-casting models of 2019 or earlier years, it should be set to 0.

The effective telecommuting percentage corresponding to a parameter of 0 is about 5.7%; with the parameter of 1 it is about 13.0% (slightly less than the CCTS rate of 14.7% due to no telecommuting assumed for agriculture employees).

The telecommute model is applied thus:

- Person-trip generation for Home-Based Work (HW) and Work-Other (WO) trip purposes uses estimated "before" trip generation rates, adjusted up from the survey-estimated 2023 rates by reversing the reductions modeled between "before" and "after" in Table TC3. (Note this is not removal of all telecommuters, only a partial removal to 2019 conditions.)
- After trip distribution and before mode choice (in the module TDMAT00B.S), telecommute share reductions are deducted from these person-trips, according to Table TC3. The reduction uses a calculation of each attraction zone's contributing share of each employment type. Consequently, the HW and WO person trips in {SCENARIO_SHORTNAME }_TRIPTABLE.mat, and all subsequent trip tables (mode choice, etc.) show lesser totals than the respective totals from trip generation. (District matrix District summary { SCENARIO_SHORTNAME }_C2CTrips.mat, and summary report {SCENARIO_SHORTNAME}_TotTrips_byPurpVeh.csv, also show the reduced trips.)

Table TC3
Telework Trip Reduction Parameters for Home-Work and Work-Other

Generator	Category	Telework deduction
Employees	Education	0.061
Employees	Food	0.028
Employees	Gov't (urban)	0.166
Employees	Gov't (rural)	0.06
Employees	Industrial	0.078
Employees	Medical	0.105
Employees	Office	0.187
Employees	Other	0.115
Employees	Retail	0.001
Employees	Agricultural	0
Households	Income classes 1, 2	0.954
Households	Income classes 3, 4	0.954
Households	Income class 5	1.188
Gateways	IX HW_L	0.077
Gateways	IX HW_M	0.103
Gateways	IX HW_H	0.114

Note: In application, the parameter "Telework_Factor" multiplies these reductions, in order to model greater or lesser telework trip reductions relative to those in the 2023 base validation model.

The 2023 validation model uses 1 for the telework parameter. Compared to a setting of 0, this step reduces total HW trips generated by 8.0%, and total WO trips generated by 8.1%.

Trip generation

Trip productions for Home-Based Work, Home-Based Shop, and Home-Based Other (HW, HS, and HO), each are the products of:

- Cross-classified base rates, by combination of persons per household and household income (each in five categories). For Home-Based Work, these rates are already adjusted from the 2023 survey estimated rates by an inverse factor of the telework trip reductions, to estimate c.2019 trip production rates.
- A new function of a zonal measure of accessibility, using the computed variable ACT_30AUT, which is the total of workers living plus working within 30 minutes by auto.
- For Home-Based Work only, a factor of 0.427 for households with householder age 65 or more.

Table TG-1 shows the cross-classified rates directly computed from Kern County samples of the CCTS with householder under age 65, along with the base rates actually applied. The applied rates were obtained by weighted-average smoothing among selected adjacent cells, toward reasonable trends seen from larger samples. The applied rates also reflect moderate calibration adjustments.

Table TG-1
Person-trip production base rates estimated from 2022-23 Central California Travel Survey

Home-Based Work (householder under age 65)

	Raw Rates in CCTS						Applied Base Rates				
	Inc 1	Inc 2	Inc 3	Inc 4	Inc 5		Inc 1	Inc 2	Inc 3	Inc 4	Inc 5
1 Pers	0.217	1.198	0.955	0.472	2.152	1 Pers	0.691	0.757	1.251	1.727	2.044
2 Pers	0.598	0.899	1.753	1.692	1.632	2 Pers	0.903	1.425	1.771	2.066	2.196
3 Pers	0.926	0.385	2.046	2.271	2.207	3 Pers	1.110	1.502	1.853	2.262	2.272
4 Pers	0.873	1.502	1.977	0.842	1.982	4 Pers	1.255	1.559	1.979	2.379	2.375
5+Pers	0.546	1.369	1.987	2.340	1.603	5+Pers	1.387	1.636	1.943	2.205	2.131

Home-Based Shop

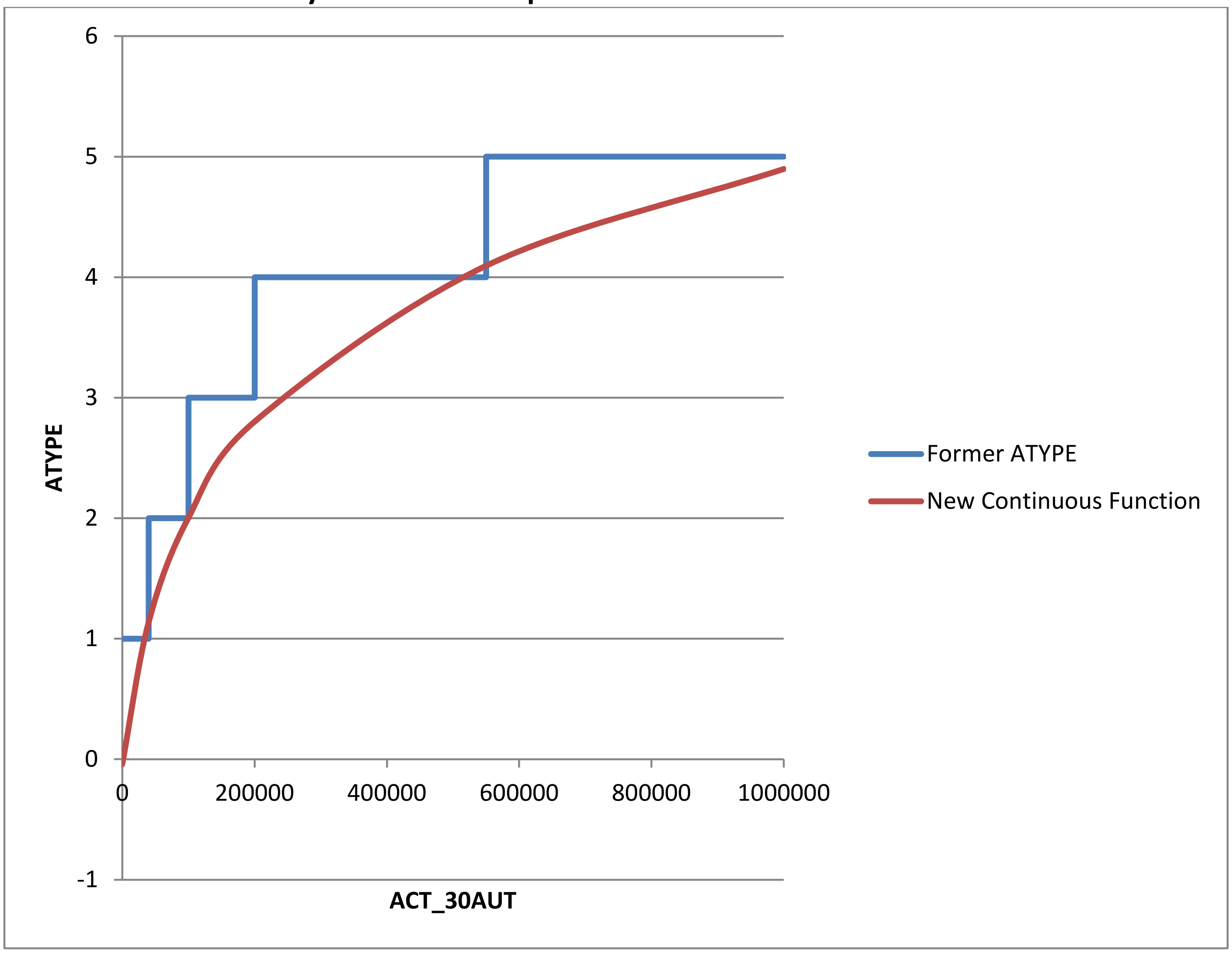
	Raw Rates in CCTS						Applied Base Rates				
	Inc 1	Inc 2	Inc 3	Inc 4	Inc 5		Inc 1	Inc 2	Inc 3	Inc 4	Inc 5
1 Pers	0.693	0.489	0.208	1.490	0.373	1 Pers	0.668	0.596	0.584	0.533	0.707
2 Pers	1.439	1.046	0.512	0.833	0.584	2 Pers	0.972	0.844	0.783	0.615	0.644
3 Pers	0.949	1.363	0.862	0.517	0.477	3 Pers	1.301	1.059	1.060	0.862	0.960
4 Pers	0.883	1.519	0.565	2.193	1.373	4 Pers	2.063	1.799	1.488	1.048	1.038
5+Pers	3.838	2.301	1.411	0.097	1.008	5+Pers	2.386	2.076	1.708	1.299	1.362

Home-Based Other

	Raw Rates in CCTS						Applied Base Rates				
	Inc 1	Inc 2	Inc 3	Inc 4	Inc 5		Inc 1	Inc 2	Inc 3	Inc 4	Inc 5
1 Pers	1.218	0.872	1.343	3.292	2.123	1 Pers	1.103	1.142	1.372	2.038	2.426
2 Pers	3.200	3.562	2.465	3.598	2.260	2 Pers	2.311	2.448	2.925	2.955	3.059
3 Pers	3.355	3.679	4.900	4.087	3.924	3 Pers	4.696	4.096	4.515	4.515	5.157
4 Pers	6.832	7.818	2.735	9.840	9.919	4 Pers	5.582	5.968	7.356	8.656	9.286
5+Pers	5.243	5.814	11.610	19.714	15.574	5+Pers	6.365	6.796	8.633	11.289	12.639

Ranges of a zonal measure of accessibility, ACT_30AUT, were used in pre-2017 versions of the Kern MIP model to categorize each zone into one of five discrete categories for trip generation rates. Beginning with the 2017 versions, an independent zonal variable PLACETYPE provided this selection. (PLACETYPE is a field in the Socioeconomic Detail input file.) This model introduces a continuous function of ACT_30AUT as a variable for the home-based trip production rates, replacing the discrete selection. This function provides a response of trip generation to congested travel times. The continuous function is *ln*(ACT_30AUT+30188)*1.4-14.47. Figure TG-1 compares it to the former discrete selection, showing it to be an approximately fitted function to the former selection.

Figure TG-1
Continuous Accessibility Function for Trip Productions



Factors for accessibility were estimated using a maximum likelihood of a modified Poisson distribution of the CSTS observed trips by each household, having the form [adjusted trips] = [raw trips] * exp(beta*[continuous ATYPE] + constant). Table TG-2 lists the estimated parameters. Table TG-2 also lists the minimum and maximum factors applied in the 2023 validation model. (These minimum and maximum factors are not constraints; higher and lower factors are possible in future and alternative scenarios.) Those particular trip purposes that estimated a negative sign for beta were replaced with beta = constant = 0.

Table TG-2
Estimated accessibility parameters for trip productions

Trip purpose	beta	constant	Minimum applied multiplier	Maximum applied multiplier
HW_H	0	0	1	1
HW_M	0.0394	-0.1577	0.855	1.013
HW_L	0.0189	-0.0756	0.928	1.006
HS	0	0	1	1
HO	0.0177	-0.0706	0.932	1.006

The CCTS's inclusion of the workplace industry question enabled direct calculation of Home-Based Work attraction rates, and Work-Other production rates. (Most household travel surveys lack this question; indirect statistical inference methods are required from such surveys.) Calibrated rates incorporate the reversing of the telecommute shares, back to c.2019 levels, as well as reasonability checks, regional production-attraction balance, and calibration adjustments motivated by traffic count, VMT, and other validation checks. Table TG-3 shows the survey analysis and the calibrated rates.

As with the most recent prior Kern MIP models, government employees are given distinct rates between those in urban areas and rural areas (the latter including prison and military installations). The zonal variable PLACETYPE in the socioeconomic input file determines the selection: 1, 2, or 3 indicate rural, 4 or 5 indicate urban. (This is the only remaining use of the PLACETYPE variable in this update of the Kern MIP model.)

Table TG-3
Home-Work and Work-Other Trip Rate Analysis from CCTS

Industry	Employees*		Home-Work			Work-Other		
	Sample Count	Weighted	Weighted Trips	Attract-tion Rate	Calibra-tion	Weighted Trips	Produc-tion Rate	Calibra-tion
Education	107	42817	64902	1.52	1.42	66978	1.56	1.77
Food	45	7981	12108	1.52	1.37	4525	0.57	0.62
Gov't	45	23601	31986	1.36		37280	1.58	
urban					1.40			1.75
rural					1.19			0.90
Industrial	99	40444	67102	1.66	1.58	27612	0.68	0.79
Medical	59	23042	30138	1.31	1.29	57258	2.48	2.95
Office	67	21195	24658	1.16	1.26	29047	1.37	1.79
Other	42	8247	13850	1.68	1.65	102451	12.42	0.82
Retail	47	16105	21137	1.31	1.16	28779	1.79	1.90
Agricultural	37	12689	21671	1.71	0.44	24682	1.95	0.48

Note: * Total CCTS weighted employees do not necessarily match Kern COG model totals or other sources.

Table TG-4 shows the remaining trip generation rates of the personal travel models. School and college (HK and HC) productions per person by age range were estimated directly from the CCTS, then adjusted for regional balance and calibration. The remaining rates were adjusted from the previous calibration by judgement, considering regional balance and traffic calibration.

Table TG-4
Attractions and other trip production rates

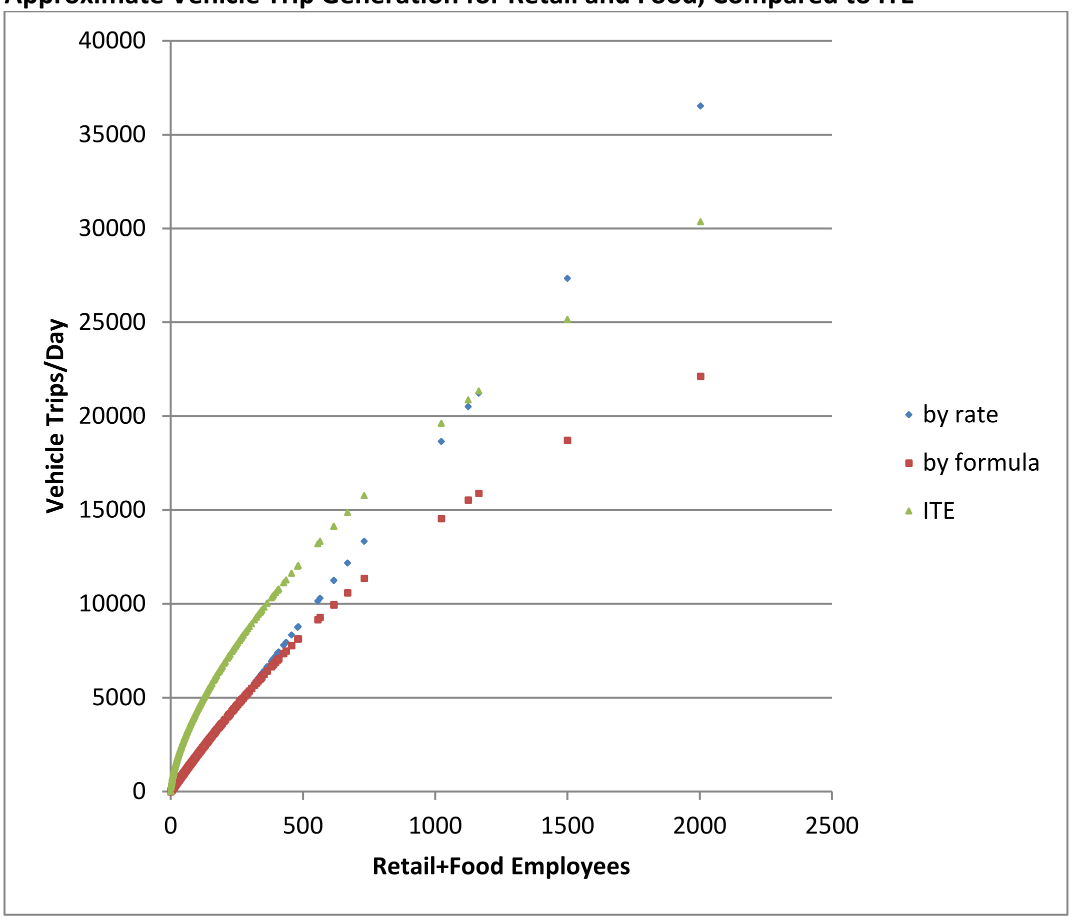
Area Type	LU_Type	HK_P	HC_P	WO_P	OO_P	HW_A	HS_A	HK_A	HC_A	HO_A	WO_A	OO_A
	All households									0.55*HO_P		
	POP0004	0	0	0	0	0	0	0	0	0	0	0
	POP0514	1.40	0	0	0	0	0	0	0	0	0	0
	POP1517	1.48	0.14	0	0	0	0	0	0	0	0	0
	POP1824	0.85	0.45	0	0	0	0	0	0	0	0	0
	POP2554	0	0.10	0	0	0	0	0	0	0	0	0
	POP5564	0	0.05	0	0	0	0	0	0	0	0	0
	POP6574	0	0.08	0	0	0	0	0	0	0	0	0
	POP75	0	0.01	0	0	0	0	0	0	0	0	0
	EMPEDU	0	0	1.77	0	1.42	0	0	0	0	0	0
	EMPFOO	0	0	0.62	5.00	1.37	0.76	0	0	7.50	6.48	5.00
1,2, 3	EMPGOV	0	0	0.90	0.05	1.19	0	0	0	0	0.2	0.05
4	EMPGOV	0	0	1.75	1.20	1.40	0	0	0	2.20	0.82	1.20
5	EMPGOV	0	0	1.75	1.80	1.40	0	0	0	3.00	1.70	1.80
	EMPIND	0	0	0.79	0.02	1.58	0	0	0	0	0.35	0.02
	EMPMED	0	0	2.95	1.20	1.29	0	0	0	2.50	0.35	1.20
	EMPOFC	0	0	1.79	1.20	1.26	0	0	0	0.80	0.71	1.20
	EMPOTH	0	0	0.82	0.02	1.65	0	0	0	0	0.35	0.02
	EMPRET	0	0	1.90	4.00	1.16	8.29	0	0	3	3.89	4.00
	EMPAGR	0	0	0.48	0	0.44	0	0	0	0	0.12	0
	ELEM	0	0	0	0.24	0	0	1.4	0	0.35	0.12	0.24
	HS	0	0	0	0.24	0	0	1.4	0	0.35	0.12	0.24
	COLLEGE	0	0	0	0	0	0	0	1.2	0	0	0

Calibration efforts found modeled traffic volumes high compared to counts in areas with large concentrations of commercial activity, such as near the shopping mall at Ming and SR 99, large auto dealerships along Wible Rd, and the Riverwalk shopping center. Trip-based travel models usually use proportional attractions, as from fixed rates, for all land uses including retail, to keep aggregate trip generation independent of the zone boundaries and sizes. However, ITE has long reported a non-linear relationship between shopping center size and trip generation, with marginal trips per thousand square feet decreasing with size. (Institute of Transportation Engineers, *Trip Generation*, various editions) This is usually not a problem with travel demand models, because after deducting “pass-by” trips by ITE methods, the remaining “primary” trips are closer to proportional to size. (Distribution of “pass-by” trips is rare and difficult in trip-based models, but “intermediate stop” modeling is common in practical activity-based models.) Furthermore, in models, larger zones distribute a higher intrazonal share of their trips, also lessening their marginal loading rate.

Many activity-based travel demand models include non-linear attraction functions using “log-size multipliers,” which effectively raise each zone’s (or sub-zone’s) proportional attractions to a power between zero and one. They equivalently represent the individual unit destinations as “nested” within their TAZs. Four out of five do so in the present Sacramento regional model (SACOG).

The persistence of high modeled volumes around large retail zones despite efforts to maximize their intrazonal capture prompted introduction of non-linear trip attractions for retail and food zonal employment. This works as a multiplier upon the rate-based trip attractions by retail and food equal to 9.22*2400 / (8.29*([retail employees]+[food employees]+2400)). Figure TG-1 plots this function with a data point for each TAZ, and compares it to the fitted function in the ninth edition of ITE *Trip Generation*. (Assumptions for comparability: 500 sf per retail and food employee, 26.5 person trips per retail and food employee, and the model's average ratio of 0.688 vehicle trips per person trip attributable to retail and food activity.) Note that the ITE function has a nearly infinite rate near zero due to its logarithmic form, whereas the model's new multiplier begins finitely slightly greater than one for small zones (the plotted red points imperceptibly above the blue points), but falls significantly only for the largest retail zones. The function was tuned so that the increase upon many small zones balances out in total against the decrease upon the largest zones. (The trip generation "by formula" remains intentionally below ITE, to maintain regional production-attraction balance and to exclude "pass-by" trips.)

Figure TG-1
Approximate Vehicle Trip Generation for Retail and Food, Compared to ITE



Trip distribution

Table TD-1 compares the trip lengths (travel time) from the Validation Summary spreadsheets from the previous 2019 calibration using regional trips from the 2012 California Household Travel Survey (CHTS), and the new 2023 calibration using regional trips in the 2022-23 Central California Travel Survey (CCTS). It is not clear why the surveyed trip lengths compute longer in the new survey for most trip purposes, when the surveys used different recruitment, data collection, and processing methods. Unless differences in the surveys are analyzed and understood well, no trend can be reliably inferred.

While the surveyed trip lengths appear to have lengthened, the model was adjusted toward shorter trip lengths than the previous model for calibration. Indications for this include:

- Reducing trip generation would have similarly reduced traffic volumes. But the errors inherent in travel surveys have more ways to miss some trips, rather than add trips in.
- Previous draft models tended to have low traffic volumes in residential areas, but high on the freeways, compared to counts. Shortening trips thus removed many trips from the freeways without removing them from the neighborhoods.

Table TD-1
Model and Survey Comparison: Average Travel Time (in minutes) by Trip Purpose

Year 2019	Trip Purpose					
	HBW		HBO		NHB	
	CHTS	Model	CHTS	Model	CHTS	Model
	21.1	16.7	14.2	13.2	13.5	10.3
	Notes: 2012 California Household Travel Survey, Weekday Trips, re-weighted by F&P. Includes only internal-to-internal, weekday person trips for all modes. HBO excludes HK and HC.					

Year 2023	HBW		HBO		NHB	
	CCTS	Model	CCTS	Model	CCTS	Model
	27.2	15.5	15.0	10.5	20.0	8.3
	Notes: 2022-23 Central California Travel Survey, Weekday Trips, Includes only internal-to-internal, weekday person trips for all modes. HBO excludes HK and HC.					

Table TD-2 shows the friction factor beta parameters for the new calibrated Kern MIP model.

Table TD-2
Friction Factor Parameters for Trip Distribution

Trip Purpose	I-I	I-X & X-I
HWH	-0.08	-0.0736
HWM	-0.068	-0.0626
HWL	-0.05	-0.046
HS	-0.19	-0.152
HK	-0.31	-0.2852
HC	-0.127	-0.1168
HO	-0.138	-0.1104
WO	-0.137	-0.1096
OO	-0.175	-0.140

Network

A "master network" represents the modeled highway network not only in one year, but specifies new roadways, widenings, and closures for the range of years of the model's application. Most notable among the latter is the Centennial Freeway still under construction in 2023, which extends the Westside Freeway eastward to the SR 99 - SR 58 junction.

DKS made additional edits to the highway network in the effort to calibrate the model to better fit traffic counts, and otherwise to review for accuracy:

- Check the Centennial Freeway and ramps for consistency that the year of opening is 2024.
- Narrow SR 99 and SR 58 by one lane per direction in the vicinity of the Centennial construction area, where discernable in Google Earth historical aerial images during the Centennial construction years. Set their existing lanes to be restored in 2024.
- Narrow SR 99 between Panama Rd and White Lane, for a construction project during at least a portion of 2023 seen in Google Earth historical aerial images. Set existing lanes to be restored in 2024.
- Modify the network connections to Edwards Air Force Base so ensure no traffic can pass through the base.
- Activate centroid connectors that were inactive but whose zones have land use.
- Activate a link that exists on Stein Rd near Bear Mountain Rd.
- Adjust speeds on Stockdale, Buena Vista Rd, Akers, Real Rd, Lerdo Highway, Rosedale, streets at interchanges with the Westside Freeway.

Model updates

Highway network modeling

- Auto operating cost rates per mile for the base and future years were replaced with new estimates in "San Joaquin Valley Auto Operating Cost Update" by Trinity Consultants communicated by Alex Marcucci 9/25/2024, and forwarded to DKS on 9/30/2024. Table AOC reports the years given. Intervening years were interpolated, and years after 2046 keep the 2046 value. Being given in 2023 cents, they were adjusted to the model's monetary units year of 2008, using the US Bureau of Labor Statistics inflation calculator's average equivalence of $0.71 in 2008 to $1.00 in 2023.

- In the processing of the master network to build the scenario year network, the link distances are now calculated from the x-y coordinates, except where a non-zero "DIST_ADJ" link value is provided, which overrides (mainly on gateway links). A significant number of links had inexplicably incorrect distances, and Cube was defaulting to an incorrect distance scale.

Table AOC
Updated Auto Operating Costs

	Cost per mile	
Year	2023 ¢	2008 ¢
2010	33.58	23.84
2020	23.20	16.47
2025	29.65	21.05
2030	29.87	21.21
2035	31.36	22.26
2040	34.33	24.37
2046	38.03	27.00

Sources: Trinity Consultants memo of 9/25/2024, US BLS

Transit network

The KernCOG model calibration document dated 9/12/2025 reported model calibration using transit line data furnished by KernCOG. The line data closely followed the recommended routes in *Metro Bakersfield Moves Long-Range Transit Plan* (LRTP) by the Golden Empire Transit District (GET), June 2024 (https://www.getbus.org/wp-content/uploads/2025/03/Metro-Bakersfield-Moves-Final-Report.pdf). Particularly, KernCOG provided the plan's short-term recommended routes for the 2023 calibration base year through 2029 scenarios, its medium-term recommended routes for 2030 through 2034 scenarios, and its long-term recommended routes for 2035 and later scenarios. The decision to use a near-term planned transit network instead of the actual routes in service reflects a judgement that the near-term service network reasonably represents the coverage and quality of existing service, considering that the near-term planned lines were modified incrementally from existing lines, as well as an expectation that the near-term plan would be implemented soon.

Since the coverage area and level of service was similar between the existing and near-term planned routes, it was further judged that a calibration using the near-term plan would, in the aggregate of all GET lines, would be appropriate for a model using those planned networks in the future. The calibration document of 9/12/2025 therefore reported total boardings of each service, but not of each individual line, because the lines are significantly different and do not directly correspond to existing lines.

At the request of KernCOG, to enable line-by-line comparison of the base-year model to passenger counts, a base-year scenario of existing transit lines was prepared. This existing transit line file was updated according to maps and schedules published by the three fixed-route transit services in Kern County:

- Golden Empire Transit (GET)
- City of Delano Transit (DART)
- Kern Regional Transit

For each, sources close to 2023 were sought. Few changes in services could be identified between 2023 and early 2026. The GET LRTP shows an existing route map identical to the current map, except for a line 92 already being phased out. Kern Regional Transit's schedules effective December 2022 were published as an appendix in *Kern Transit Unmet Nees Report, Fiscal Year 2022-2023.* Delano Transit's website publishes a schedule document bearing a 2022 date, which agrees with the current online weekday schedules.

Recalibration was necessary due to the update of the existing transit network, not only for the aggregate boardings by the three services, but to improve individual line validation. Calibration of the model's transit-related parameters included:

- correction of all bus services miscoded as "rail" transit,
- adjustment the "TimeFacB" key values for arterial and lower-class roadways from 1.3 to 1.7 (to lessen the model's over-prediction of Kern Regional relative to the others, and to bring modeled run times closer to scheduled run times),
- re-adjustment of the mode choice alternative-specific parameters, and
- enlargement of the model's permitted walk distance on the network to enable walk access through the longer centroid connectors of zones served by Kern Regional Transit. (Formerly, these zones had long walk-access distances enabled by the "rail" miscoding.)

All other recalibrated inputs and parameters of the Kern MIP-3 model remain the same as reported in the 9/12/2025 model documentation, and model data furnished therewith, although all model outputs changed by minor amounts.

Auto availability model

- The alternative-specific constants were adjusted to better fit distributions in the CCTS Kern samples and recent Census ACS/PUMS tabulations shown in Table AA-1.

Table AA-1

Autos	Model	2023 CCTS	2019 ACS 1yr	PUMS 2022-2023
0 Veh	6.5%	4.4%	6.4%	6.9%
1 Veh	29.6%	32.6%	29.6%	28.9%
2 Veh	37.2%	36.7%	38.3%	37.5%
3 Veh	17.6%	18.1%	16.5%	17.7%
4+ Veh	9.1%	8.2%	9.2%	8.9%
Total	100.0%	100.0%	100.0%	100.0%
Avg Veh/HH	1.97	1.97	1.97	1.97

Mode choice

- The demand-responsive transit (DRT) modelling feature, introduced in the 2021 model update to represent the GET On-Demand service, remains in the model. But due to that service's discontinuation, the zone set for its service area has been coded empty.
- Adjusted alternative-specific constants, calibrating toward the CCTS and recent transit ridership counts. Table MC-1 below compare survey and model mode shares by purpose and car-per-person household class, and ridership comparisons. The CCTS targets were developed as a composite, using survey records from Kern County households alone for the larger components, but using all central California survey records for smaller components where necessary to smooth small-sample noise.
- The model's accessibility script, which performs most of the actual mode choice calculation, had inadvertently left out a factor of 60 minutes per hour in the division of monetary costs by value-of-time when converting to time equivalence. Following correction, mode choice alternative-specific constants were recalibrated.
- Since trip distribution uses mode choice composite utilities (logsums), the friction factor parameters had to be adjusted to account for the increased composite costs. The parameters in Table TD-2 reflect this adjustment.

Table MC-1a
Mode shares by trip purpose and household segment
2022-23 CCTS, composite of Kern County and all surveyed households

Purpose	Class	DA	SR2	SR3+	Transit	Bike	Walk	School Bus
HW	0Veh	0.0%	72.6%	0.5%	18.8%	6.8%	1.4%	
	Veh<Pers	75.1%	15.8%	4.3%	0.1%	3.5%	1.3%	
	Veh≥Pers	95.0%	2.9%	1.4%	0.0%	0.4%	0.2%	
HW Total		**81.8%**	**11.6%**	**3.1%**	**0.4%**	**2.3%**	**0.8%**	
HS	0Veh	0.0%	56.8%	17.5%	9.9%	1.3%	14.5%	
	Veh<Pers	35.5%	31.5%	28.3%	0.2%	0.2%	4.4%	
	Veh≥Pers	75.8%	17.0%	5.2%	0.0%	0.9%	1.1%	
HS Total		**46.6%**	**27.9%**	**21.0%**	**0.5%**	**0.4%**	**3.7%**	
HK	0Veh	0.0%	10.8%	30.7%	0.9%	1.7%	19.3%	36.6%
	Veh<Pers	2.4%	24.9%	45.3%	0.0%	0.4%	7.4%	19.6%
	Veh≥Pers	15.1%	75.2%	5.8%	0.4%	0.1%	0.4%	3.0%
HK Total		**2.9%**	**26.6%**	**43.7%**	**0.0%**	**0.4%**	**7.3%**	**19.1%**
HC	0Veh	0.0%	54.6%	11.0%	5.1%	8.2%	21.1%	
	Veh<Pers	32.7%	33.0%	18.9%	4.7%	0.0%	10.8%	
	Veh≥Pers	96.2%	0.5%	2.4%	0.2%	0.5%	0.2%	
HC Total		**50.4%**	**23.9%**	**14.2%**	**3.4%**	**0.2%**	**7.9%**	
HO	0Veh	0.0%	42.0%	39.1%	1.7%	2.5%	14.7%	
	Veh<Pers	22.7%	30.4%	40.5%	0.1%	0.2%	6.1%	
	Veh≥Pers	56.2%	27.0%	7.3%	0.1%	0.9%	8.6%	
HO Total		**29.4%**	**30.0%**	**33.2%**	**0.1%**	**0.4%**	**6.9%**	
WO	0Veh	0.0%	78.3%	4.5%	6.3%	2.9%	8.0%	
	Veh<Pers	68.6%	15.1%	5.8%	0.1%	0.0%	10.4%	
	Veh≥Pers	83.8%	6.1%	4.5%	0.4%	0.6%	4.6%	
WO Total		**73.1%**	**12.6%**	**5.4%**	**0.2%**	**0.2%**	**8.5%**	
OO	0Veh	0.0%	33.7%	34.7%	1.9%	1.2%	28.6%	
	Veh<Pers	22.8%	32.0%	40.5%	0.1%	0.1%	4.6%	
	Veh≥Pers	59.5%	29.2%	8.0%	0.1%	0.5%	2.6%	
OO Total		**31.0%**	**31.4%**	**31.7%**	**0.2%**	**0.3%**	**5.5%**	

Table MC-1b
Mode shares by trip purpose and household segment
Kern MIP-3 updated model (3/1/2025)

Purpose	Class	DA	SR2	SR3+	Transit	Bike	Walk	School Bus
HW	0Veh	0.0%	77.5%	0.5%	13.1%	7.5%	1.4%	
	Veh<Pers	75.1%	15.7%	4.3%	0.0%	3.5%	1.2%	
	Veh≥Pers	95.0%	2.9%	1.5%	0.0%	0.5%	0.2%	
HW Total		**80.5%**	**12.9%**	**2.9%**	**0.6%**	**2.3%**	**0.8%**	
HS	0Veh	0.0%	58.4%	18.2%	7.1%	1.5%	14.9%	
	Veh<Pers	35.4%	31.4%	28.5%	0.1%	0.2%	4.3%	
	Veh≥Pers	75.7%	17.0%	5.3%	0.0%	0.9%	1.1%	
HS Total		**47.7%**	**27.8%**	**19.6%**	**0.5%**	**0.5%**	**3.8%**	
HK	0Veh	0.0%	10.8%	30.9%	0.6%	1.8%	19.3%	36.7%
	Veh<Pers	2.4%	24.7%	45.4%	0.0%	0.4%	7.4%	19.6%
	Veh≥Pers	15.1%	75.3%	5.9%	0.2%	0.1%	0.4%	3.0%
HK Total		**3.1%**	**27.4%**	**42.7%**	**0.0%**	**0.4%**	**7.3%**	**19.0%**
HC	0Veh	0.0%	55.3%	11.2%	3.4%	8.7%	21.4%	
	Veh<Pers	33.2%	33.4%	19.3%	3.1%	0.0%	10.9%	
	Veh≥Pers	96.4%	0.5%	2.5%	0.1%	0.5%	0.0%	
HC Total		**59.7%**	**19.9%**	**11.2%**	**1.8%**	**0.8%**	**6.7%**	
HO	0Veh	0.0%	42.1%	39.5%	1.1%	2.6%	14.7%	
	Veh<Pers	22.6%	30.3%	40.7%	0.0%	0.2%	6.1%	
	Veh≥Pers	56.2%	27.0%	7.4%	0.0%	0.9%	8.6%	
HO Total		**32.3%**	**29.7%**	**30.2%**	**0.1%**	**0.5%**	**7.2%**	
WO	0Veh	0.0%	80.1%	4.7%	4.2%	3.1%	8.0%	
	Veh<Pers	68.8%	15.1%	5.9%	0.0%	0.0%	10.1%	
	Veh≥Pers	84.0%	6.2%	4.6%	0.2%	0.6%	4.4%	
WO Total		**71.8%**	**14.3%**	**5.4%**	**0.2%**	**0.4%**	**7.9%**	
OO	0Veh	0.0%	34.3%	35.7%	1.2%	1.2%	27.6%	
	Veh<Pers	22.6%	32.0%	40.9%	0.0%	0.1%	4.4%	
	Veh≥Pers	59.6%	29.2%	8.1%	0.0%	0.6%	2.5%	
OO Total		**35.0%**	**31.1%**	**29.1%**	**0.1%**	**0.3%**	**4.5%**	

As shown in Table MC-2, overall ridership for each of the three fixed-route service agencies in Kern County agree well with observed boarding counts. (Kern Regional Transit boarding counts were changed from those in the 9/12/2025 documentation. The former were per operation day including weekends, the updated are a more-correct average weekday estimation.)

Table MC-2
Comparison of modeled transit boardings (average per weekday),
Totals by service agency

Service	Observed (2023)	Modeled
Golden Empire Transit	10,522	10,278
Kern Regional Transit	654	804
Delano Area Regional Transit	333	324
Total	11,509	11,406

Truck/Commercial Vehicle Model

The Kern MIP3 model has a 3-step trip-based truck and commercial vehicle model, consisting of trip generation, trip distribution, time of day splitting; traffic assignment includes truck/CV trips along with all other vehicle trips. Trucks and commercial vehicles are generated, distributed, and assigned in three classes:

- small “TS” vehicles that traffic classification counts cannot distinguish from other autos,
- single-unit configurations, also referred to as medium “TM” vehicles,
- multi-unit configuration, also referred to as heavy “TH” vehicles.

While this model covers not just the travel of trucks per se, but of a broader range of commercial vehicles, “trucks” hereafter refers to the full range of vehicles and their travel.

Trip generation

The input file “CrossClass_TripRates_Trucks.csv” provides the trip generation rates. In the original 2017 version of the Kern MIP model from Fehr & Peers, this file had the short-haul truck trip generation rates from Table 22 of *San Joaquin Valley Model Improvement Program Freight Forecasting Models*, RSG, 2008 (hereafter “*FFM*”). Truck trips therefrom were distributed as internal-internal only. IX and XI trips were provided from an exogenous truck trip matrix. In the 2017 DKS update of the Kern MIP model, DKS noted that the exogenous trips were not sensitive or even proportionate to zonal land use, and to mitigate this, DKS changed the truck model to a combined II+IX+XI model. To account for the additional trip generation being modeled, DKS increased the truck trip generation rates to include long-haul trips computed from commodity flow tables in the *FFM*.

The basis of the additional long-haul trip rates is the inbound and outbound commodity flows for Kern County in Tables 2, 3, 4, 5, 7, summarized here in Table TM-1. Also shown is a straight-line estimate for 2015, the base-year of the model then under preparation.

Table TM-1
Commodity Flows for Kern County

Outbound commodity flows (tons/year)					
Commodity	2007	2040	2015 SL	Supplemental	Total 2015
Agr	8,540,037	21,164,870	11,600,603	30,323,389	41,923,992
MfgEquip	803,788	1,776,473	1,039,590		1,039,590
MfgProd	4,846,764	6,781,443	5,315,777		5,315,777
Mining	50,252,908	85,147,435	58,712,187		58,712,187
Wholesale	3,552,349	6,566,785	4,283,121		4,283,121

Inbound commodity flows (tons/year)					
Commodity	2007	2040	2015 SL	Supplemental	Total 2015
Agr	8,187,089	16,219,467	10,134,332	23,199,868	33,334,200
MfgEquip	1,341,445	2,167,730	1,541,757		1,541,757
MfgProd	5,978,893	8,284,565	6,537,844		6,537,844
Mining	56,454,056	76,394,447	61,288,090		61,288,090
Wholesale	2,659,250	5,000,512	3,226,829		3,226,829

Source: *San Joaquin Valley Model Improvement Program Freight Forecasting Models*, RSG, Tables 2, 3, 4, 5, 7.

Table 10 of the *FFM* gave payload factors for inter-county flows, and estimated splits into medium and heavy trucks. Table TM-2 summarizes those factors and splits, and estimates their resultant trips per weekday.

Table TM-2
Inter-County Commodity Payload Factors and Medium-Heavy Vehicle Splits

	Payload Factors (tons/veh)			Outbound		Inbound	
Commodity	Medium	Heavy	M/H ratio	TM Trips	TH Trips	TM Trips	TH Trips
Agr	10.38	19.85	0.13	1,859	7,476	1,478	5,944
MfgEquip	7.45	14.74	0.14	69	247	102	367
MfgProd	10.09	16.82	0.06	119	1,193	147	1,467
Mining	9.32	11.04	0.08	1,867	19,697	1,948	20,561
Wholesale	9.09	14.53	0.11	187	1,062	141	800

Source for factors and split: *San Joaquin Valley Model Improvement Program Freight Forecasting Models*, RSG, Table 10. Trips calculated from Table TM-1 Total 2015, and the factors and splits.

Dividing the inbound plus outbound daily truck trips in Table TM-2 by employment associated with the respective commodities yields estimated long-haul truck trip generation rates, as summarized in Table TM-3. For mining, the computed rates were not applied in the Kern MIP, since they are exceptionally high and do not account for rail shipment. (For example, the large borax mine in eastern Kern County has its own rail yard and spur line.) The agricultural rates are applied instead.

Table TM-3
Estimated Long-Haul Truck Trip Generation Rates for Kern County

		Total Out + In trips/day			
		TM	TH	TM	TH
Commodity	Employees	Trips	Trips	Tr/Emp	Tr/Emp
Agr	61,269	3,336	13,421	0.0545	0.2190
MfgTotal	14,080	436	3,274	0.0310	0.2325
Mining	14,080	3,815	40,258	0.2709	2.8592
Wholesale	15,327	327	1,863	0.0214	0.1215

The truck trip generation model uses the following equivalencies for employment types in the Kern MIP input data files, as shown in Table TM-4.

Table TM-4
Truck Trip Generation Employment Type Equivalencies

Truck Model Variable (Table CV-2)	Socioeconomic Input (SED_Detail) field
Retail Employment	EMPRET + EMPFOO
Mining Employment	EMPOTH/2
Construction Employment	EMPIND/3
Manufacturing Employment	EMPOTH/2
Transportation Employment	EMPIND/3
Wholesale Employment	EMPIND/3
Finance Employment	EMPOFC
Government Employment	EMPGOV + EMPEDU + EMPMED

Table TM-5 shows the combined short- plus long-haul truck trip generation rates derived from the *FFM*, as they were applied in the Kern MIP models updated by DKS from 2017 through 2022.

Table TM-5
Truck Trip Generation Rates from Prior Kern MIP3 Models of 2017-2022

Type	Light	Medium	Heavy	Attraction variables
Moving People (Bus, Shuttle, Taxi, Rental)	0.00750	0.00963	0	Households
	0.01210	0.00298	0	Employment
Package/Product/Mail	0.00167	0.00015	0.00001	Households + Employment
Urban Freight	0.03551	0.01357	0.00345	Households
	0.12571	0.03463	0.00592	Retail Employment
	0.15714	0.06684	0.12535	Agriculture, Mining Employment
	0.15714	0.03961	0.01583	Construction Employment
	0.13278	0.04867	0.12571	Manufacturing Employment
	0.13278	0.03318	0.00945	Transportation Employment
	0.13278	0.04386	0.07021	Wholesale Employment
	0.06186	0.00925	0.00081	Finance, Government, Education Employment
Construction	0.03041	0.02020	0.00394	Households, Total Employment
Providing Services (Business, Utility, Safety)	0.35243	0.17895	0.00161	Households
	0.32839	0.15928	0.00161	Employment

For the current calibration, two adjustments were made for application and calibration:

- Due to an unknown amount of overlap between the non home-based trip purposes and work-related travel largely in the light vehicle category, the given non-residential light rates were reduced by half.
- To improve calibration, half of the medium category was changed to the light category.

Expressing these adjustments mathematically, for non-residential generators,

[Adjusted TS] = [RGS TS]/2 + [RSG TM]/2, and

[Adjusted TM] = [RSG TM]/2.

For residential generators,

[Adjusted TS] = [RSG TS] + [RSG TM]/2, and

[Adjusted TM] = [RSG TM]/2.

Table TM-6 lists the resulting adjusted rates.

Table TM-6
Truck Trip Generation Rates for Update of Kern MIP3 Model

Type	Light	Medium	Heavy	Attraction variables
Moving People (Bus, Shuttle, Taxi, Rental)	0.01232	0.00482	0	Households
	0.00754	0.00149	0	Employment
Package/Product/Mail	0.00174	0.00008	0.00001	Households
	0.00091	0.00008	0.00001	Employment
Urban Freight	0.04230	0.00678	0.00345	Households
	0.08017	0.01732	0.00592	Retail Employment
	0.11199	0.03342	0.12535	Agriculture, Mining Employment
	0.09838	0.01980	0.01583	Construction Employment
	0.09072	0.02434	0.12571	Manufacturing Employment
	0.08298	0.01966	0.00945	Transportation Employment
	0.08832	0.02193	0.07021	Wholesale Employment
	0.03556	0.00462	0.00081	Finance, Government, Education Employment
Construction	0.04051	0.01010	0.00394	Households
	0.02530	0.01010	0.00394	Total Employment
Providing Services (Business, Utility, Safety)	0.44190	0.08948	0.00161	Households
	0.24384	0.07964	0.00161	Employment

Gateway trip generation for commercial vehicles was obtained by factoring from the California Statewide Travel Demand Model (CSTDM), alongside all purposes of personal travel. Light commercial vehicles were factored as for the personal trip purposes, while the medium and heavy vehicle each had their own factors calculated for each gateway, in pursuit of matching single-unit and multi-unit traffic counts, respectively, where available. As previously discussed in the “Gateway Data” section, this factoring was a form of IPF to solve for agreement with the updated Kern MIP model's trip generation by district, and 2023 traffic classification counts at the model gateways.

Trip distribution

Friction factors for the three commercial vehicle types were first tried from the *Quick Response Freight Manual* (Cambridge Systematics, 1996). These were exponential factors of -0.08 for four-tire (light), -0.10 for single-unit trucks (medium), and -0.03 for combination (heavy) trucks. Calibration adjustments were moderate, with no change for light or medium vehicles, and -0.027 for heavy vehicles.

Table CV-4
Model Truck Trip Lengths

Measure	Light	Medium	Heavy	Total
Total Trips	276,520	75,697	42,088	394,305
Avg. Time (min)	19.6	32.5	128.6	33.7
Avg. Distance (miles)	12.5	26.1	124.9	27.1

Assignment

Traffic assignments in the Kern MIP3 model are calculated for six time periods of the day (four which add up to the full day, and two peak hours within the AM and PM periods). Each is a multi-class assignment approximating full simultaneous equilibrium, in which each class of vehicles has a distinct value-of-time representing heterogeneous trade-offs between costs and time throughout the population, along with the possibility of high-occupancy (HOV) lanes. Managed lanes with a pricing solved to achieve a target level-of-service within peak periods was enabled in the Kern MIP3 model (*Toll and transit access enhancements to the Kern COG MIP-3 travel demand model*, DKS Associates, February 10, 2023).

Among the multiple classes of vehicles are each of the three commercial vehicle classes. For the link congestion calculations, small commercial vehicles are counted equivalent to passenger cars (TS_PCE=1), while medium trucks are counted equivalent to 2.5 passenger cars (TM_PCE=2.5), and heavy trucks to 3.5 passenger cars (TH_PCE=3.5). Passenger-car equivalence is a practical means within travel demand model assignments to account for the disproportionate consumption of roadway capacity by heavy vehicles.

The Kern MIP3 model has long had a means to limit the speed of trucks on freeways. The parameter key "TruckFwySpdFac" had been set to 0.85 in the prior model version, indicating that all three types of commercial vehicles are to flow at 85% of the speed calculated for regular vehicles. In traffic assignment, speeds determine path choice, so this speed adjustment deters trucks from using freeways.

For this model update, the truck freeway speed factor was reset to 1, so commercial vehicles flow and choose paths according to the same speeds as other vehicles. Indications for this included:

- Calibration before adjustment found high truck volumes (compared to classification counts) on arterials but not on freeways.

- Assigned total volumes were high on freeways but low on arterials (before adjustment). Shifting trucks onto freeways can reduce their volumes due to their PCEs' effect on congestion.
- On arterials with signalized intersections, trucks are even slower, in proportion to regular cars, than they may be on freeways.
- Cities commonly discourage trucks from using surface streets where freeways are available. The Kern MIP traffic assignment model has no feature to explicitly keep trucks on designated truck routes, or bar them from any surface streets.

Highway validation

Table HV-1 reproduces the standard highway validation spreadsheet analysis of the latest model. Table HV-2 reproduces the validation summary of VMT compared to the 2023 HPMS report from Caltrans.

Traffic counts in the highway validation spreadsheet were updated to 2023 counts provided by Kern COG. Additional counts were entered for state highways, from sources:

- Spreadsheet D05 06 09 10 Hrly FY10_24 and ADT FY10_24 241217.xlsx furnished by David Berggren of Caltrans District 6, selected from 2022 through 2024 mid-week ("3-day") counts, but avoiding those in 2024 that might be affected by opening of the Centennial Freeway,
- 2022 traffic volumes on California state highways, downloaded from Caltrans Traffic Census, https://dot.ca.gov/programs/traffic-operations/census,
- 2022 truck traffic volumes on California state highways, also from the Caltrans Traffic Census.

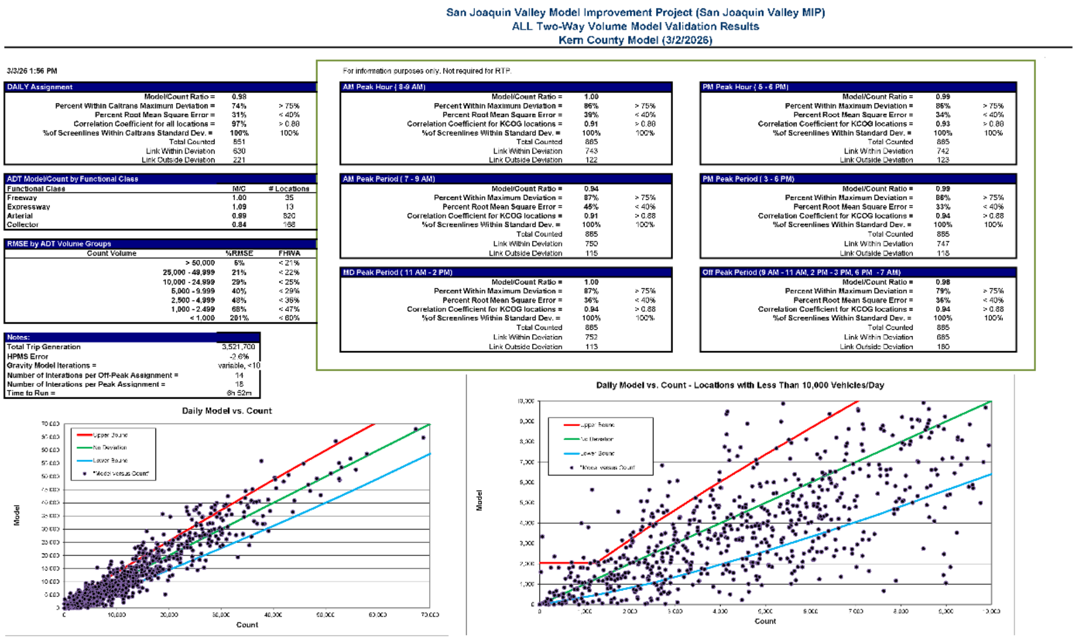
Figure HV-1 shows screenline locations, and Table HV-3 compare their total model and count volumes.

Truck counts were provided and selected similarly to total traffic counts. To the "CountData" tab, new fields contain the selected counts for analysis, distinguishing single-unit trucks "SU" and multi-unit trucks "MU."

Updated traffic and truck counts were supplemented by selected Caltrans count locations.

The tab in the highway validation spreadsheet, "Truck_PivotTables," compares totals of modeled medium and heavy truck volumes at counted locations to SU and MU counts. Count locations are distinguished between Kern COG locations and Caltrans locations (state highways). Table HV-4 summarizes this analysis. While trucks have been a distinct part of the Kern MIP models, this is the first calibration of modeled truck traffic to count data.

Table HV-1



San Joaquin Valley Model Improvement Project (San Joaquin Valley MIP)
ALL Two-Way Volume Model Validation Results
Kern County Model (3/2/2026)

3/3/26 1:56 PM

DAILY Assignment		
Model/Count Ratio =	0.98	
Percent Within Caltrans Maximum Deviation =	74%	> 75%
Percent Root Mean Square Error =	31%	< 40%
Correlation Coefficient for all locations =	97%	> 0.88
%of Screenlines Within Caltrans Standard Dev. =	100%	100%
Total Counted	851	
Link Within Deviation	630	
Link Outside Deviation	221	

ADT Model/Count by Functional Class		
Functional Class	M/C	# Locations
Freeway	1.00	35
Expressway	1.09	13
Arterial	0.99	820
Collector	0.84	168

RMSE by ADT Volume Groups		
Count Volume	%RMSE	FHWA
> 50,000	6%	< 21%
25,000 - 49,999	21%	< 22%
10,000 - 24,999	29%	< 25%
5,000 - 9,999	40%	< 29%
2,500 - 4,999	48%	< 36%
1,000 - 2,499	68%	< 47%
< 1,000	201%	< 60%

Notes:	
Total Trip Generation	3,521,700
HPMS Error	-2.6%
Gravity Model Iterations =	variable, <10
Number of Interations per Off-Peak Assignment =	14
Number of Interations per Peak Assignment =	18
Time to Run =	6h 52m

For information purposes only. Not required for RTP.

AM Peak Hour (8-9 AM)		
Model/Count Ratio =	1.00	
Percent Within Maximum Deviation =	86%	> 75%
Percent Root Mean Square Error =	39%	< 40%
Correlation Coefficient for KCOG locations =	0.91	> 0.88
%of Screenlines Within Standard Dev. =	100%	100%
Total Counted	865	
Link Within Deviation	743	
Link Outside Deviation	122	

PM Peak Hour (5 - 6 PM)		
Model/Count Ratio =	0.99	
Percent Within Maximum Deviation =	86%	> 75%
Percent Root Mean Square Error =	34%	< 40%
Correlation Coefficient for KCOG locations =	0.93	> 0.88
%of Screenlines Within Standard Dev. =	100%	100%
Total Counted	865	
Link Within Deviation	742	
Link Outside Deviation	123	

AM Peak Period (7 - 9 AM)		
Model/Count Ratio =	0.94	
Percent Within Maximum Deviation =	87%	> 75%
Percent Root Mean Square Error =	45%	< 40%
Correlation Coefficient for KCOG locations =	0.91	> 0.88
%of Screenlines Within Standard Dev. =	100%	100%
Total Counted	865	
Link Within Deviation	750	
Link Outside Deviation	115	

PM Peak Period (3 - 6 PM)		
Model/Count Ratio =	0.99	
Percent Within Maximum Deviation =	86%	> 75%
Percent Root Mean Square Error =	33%	< 40%
Correlation Coefficient for KCOG locations =	0.94	> 0.88
%of Screenlines Within Standard Dev. =	100%	100%
Total Counted	865	
Link Within Deviation	747	
Link Outside Deviation	118	

MD Peak Period (11 AM - 2 PM)		
Model/Count Ratio =	1.00	
Percent Within Maximum Deviation =	87%	> 75%
Percent Root Mean Square Error =	36%	< 40%
Correlation Coefficient for KCOG locations =	0.94	> 0.88
%of Screenlines Within Standard Dev. =	100%	100%
Total Counted	865	
Link Within Deviation	752	
Link Outside Deviation	113	

Off Peak Period (9 AM - 11 AM, 2 PM - 3 PM, 6 PM - 7 AM)		
Model/Count Ratio =	0.98	
Percent Within Maximum Deviation =	79%	> 75%
Percent Root Mean Square Error =	36%	< 40%
Correlation Coefficient for KCOG locations =	0.94	> 0.88
%of Screenlines Within Standard Dev. =	100%	100%
Total Counted	865	
Link Within Deviation	685	
Link Outside Deviation	180	

Table HV-2
VMT comparison to 2023 HPMS

Trip Assignment - VMT

	Quantity	Notes
Model AWDT	24,354,500	Weekday average, interior, including intrazonal
AWDT/AADT ratio	0.986	Calculated from BTS trips by distance 3-day/7-day for Kern County, 2023*
AADT	24,707,200	Equivalent annual average of model VMT
HPMS	25,440,800	2023 Caltrans HPMS
% Deviation	-2.6%	Evaluation Criterion: +/- 3%
% XX VMT	27.6%	

* Source: https://data.bts.gov/Research-and-Statistics/Trips-by-Distance/w96p-f2qv/data 1/22/2025

Figure HV-1
Screenlines 1 to 13 locations

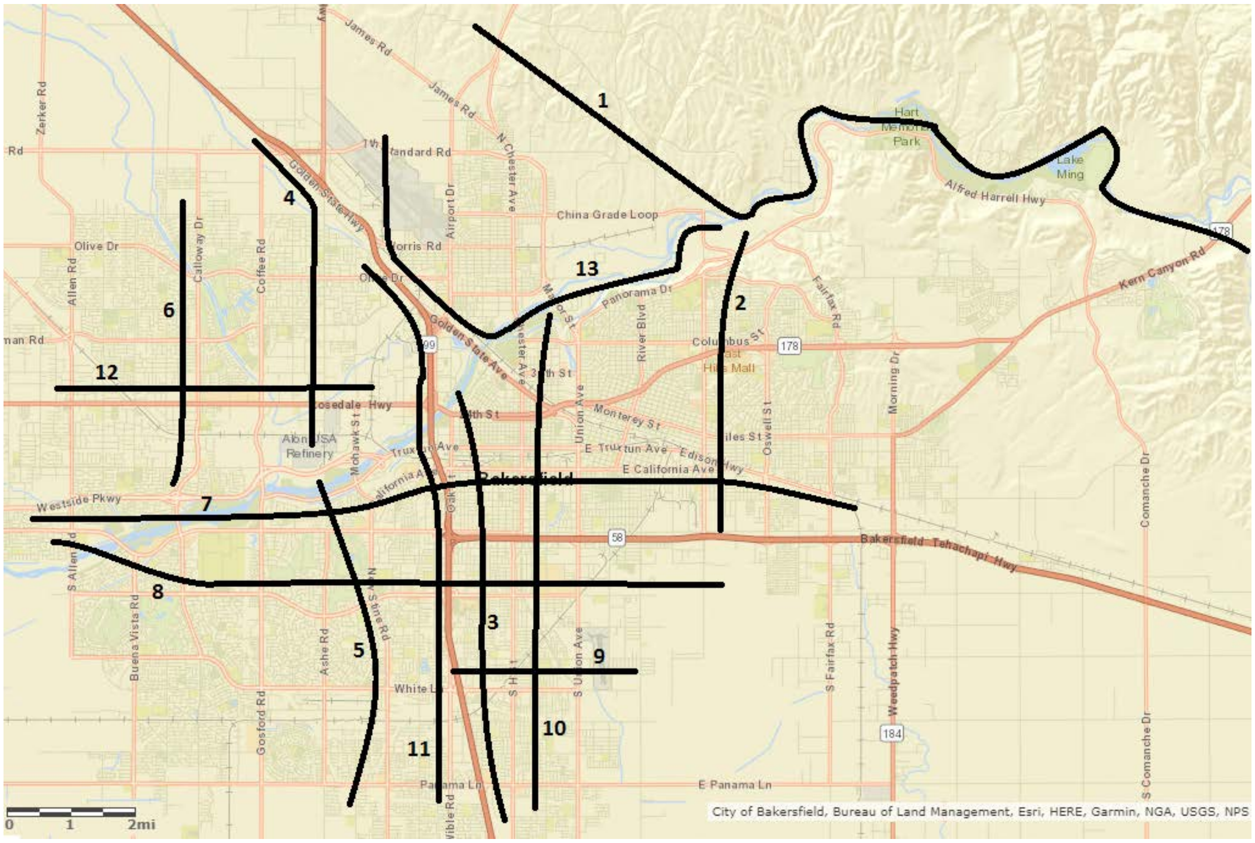


Figure HV-2
Screenlines 14 to 20 locations

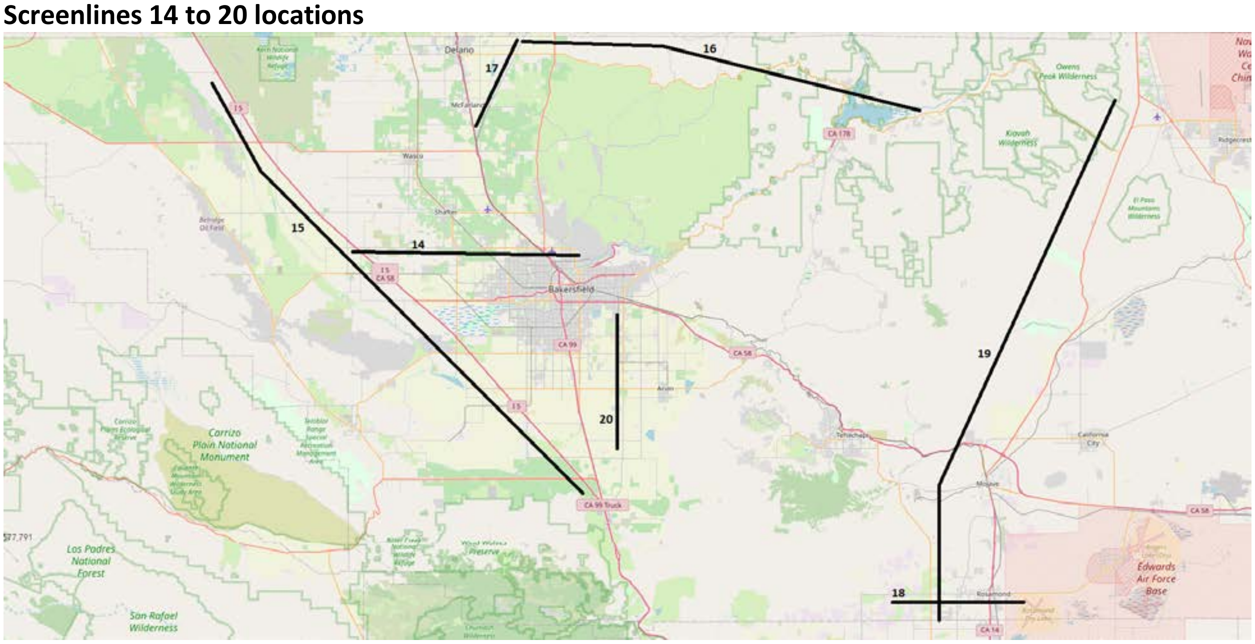


Table HV-3
Screenline Validation Comparison

Screenline Number	AM Peak Hour Model	AM Peak Hour Count	Model/ Count Ratio	AM Peak Period Model	AM Peak Period Count	Model/ Count Ratio	PM Peak Hour Model	PM Peak Hour Count	Model/ Count Ratio	PM Peak Period Model	PM Peak Period Count	Model/ Count Ratio
1	565	497	1.14	1,025	977	1.05	766	610	1.26	2,270	1,909	1.19
2	9,072	9,952	0.91	16,084	17,535	0.92	11,329	12,319	0.92	34,417	35,343	0.97
3	15,103	14,994	1.01	27,269	26,365	1.03	19,680	20,297	0.97	60,245	59,753	1.01
4	8,436	7,698	1.10	15,333	13,868	1.11	10,559	9,043	1.17	31,739	27,613	1.15
5	11,347	10,472	1.08	20,248	19,641	1.03	14,432	14,062	1.03	43,894	41,510	1.06
6	4,481	5,611	0.80	8,243	9,696	0.85	5,484	6,783	0.81	16,707	19,513	0.86
7	27,660	26,610	1.04	49,320	51,437	0.96	34,639	34,357	1.01	105,072	101,440	1.04
8	22,886	23,265	0.98	40,820	44,780	0.91	29,094	30,115	0.97	87,676	90,252	0.97
9	9,731	9,014	1.08	17,323	19,391	0.89	12,035	12,160	0.99	36,244	36,949	0.98
10	12,759	11,429	1.12	22,637	22,082	1.03	16,023	15,877	1.01	49,267	49,826	0.99
11	25,575	24,516	1.04	45,665	44,937	1.02	32,621	31,813	1.03	99,098	96,008	1.03
12	14,213	13,756	1.03	25,199	27,371	0.92	18,537	17,268	1.07	55,348	52,877	1.05
13	4,501	3,294	1.37	7,859	5,857	1.34	6,148	4,684	1.31	18,721	14,669	1.28
14	12,432	12,859	0.97	21,974	24,472	0.90	16,430	15,628	1.05	48,677	47,333	1.03
15	3,118	2,958	1.05	5,564	6,527	0.85	4,240	3,841	1.10	12,316	13,580	0.91
16	663	661	1.00	1,214	1,427	0.85	860	824	1.04	2,562	2,873	0.89
17	704	769	0.91	1,300	1,599	0.81	951	1,055	0.90	2,749	3,343	0.82
18	2,297	2,626	0.87	4,252	5,551	0.77	2,829	3,507	0.81	8,666	10,305	0.84
19	1,335	1,423	0.94	2,337	2,936	0.80	1,747	1,878	0.93	5,137	6,266	0.82
20	1,644	1,632	1.01	2,950	3,202	0.92	2,225	2,191	1.02	6,461	6,684	0.97

Screenline Number	Midday Model	Midday Count	Model/ Count Ratio	Night Model	Night Count	Model/ Count Ratio	Daily Model	Daily Count	Model/ Count Ratio
1	1,782	1,540	1.16	4,799	3,468	1.38	9,876	7,893	1.25
2	27,138	27,326	0.99	67,215	70,008	0.96	144,854	150,211	0.96
3	51,171	49,334	1.04	121,932	120,052	1.02	260,618	255,504	1.02
4	25,949	21,998	1.18	68,775	55,429	1.24	141,797	118,908	1.19
5	35,897	35,271	1.02	89,617	82,561	1.09	189,657	178,983	1.06
6	13,500	14,769	0.91	36,539	40,084	0.91	74,988	84,062	0.89
7	90,502	82,455	1.10	230,564	209,762	1.10	475,458	445,094	1.07
8	74,978	71,784	1.04	190,721	189,834	1.00	394,196	396,649	0.99
9	34,085	30,306	1.12	92,398	88,369	1.05	180,051	175,015	1.03
10	40,781	44,098	0.92	96,621	101,881	0.95	209,305	217,887	0.96
11	83,919	82,726	1.01	209,299	198,001	1.06	437,980	421,672	1.04
12	46,709	43,210	1.08	122,934	116,671	1.05	250,190	240,129	1.04
13	13,801	11,199	1.23	30,097	26,881	1.12	70,479	58,606	1.20
14	42,177	37,296	1.13	118,302	110,861	1.07	231,130	219,963	1.05
15	9,830	9,874	1.00	28,013	28,764	0.97	55,722	58,745	0.95
16	1,992	2,636	0.76	5,383	6,055	0.89	11,151	12,991	0.86
17	2,143	2,227	0.98	5,704	6,202	0.92	11,926	13,371	0.89
18	7,946	7,005	1.13	21,160	21,822	0.97	42,023	44,683	0.94
19	4,309	5,296	0.81	12,357	14,999	0.82	24,140	30,896	0.78
20	4,557	5,257	0.87	12,655	14,562	0.87	26,624	29,705	0.90

Table HV-4
Truck Volume Model-to-Count Comparison

Locations	Single-Unit	Multi-Unit	Total Trucks
	Count totals		
KernCOG locations (231)	70,801	80,164	150,965
Caltrans locations (52)	82,812	212,250	295,062
	Model totals		
KernCOG locations	81,116	75,852	156,968
Caltrans locations	76,549	206,683	283,232
	Model to Count ratios		
KernCOG locations	1.15	0.95	1.04
Caltrans locations	0.92	0.97	0.96

Transit Validation

Figure TV1 and Table TV1 compare modeled to observed passenger boardings to scheduled transit lines. Observed passenger boardings were summarized from those reported by the three fixed-route transit agencies in Kern County. (Kern Regional Transit boardings were given in terms of monthly totals; they were prorated to average weekdays in proportion to numbers of scheduled runs by day of week.)

Figure TV1
Transit Model to Count Comparison

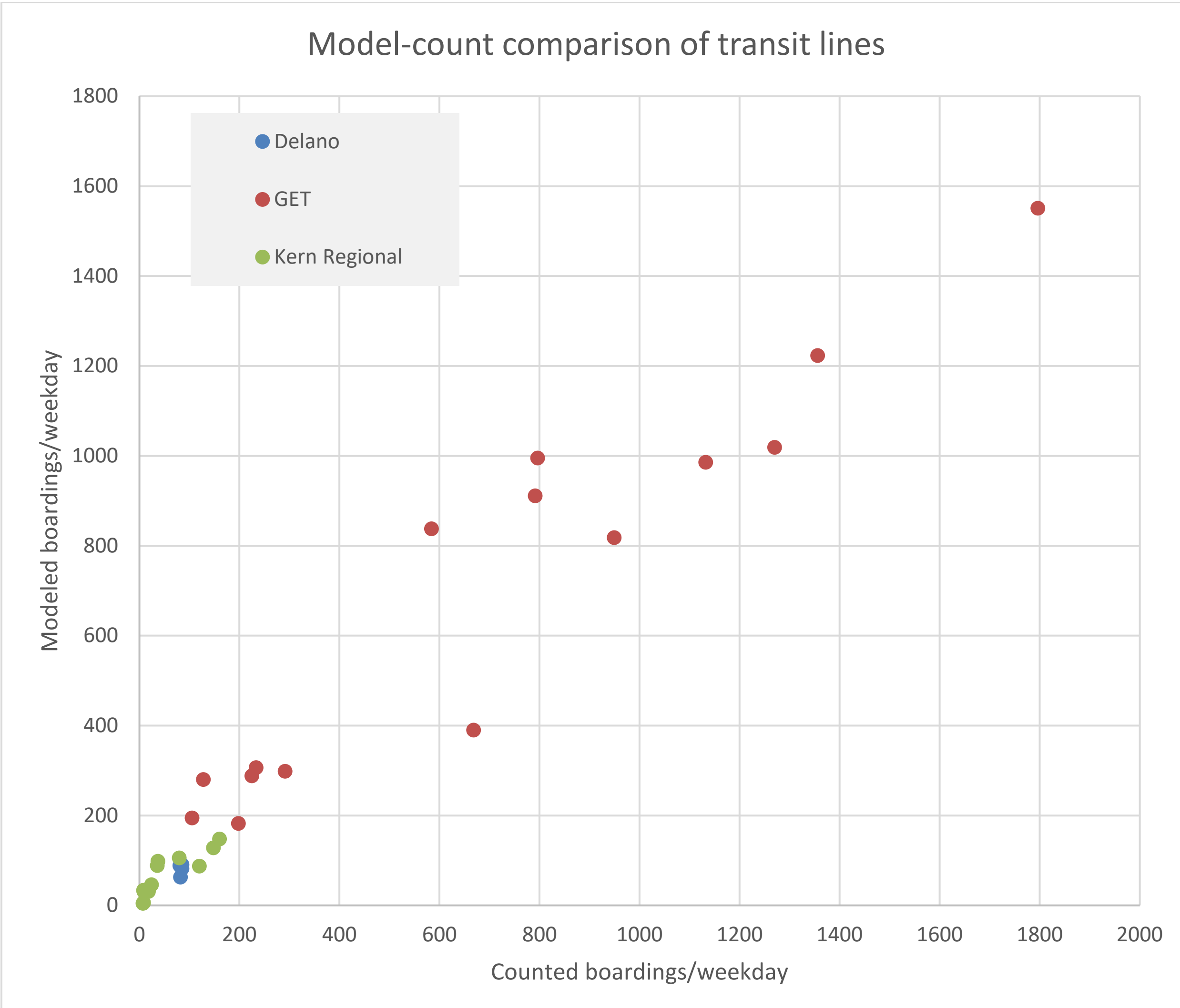


Table TV
Transit Model-to-Count Comparison

Route	Observed weekday ridership	Modeled
Delano (DART)		
DE001	85	90
DE002	85	82
DE003	82	63
DE004	81	89
Subtotals	333	324
Golden Empire Transit (GET)		
GE021	1,132	986
GE022	1,796	1,551
GE041	949	818
GE042	791	911
GE043	796	995
GE044	1,270	1,019
GE045	1,356	1,223
GE046	668	389
GE047	128	280
GE061	584	837
GE062	291	298
GE081	198	182
GE082	233	306
GE083	225	288
GE084	105	194
Subtotals	10,522	10,278
Kern Regional Transit		
KR100	160	147
KR110	120	87
KR120	36	88
KR130	18	31
KR140	80	105
KR145	37	98
KR150	24	46
KR220	9	6
KR227	9	31
KR230	8	34
KR240	7	4
KR250	148	128
Subtotals	654	804
Total	11,509	11,406

Summaries

- Added a second Environmental Justice (EJ) area for EJ analysis. This is the set of TAZs identified by a 1 value in field EJTITLEVI, and a 1 in master network field EJTITLEVI.
- Revised accident rates for 2023 were coded into the appropriate model input keys, as tabulated below in Table SU-1.

Table SU-1
Environmental Justice report parameters for accidents

Key	Value	Source
ACCIDENTS_VMT	9241	Calibrated, to achieve a near match of the base 2023 scenario report in EJ_Accidents.county.csv
ACCIDENTS_TOTAL	9455	2023 accidents reported by CHP (as transmitted by Kern COG).
ACCIDENTS_PDO	5524	
ACCIDENTS_INJURY	3766	
ACCIDENTS_FATAL	165	
VICTIMS_KILLED	176	
VICTIMS_INJURED	486	

Zonal Crash Prediction Model

A zonal crash prediction suite of models developed for the Southern California Association of Governments (SCAG) was adapted and incorporated into the current update of the Kern MIP3 model. The source models are described in Hamilton, Himes, Tanzen (VHB), *Safety data & analysis technical assistance program final memo* (to Southern California Association of Governments), July 9, 2021. In particular, these are the "community models" designed for TAZ level analysis, giving predictions of annual crashes in each of the following categories:

- Total fatal crash (K),
- Total fatal and serious injury (KA),
- Total fatal and injury (KABC),
- Pedestrian and bicycle fatal and serious injury (KA_wb)
- Pedestrian and bicycle fatal and injury (KABC_wb)

The model equations are as follows:

K = exp(0.491 * ln([annual VMT within TAZ]) +
    -0.008 * [median household income] +
    0.0007 * [Intersections] +
    -1.351 * [inverse area variable] +
    -5.641 [original constant]
    -3.057 [Kern calibration constant])

KA = exp(0.508 * ln([annual VMT within TAZ]) +
    -0.006)* [median household income] +
    0.001 * Intersections +

-0.745 * [inverse area variable] +
0.044 * ln[employment] +
-5.084 [original constant]
-3.392 [Kern calibration constant])

KABC = exp(0.507 * ln([annual VMT within TAZ]) +
-0.005 * [median household income] +
0.166 * [working-age population]/1000 +
0.176 * [flag indicating 10% or more of centerline mileage is on the NHS] +
0.126 * ln[employment] +
-3.735 [original constant]
-3.600 [Kern calibration constant])

KA_wb = exp(0.792 * ln([annual VMT within TAZ]) +
0.960 * ln([population] + [employment]) +
-0.008 * [median household income] +
0.555 * [inverse area variable] +
0.441 * [indicator for more than 5 total transit stops within TAZ] +
-0.065 * ln([annual VMT within TAZ]) * ln([population] + [employment]) +
-12.14 [original constant]
-3.392 [Kern calibration constant])

KABC_wb = exp(0.694 * ln([annual VMT within TAZ]) +
0.940 * ln([population] + [employment]) +
-.003 * [median household income] +
1.493 * [inverse area variable] +
0.484 * [indicator for more than 5 total transit stops within TAZ] +
0.00002 * [Population] * [inverse area variable] +
-0.053 * ln([annual VMT within TAZ]) * ln([population] + [employment])+
-11.32 [original constant]
-3.600 [Kern calibration constant])

Variables in these equations

- [median household income] is computed from the zone's household cross-classification distribution, using boundaries for its five quantiles of $0, $25k, $50k, $75k, $125k
- [inverse area variable] = 1 / (1 + total square mileage of the TAZ), where the total square mileage is 1/640 of field "area_ac" in the TAZ data
- [Intersections] is taken from given file {catalog_dir}\GIS\Intersections.dbf. (This file is exogenous and independent of the master highway network, and has not been reviewed.)
- [working-age population] is from the socioeconomic detail file, fields pop1517 + pop1824 + pop2554 + pop5564
- [flag indicating 10% or more of centerline mileage is on the NHS] uses an approximate calculation from the master network in which all links that are not centroid connectors and either field private='N' or field paved='Y', or have lanes, alongside its subset of only arterial and freeway links, are accumulated in an apportioned manner to each zone for which the distance from midpoint to centroid is less than the longest centroid connector plus 0.25 miles. The flag is set to 1 if the accumulation of apportioned arterials and freeways is more than 10% of the apportioned greater set of links. The greater set of links is intended to exclude parking lot aisles,

forest roads, and proposed roads. The subset of arterials and freeways is intended to approximate the NHS.

- [annual VMT within TAZ] is computed by a similar apportionment method.
- [indicator for more than 5 total transit stops within TAZ] uses a simple count of the walk-access links in the loaded transit network that are no longer than the length of the longest centroid connector. (This excludes walk-access links that the transit network builder creates to more distant stops.)
- [original constant] was given in the model as specified to SCAG
- [Kern calibration constant] is an additional constant added to calibrate the Kern County regional total as applied in the Kern MIP3 model, based on recorded crashes in Kern County, in Table SU-1. Table SU-2 lists how these recorded crashes are applied to calibration.

Table SU-2
Crash model calibration targets

Variable	Calibration target
K	Fatal accidents = 165
KA	478 = Fatal accidents [165] + injury accidents [3766] * severely injured victims [486] / all injured victims [5842]
KABC	3931 = Fatal accidents [165] + injury accidents [3766]
KA_wb	Not available. Used same Kern calibration constant as KA. Result = 40
KABC_wb	Not available. Used same Kern calibration constant as KABC. Result = 106

Due to the indirect manner in which some of the variables are estimated from the available data, accuracy of the variables may be improved replacing or modifying their derivation using countywide GIS and/or other sources. Doing so may change modeled totals, so whenever an input variable is changed, the Kern calibration constants should be recalculated. Recalculation is incremental, given a trial run with [prior Kern calibration constant], each model with a target (K, KA and KABC) is revised individually:

[revised Kern calibration constant] = [prior Kern calibration constant] + ln([target] / [modeled total of all TAZs resulting from prior calibration constant].

Forecast model preparation

For forecasting, Kern COG provided the master highway network (from which the MIP model extracts any forecast year's model network), and socioeconomic "template" data (employment in the 9 categories, school enrollments, and households by single-family, multi-family, and mobile/other) for 2035 and 2049.

Splits of households into cross-classifications include user-set population distribution adjustments which, relative to the direct calculation from the Census, reweight the zonal distributions of 1, 2, 3, 4, and 5+ member households toward the higher or lower sides of the distribution. Kern COG specified countywide populations of 954,200 for 2035, and 995,200 for 2049. (Being user-adjusted rather than formulas, prepared model inputs approximate rather than duplicate these target populations.) Table F1 summarizes countywide households and populations. The resulting average populations per household exhibit a declining trend into the future.

Table F1
Countywide average population per household, base and forecast

Year	Households	Population in households	Avg Persons/ HH
2023	288,543	883,066	3.06
2035	328,200	954,200	2.91
2049	351,900	995,200	2.83

Source: Kern COG, except 2023 population from California State Department of Finance

Table F2 summarizes total employment and school enrollment for the base and forecast years. Kern COG provided the source data. The only change for model application was the propagation of the adjustment of Bakersfield College to the forecast years.

Table F2
Countywide total employment and school enrollment, base and forecast

Variable	Field name	2023	2035	2049
Total Employment	TOTEMP	336,300	378,116	426,900
Educational	EMPEDU	26,979	29,231	31,858
Food & Accom	EMPFOO	28,430	31,276	34,595
Government	EMPGOV	36,641	41,334	46,810
Industrial	EMPIND	60,483	68,803	78,510
Medical	EMPMED	45,532	51,506	58,477
Office	EMPOFC	36,749	42,108	48,360
Other	EMPOTH	18,486	22,090	26,294
Retail	EMPRET	33,665	35,945	38,606
Agricultural	EMPAGR	49,335	55,822	63,390
Elem Sch Students	ELEM	130,792	129,962	128,994
High Sch Students	HS	59,659	58,331	56,782
College Students	COLLEGE	67,951	66,295	64,364

Kern COG provided special generators for 2035 and 2049 which are unchanged from 2023 inputs.

The TAZ input file is the same for forecast years as compiled for the base year, except the external trip generation shares, which are updated as part of the gateway inputs forecasting (below).

DKS provided a stand-alone Cube Voyager script to create interpolated forecast year inputs, for any specified intervening years between the 2023, 2035, and 2049 base models. The interpolated inputs are through trips, gateway IX and XI trips, special generators, the TAZ file, and the fully-prepared socioeconomic detail file.

Gateway data estimates for forecast years

Gateway inputs for future years were updated using the most recent population forecasts available in March 2025 for their tributary areas. Sources of these population forecasts are:

- California State Department of Finance for the counties of California
- Clark County, Nevada (Nevada State Demographer, Department of Taxation, 10/1/2023 and 10/1/2024)
- State of Arizona (Arizona Commerce Authority)
- cities of Lancaster and Palmdale (Southern California Association of Governments, *2016-2040 RTP/SCS Final Growth Forecast by Jurisdiction*)

Each of the model gateways was associated with a representative tributary area. For low-volume gateways mainly serving local traffic, this was the adjacent county. For larger gateways serving longer-distance traffic, additional counties were included. Adjacent counties were fully counted, while more distant counties were counted with fractional weights, declining with distance. Table F3 describes the chosen tributary area, and its weighted total population for base-year 2023 and forecast reference years 2035 and 2049.

Table F3
Gateway forecasts from tributary area populations

Kern MIP Gate-way	Location	Tributary areas		Populations of tributary areas (1000s)			Growth ratios		Gateway AWDT		
		Major	Other	2023	2035	2049	2035/ 2023	2049/ 2023	2023 est.	2035 est.	2049 est.
61	SR 33 (N)	Kings		152	163	161	1.070	1.058	2,521	2,697	2,666
62	Barker (Baker)	Kings		152	163	161	1.070	1.058	48	51	51
63	King Rd	Kings		152	163	161	1.070	1.058	831	889	879
64	I-5 (N)	W. Central Valley	Bay Area	5,733	6,015	6,394	1.049	1.115	31,244	32,780	34,848
65	Corcoran/ Dairy	Kings		152	163	161	1.070	1.058	1,744	1,866	1,845
66	Road 80	Tulare		475	502	520	1.057	1.096	95	100	104
67	SR 43	Kings & Tulare		627	665	682	1.060	1.087	2,935	3,112	3,189
68	Roads 128 + 136	Tulare		475	502	520	1.057	1.096	1,800	1,903	1,973
69	SR 99	E. Central Valley	Sacramento & vic.	2,916	3,113	3,373	1.067	1.156	52,597	56,144	60,828
82	Road 144 (Girard)	Tulare		475	502	520	1.057	1.096	3,500	3,700	3,836
70	Roads 152 + 156	Tulare		475	502	520	1.057	1.096	1,000	1,057	1,096
83	Rd 160 (Veneto/ Bowman)	Tulare		475	502	520	1.057	1.096	2,000	2,114	2,192
85	Road 192	Tulare		475	502	520	1.057	1.096	3,500	3,700	3,836
71	Famoso-Porterville (Richgrove)	Tulare		475	502	520	1.057	1.096	4,219	4,460	4,623
72	SR 65	Tulare		475	502	520	1.057	1.096	8,384	8,862	9,188
73	Jack Ranch	Tulare		475	502	520	1.057	1.096	249	263	273

Kern MIP Gate-way	Location	Tributary areas: Major	Tributary areas: Other	Populations of tributary areas (1000s): 2023	2035	2049	Growth ratios: 2035/ 2023	2049/ 2023	Gateway AWDT: 2023 est.	2035 est.	2049 est.
74	Sierra Way	Tulare		475	502	520	1.057	1.096	945	999	1,036
29	SR 395 (N)	Inyo, Mono	Alpine	33	31	27	0.948	0.839	5,700	5,402	4,780
30	SR 178	San Bernardino		2,171	2,293	2,368	1.056	1.091	2,600	2,747	2,836
75	Searles Sta. Cutoff	San Bernardino		2,171	2,293	2,368	1.056	1.091	424	448	463
31	US 395 (S)	San Bernardino	Riverside	3,386	3,592	3,769	1.061	1.113	4,567	4,845	5,083
76	Randsburg Cutoff + 20 M.T.Pkwy	San Bernardino		2,171	2,293	2,368	1.056	1.091	73	77	80
32	SR 58 (E)	San Bernardino	Arizona, Clark County NV	7,119	8,087	8,793	1.136	1.235	16,294	18,510	20,126
77	20 Mule Team Rd in Boron	San Bernardino		2,171	2,293	2,368	1.056	1.091	1,099	1,161	1,199
81	Lancaster Bl (Redman Rd, 120thE)	Lancaster, Palmdale		343	379	470	1.105	1.370	1,352	1,494	1,853
33	Sierra Hwy	Lancaster, Palmdale		343	379	470	1.105	1.370	4,080	4,508	5,591
34	SR 14	Los Angeles	Riverside	11,041	11,020	10,977	0.998	0.994	39,392	39,316	39,161
35	60th St West	Lancaster, Palmdale		343	379	470	1.105	1.370	997	1,102	1,366
36	90th St West	Lancaster, Palmdale		343	379	470	1.105	1.370	841	929	1,152
78	170th St West	Lancaster, Palmdale		343	379	470	1.105	1.370	528	583	724
37	I-5 (S)	Los Angeles exc. Lancaster, Palmdale	Other S. Calif.	12,926	12,881	12,663	0.997	0.980	72,319	72,068	70,847
38	Lockwood Valley Rd (Mt Pinos)	Los Angeles		9,826	9,721	9,576	0.989	0.975	1,303	1,289	1,270
39	SR 33 (S)	Ventura	Santa Barbara	1,047	1,063	1,059	1.015	1.011	3,261	3,310	3,297
79	Soda Lake	San Luis Obispo		280	290	307	1.035	1.097	24	25	26
40	SR 58 (W)	San Luis Obispo		280	290	307	1.035	1.097	152	157	167
80	Bitterwater Valley Rd	San Luis Obispo		280	290	307	1.035	1.097	133	138	146
41	SR 46	San Luis Obispo	Monterey	717	764	825	1.066	1.151	8,194	8,737	9,434

Note: Actual model results vary from these calculated forecasts.

Gateway IX, XI, and through trip model inputs were prepared by the same IPF-based method as for the base-year, using the respective 2035 and 2049 estimated AWDT traffic volumes, and trip generation from the socioeconomic data prepared by Kern COG for those years. As with the base-year inputs, each re-factored tabulation from the CSTDM statewide model (2035 and 2049) yielded model inputs for productions and attractions by trip purpose:

- Zonal (in 13 districts) IX and XI shares of trip generation
- Gateway IX and XI trip generation
- Through trips

The forecast IPF provides that interaction growth accounts for population growth at both sides of the interaction. Sums of interactions were controlled to be proportional to the actual populations. This method prevented, say, interactions by a low-growth area being made to grow disproportionate to its population due to interactions with adjacent high-growth areas. As a consequence, a few particular movements actually decrease into the future.

Forecast-year through-trips were adjusted to account for the opening of the Centennial freeway, which is not present in the CSTDM base year. Based on the adjustments applied in prior Kern MIP forecast models, 20% of movements between SR 58 east (gateway 32) and SR 99 north (gateway 69) were diverted to/from I-5 north (gateway 64).

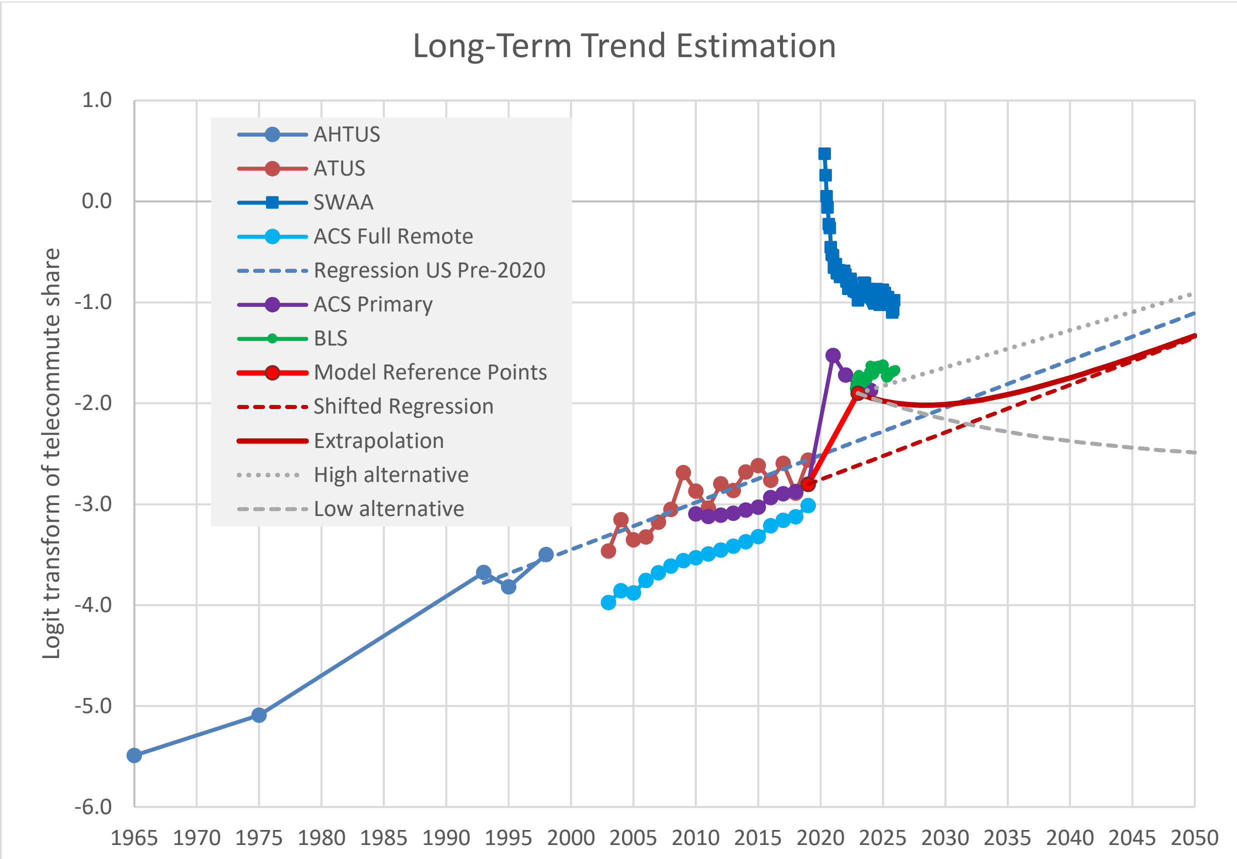
Telecommute forecasting

Recalling from Figure TC1, both national and regional telecommuting rates are continuing to change, though more gradually, than they did in 2020 to 2023. The base-year 2023 model was calibrated using telecommuting rates from the CCTS survey conducted in 2022 and 2023. The model includes an adjustable parameter for scaling up or down the telecommuting propensity of workers in Kern County, leaving KernCOG flexibility in how they apply telecommuting effects in this model in forecasting, particularly as telecommuting behaviors change. While these behaviors are difficult to forecast, both recent and long-term history give indications for how they may be changing and may change in the model forecast years.

To set telecommuting trends into a long-term context, Figure TC2 presents telecommuting rates from as far back as 1965. Along with the SWAA, pre-covid sources were compiled by Jose Maria Barrero, Nicholas Bloom, and Steven J. Davis, 2021, *Why working from home will stick*, National Bureau of Economic Research Working Paper 28731, including the American Heritage Time Use Study (AHTUS), American Time Use Survey (ATUS), and a pre-covid analysis of fully-remote telecommuting from the American Community Survey (ACS). (The latter is not directly comparable to the more-readily obtained Means of Transportation to Work reports.)

The vertical axis is shown as a logit transform of the telecommute shares, i.e. $\ln\left(\frac{\text{share}}{1-\text{share}}\right)$. This is mathematically more suitable for linear analysis, interpolation, and extrapolation than shares are directly, being unbounded, unlike shares that are necessarily between 0 and 1. (Also called “log-odds”, it is the inverse of the logistic function share $= \frac{\exp(x)}{\exp(x)+1}$.) Concurrent but differently-measured trends appear as parallel by this transformation.

Figure TC2
Long-term telecommuting trend estimation



Pre-covid sources show a gradually increasing trend all the way from 1965 to 2019. A linear regression of the ATUS, along with the later years of AHTUS (when the internet was becoming widely accessible), is proposed as a long-term trend likely to have continued without the covid disruption. The other pre-covid sources show similar rates of increase.

The "Model Reference Points" shown are the pre-covid and 2023 settings of the KernCOG telecommute model, corresponding to Telework Factor parameter settings of 0 and 1 respectively representing approximately 5.7% and 13.0% telecommute shares in Kern County respectively. These are both close at the respective times to national ACS shares of telecommute as primary means of transportation to work, although they are defined differently and are thus parallel rather than coincident trends.

The SWAA and ACS show telecommuting decreasing from covid highs, rapidly at first but decelerating, since when they began collecting data during the covid disruption. The BLS data, however, show gradual increase through 2023 to 2024, but fluctuation with a net decrease across 2025. Local ACS and Godbe (Figure TC1) also show an increase from 2023 to 2025.

An extrapolation is proposed in which the long-term pre-covid trend continues into the future, and the covid disruption is added as a temporary effect with exponential decay. The rate of decay is taken from the last years of the SWAA, ACS, and BLS rates, from which the average decrease of the logit transform is 0.0442 per year. Against an increase of 0.00013 per year of the pre-covid trend, the disrupted value minus the long-term growth contracted by a factor of 0.873 per year. The resulting “Extrapolation” curve in Figure TC2 continues that annual contraction as an exponential decay, superimposed over the linear long-term growth trend. The resulting linear plus exponential relation continues to decrease gradually before leveling, then resuming the long-term increase.

The Telework Factor parameters for model use are given in Table TC4 below, by back-solution from the extrapolated logit transformations. The “preferred extrapolation” shows the parameter setting decreasing to a minimum of 0.869 in 2028, then gradually increasing, to exceed 1.0 in 2036, and continuing to increase.

Because forecasts of a disrupted behavior come with high uncertainty, Table TC4 also gives alternative low and high alternative extrapolations (but no claim is made for these as “confidence limits” of any kind). The low alternative continues the 2023 to 2025 trend on an exponential decay toward the 2019 rate as a fixed limit. The high alternative assumes the whole BLS dataset’s generally increasing trend will continue, so it uses the slope from a regression through those points, but shifts the line to pass through the 2023 model reference point. Another reasonable “middle” alternative (not shown) is simply to keep the 2023 rates flat and unchanging into the future.

Actual results from the model, for any given Telework Factor setting, can vary from what may be inferred from Figures TC1 and TC2, since they are applied upon the industry-specific and demographic parameters in Table TC3.

Table TC4
Model Telework Factor settings corresponding to extrapolations

Year	Preferred Extrapolation (linear + exponential)	High alternative	Low alternative
2023	1.000	1.000	1.000
2024	0.951	1.040	0.951
2025	0.915	1.081	0.905
2026	0.891	1.122	0.862
2027	0.876	1.162	0.822
2028	0.869	1.203	0.784
2029	0.870	1.243	0.749
2030	0.877	1.284	0.716
2031	0.891	1.324	0.684
2032	0.909	1.365	0.655
2033	0.931	1.405	0.628
2034	0.957	1.446	0.602
2035	0.986	1.486	0.578
2036	1.019	1.527	0.555
2037	1.053	1.567	0.534
2038	1.090	1.608	0.514
2039	1.129	1.648	0.495
2040	1.169	1.689	0.477
2041	1.211	1.729	0.461
2042	1.255	1.770	0.445
2043	1.299	1.810	0.431
2044	1.344	1.851	0.417
2045	1.390	1.891	0.405
2046	1.437	1.932	0.393
2047	1.484	1.972	0.381
2048	1.532	2.013	0.371
2049	1.581	2.053	0.361
2050	1.630	2.094	0.352

Other inputs for forecasting

While the 9/12/2025 documentation for the Kern MIP-3 model included summaries of 2035 and 2049 forecasts, presently no new forecasts have been made involving the updated existing transit lines, the new transit and mode choice recalibration, or the telecommute parameter varying over time. If the Golden Empire Transit District still plans to change its routes to those in the LRTP, the three input line files incorporating them (short-, medium-, and long-range) should be updated to include all of Kern Regional Transit's routes.

Memorandum

March 4, 2026

From: John Gibb, DKS Associates

To: KernCOG travel demand model staff

Re. Modeling truck travel conversion from through-trips to inland intermodal facilities

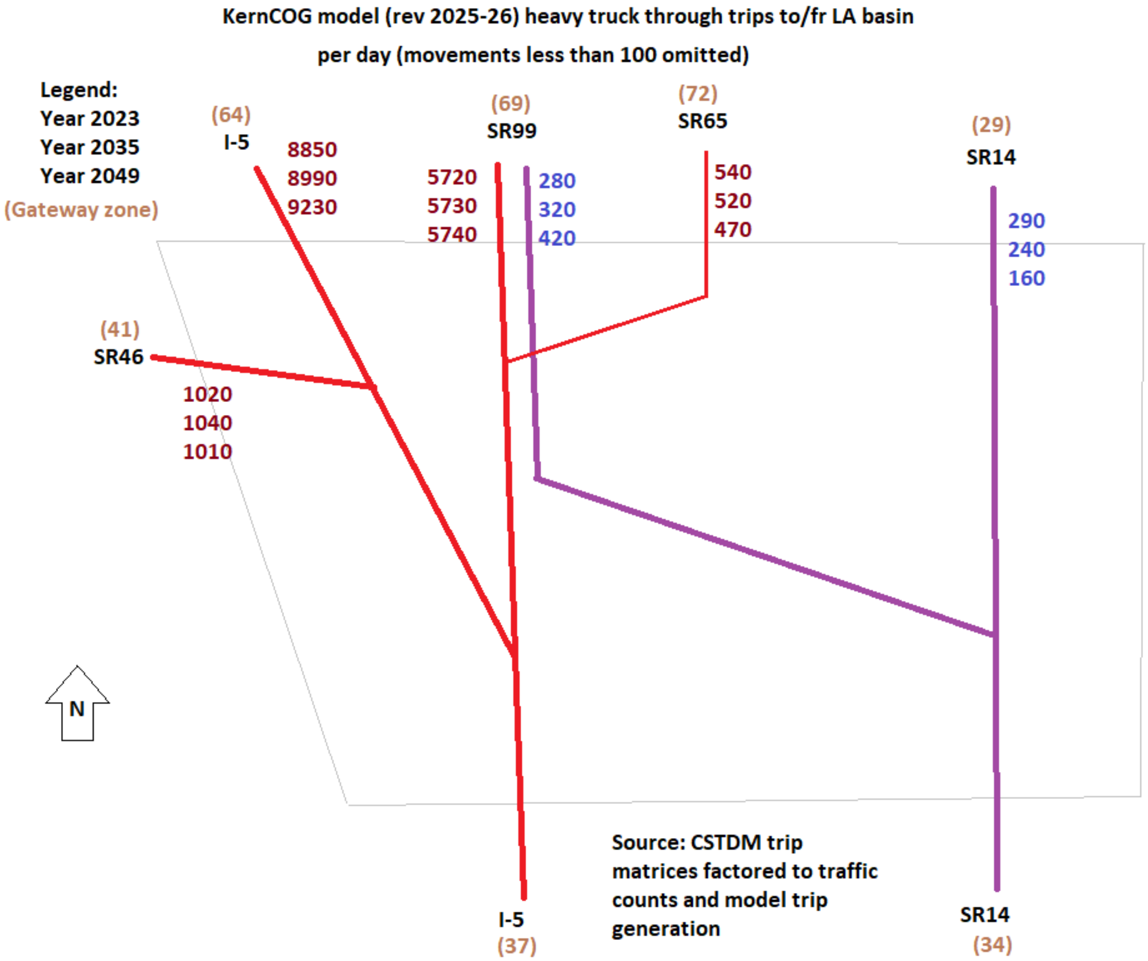
This is in response to Kern COG's inquiry by Ben Raymond about how to adjust the model to account for anticipated effects of an inland port intermodal facility proposed near Shafter. Some freight that is presently shipped by truck to or from the ports of Los Angeles and Long Beach through Kern County would instead be shipped by rail to/from this facility, where the truck trips would instead begin or end. As a result, many truck trips presently traveling through Kern County would be replaced by similar numbers of truck trips to and from this facility. In terms of the KernCOG model, this converts certain X-X (through) movements of trucks into I-X and X-I movements, the former to/from gateway 37, replacing with movements to/from zone 1750.

This facility is assumed not to affect freight already shipped by rail through Kern County to/from intermodal facilities elsewhere, nor freight shipped by truck through Kern County to/from locations elsewhere in southern California.

While the focus of this inquiry is on a facility proposed in Shafter, the method given is applicable to potential facilities elsewhere in Kern County.

This response does not attempt to quantify the numbers of truck trips that would actually be diverted, but rather, leaves them as variables to be replaced by numbers as they are made available. Such numbers may be estimated from planning documents from previous studies for this facility. These numbers, however, need to be cross-checked that they don't exceed the model's present numbers of truck through trips. Figure 1 summarizes the most significant daily heavy (multi-unit) truck flows through Kern County to/from the Los Angeles basin, as estimated for use as inputs to the KernCOG travel demand model.

Figure 1



The truck flows shown in Figure 1 total to nearly 16,130 to 16,350 daily trips (half each direction) by I-5, and about 570 to 580 by SR 14, each at the south county line. Movements less than 100 per day are not shown, which total to 200 or less, and are not expected to be significantly diverted by the proposed intermodal facility.

Two methods are given here. Method 1 uses a post-processing option, but has limited output detail. Method 2 is full integration into the model. This requires a more complex preparation, but yields full output that is most comparable among scenarios.

Method 1: Postprocessing

An optional feature in the KernCOG model is the “Truck Diversion” app within “PostProcessing”.

1) Prepare the file truck_adj.csv, located in the scenario root folder. Table 1 shows one such table, prepared for diverting 2000 trips to/from SR 99 north, and 2000 trips to/from I-5 north. These numbers are only for a tested example, not recommendations. For any other diversion amount, enter each in place of the 2000 and the 2000 entries, as pairs of a negative number and the

same positive number. Do not enter larger-magnitude numbers than the respective through-trips shown in Figure 1. The numbers to enter are two-way total volumes; the processing will split each into half for each direction.

Table 1
Example Truck Diversion Postprocessing Control File truck_adj.csv

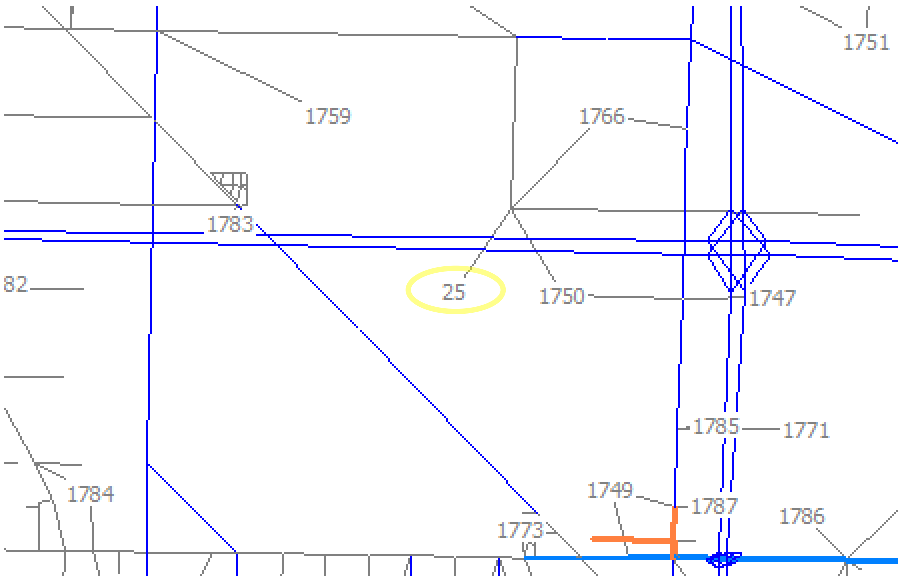
;I (activity)	J (transfer)	Reverse	I-J	I-Int	I-Ext	Int-J	Ext-J	Notes
69	37	0.5	-2000	0	0	0	0	;SR99 N XX
69	1750	0.5	2000	0	0	0	0	;to intermodal transfer in Shafter
64	37	0.5	-2000	0	0	0	0	;I-5 N XX
64	1750	0.5	2000	0	0	0	0	;to intermodal transfer in Shafter

2) In a scenario which has been fully run, open and run the "Truck Diversion" app (within the "PostProcessing" app). Before running, select the option to "Run current group only".
3) When finished, examine the scenario network ending in "_TRKDIV_VOLUMES.NET" This contains the same link variables as the SB375 highway assignments. However, these results do not distinguish the three truck types (TS, TM, TH), but rather, add them all to variables with the tag "_TRK". Also, both these and the SB375 assignments differ from the main Conformity assignments' LOADED_NETWORK_DETAIL.NET variables, in that the latter has "_TRK" variables which only combine heavy and medium trucks.

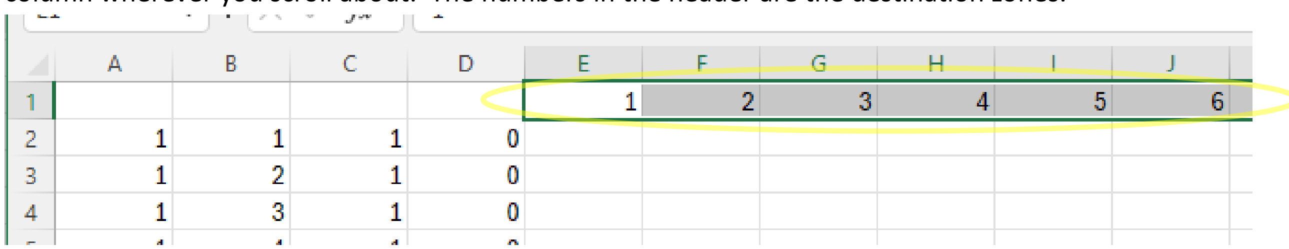
Method 2: Edit the through-trip matrix

This method is not a post-process, but a modification to the whole scenario. Consequently, scenario testing requires running the whole model instead of a post-process, but comparison of alternative scenario results can rely on closer compatibility between them. The full network loading detail is reported, including the three truck types in the model. Furthermore, the intermodal facility's effect on congestion feedback to all trips is fully present and integrated.

1) In the master highway network, insert a new node, numbered less than 99, next to the proposed intermodal facility. I will use zone 25, but you can choose any other unused node less than 99. Copy a centroid connector between this node and a node on the appropriate connecting road. In model scenarios without the truck diversion, this new link and node should make no difference on results.

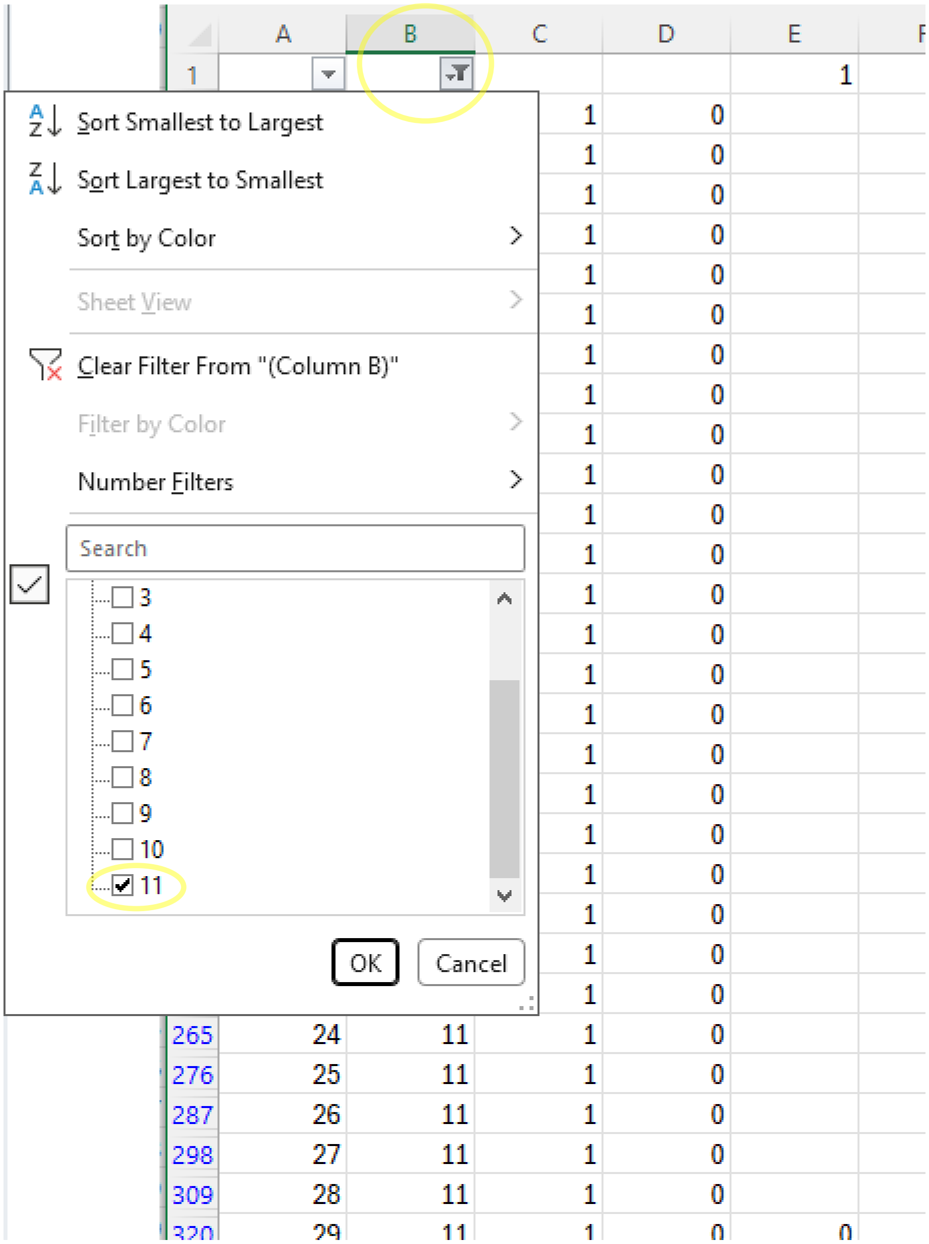


2) Prepare the number of truck through-trips to be diverted from each relevant movement involving zone 37. In the example below, I'll divert 2000 trips from 37 <-> 64 and 2000 trips from 37 <-> 69.
3) Open the appropriate through-trip input file (typically named "KE??_Through_Trips.csv" in the 1_Inputs\5_External subfolder.
4) To help with navigation, insert a row on top, then enter the sequence of numbers 1 through 81 beginning at cell E1, ending on cell CF1. Split the screen so you can see the first row and first column wherever you scroll about. The numbers in the header are the destination zones.

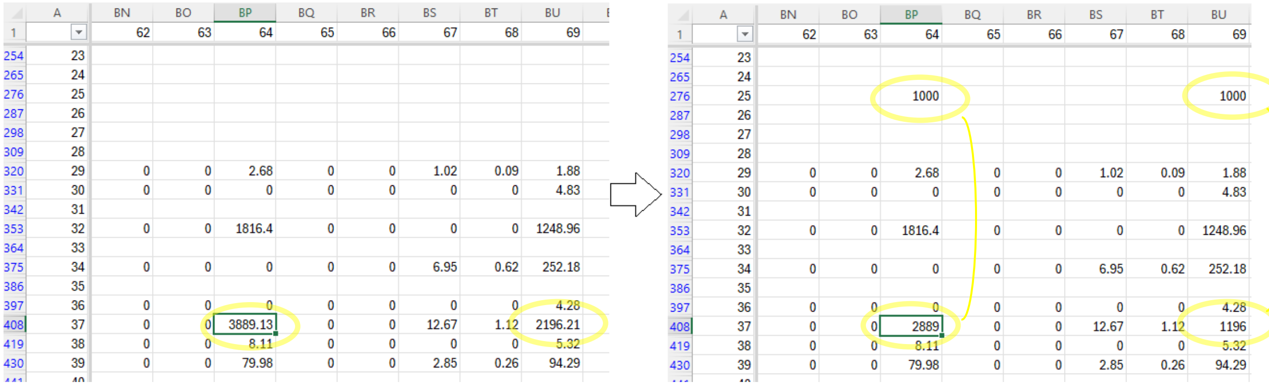


	A	B	C	D	E	F	G	H	I	J
1					1	2	3	4	5	6
2	1	1	1	0						
3	1	2	1	0						
4	1	3	1	0						

5) Select columns A and B, then choose the menu item Data, Filter. In the column B drop-down list, uncheck "Select all", then check only the "11". This filters to show TH, heavy trucks, only. Although not shown in the illustrations, you may also set the column A filter to include only zones 25, 37, 64, and 69 (and any more zones involved).



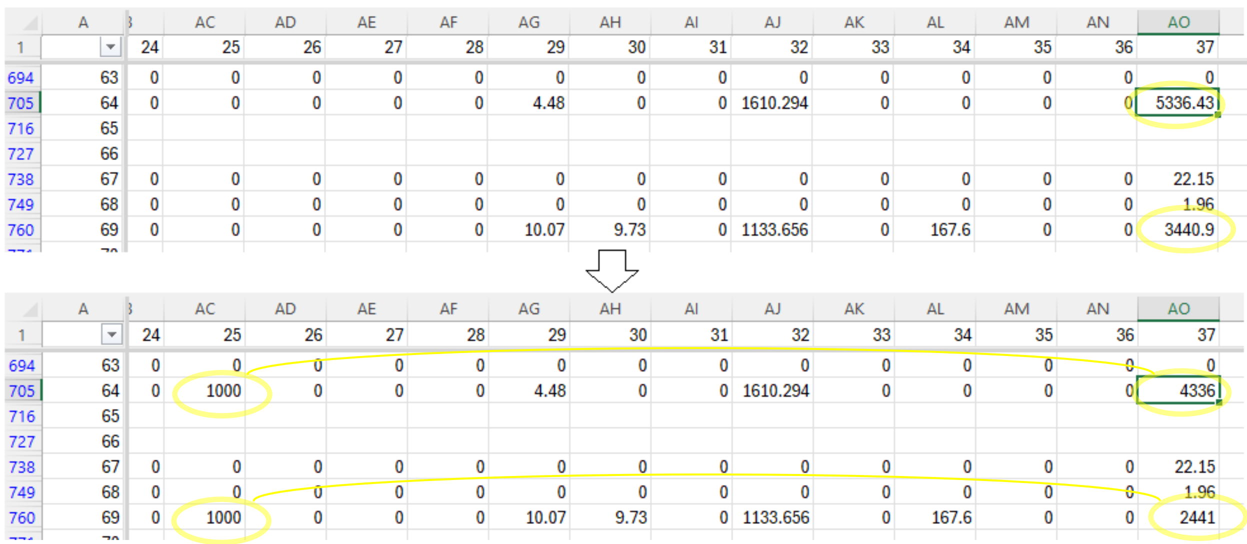
6) For each cell in the row with I=37, subtract half of your diversion for that particular movement from the value shown in columns with heading 64, 69, and any others chosen, and enter the respective difference. They should be positive, but smaller.
7) Enter half the respective diversion amounts themselves into the row with I-25, column heading 64, 69, etc. This example shows a diversion of each movement by 1000 trips. (Note that each pair of cells involving zones 25, 37, and one other must add up to the original value from zone 37.)



	A	BN	BO	BP	BQ	BR	BS	BT	BU
1		62	63	64	65	66	67	68	69
254	23								
265	24								
276	25								
287	26								
298	27								
309	28								
320	29	0	0	2.68	0	0	1.02	0.09	1.88
331	30	0	0	0	0	0	0	0	4.83
342	31								
353	32	0	0	1816.4	0	0	0	0	1248.96
364	33								
375	34	0	0	0	0	0	6.95	0.62	252.18
386	35								
397	36	0	0	0	0	0	0	0	4.28
408	37	0	0	3889.13	0	0	12.67	1.12	2196.21
419	38	0	0	8.11	0	0	0	0	5.32
430	39	0	0	79.98	0	0	2.85	0.26	94.29

	A	BN	BO	BP	BQ	BR	BS	BT	BU
1		62	63	64	65	66	67	68	69
254	23								
265	24								
276	25			1000					1000
287	26								
298	27								
309	28								
320	29	0	0	2.68	0	0	1.02	0.09	1.88
331	30	0	0	0	0	0	0	0	4.83
342	31								
353	32	0	0	1816.4	0	0	0	0	1248.96
364	33								
375	34	0	0	0	0	0	6.95	0.62	252.18
386	35								
397	36	0	0	0	0	0	0	0	4.28
408	37	0	0	2889	0	0	12.67	1.12	1196
419	38	0	0	8.11	0	0	0	0	5.32
430	39	0	0	79.98	0	0	2.85	0.26	94.29

8) For each cell in the column for J=37 (column AO), likewise subtract half of your diversion for that particular movement from the value shown with i-zone 64, 69, and any others where shown in column A.
9) For each cell in the column for J=25, (AC), enter half the respective diversion amount into i-zones 64, 69, etc.



	A		AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1		24	25	26	27	28	29	30	31	32	33	34	35	36	37
694	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
705	64	0	0	0	0	0	4.48	0	0	1610.294	0	0	0	0	5336.43
716	65														
727	66														
738	67	0	0	0	0	0	0	0	0	0	0	0	0	0	22.15
749	68	0	0	0	0	0	0	0	0	0	0	0	0	0	1.96
760	69	0	0	0	0	0	10.07	9.73	0	1133.656	0	167.6	0	0	3440.9

	A		AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1		24	25	26	27	28	29	30	31	32	33	34	35	36	37
694	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
705	64	0	1000	0	0	0	4.48	0	0	1610.294	0	0	0	0	4336
716	65														
727	66														
738	67	0	0	0	0	0	0	0	0	0	0	0	0	0	22.15
749	68	0	0	0	0	0	0	0	0	0	0	0	0	0	1.96
760	69	0	1000	0	0	0	10.07	9.73	0	1133.656	0	167.6	0	0	2441

10) Before saving (as a csv to a new name), delete row 1 (the added header row). Verify the new file for being the same format, layout, and dimensions as the source file. Also, the grand total of the new file should be the same as the source file, because trips are only diverted, not created or removed. (To see the total, select the whole file, then examine the sum on the lower right bar.)
11) To prepare the model to run, create a scenario if necessary (from the appropriate parent or sibling), select the scenario, then under Keys, edit the entry for “XX_Input” to refer to the new through-trip file. Verify the new master network with the new zone is what the scenario references. Do not modify the socioeconomic data or other inputs, or attempt to place households or employees into the new zone.
12) The results of this scenario will not have any diverted volume fields in the loaded network. To examine differences between without-diversion and with-diversion scenarios, you will need to compare them side-by-side, or else run the Compare Networks tool.