Nevada County Transportation Commission

Travel Demand Model Update

AUGUST 31, 2020

Table of Contents

List of Tables

List of Figures

1. INTRODUCTION

The Nevada County Transportation Commission maintains a travel demand model for western Nevada County using TransCAD software. This 2020 model update builds upon the previous September 2014 model, incorporating the latest land use, demographics and transportation networks. The earlier travel model utilized 2012 as its base year with this update moving to a 2018 base year and 2040 forecast year. The end product of these efforts is a robust up to date model that provides reliable forecasts of travel demand in western Nevada County. The focus of the model update, aside from using the latest data, is to update the mathematical formulas used in achieving required model calibration and validation. The processes and parameters that did not warrant a change were kept the same as the 2012 model. The result is a fully calibrated and validated travel model that can be used to forecast traffic for various kinds of projects.

1.1 HIGHLIGHTS OF MODEL UPDATE

- Update the base year to 2018 and forecast year to 2040.
- Update the roadway networks with data received from the local jurisdictions.
- Update the land use data with data received from the local jurisdictions.
- Calibrate the model using data from the latest 2012 California Household Travel Survey.
- Validate the model across several criteria to match observed data.

The previous model development report, titled “NCTC Model Development Report” prepared by Fehr & Peers provides information on the development, estimation, and application of the base model and should continue to be referenced for model background and specifics. The following Model Update focuses on the new data and process revisions that were performed as part of the model update.

2. MODEL INPUTS - LAND USE, NETWORKS AND SURVEY DATA

Population / Land use / Demographics and transportation networks are the two important inputs to a travel demand model.

2.1 TRAFFIC ANALYSIS ZONES

The model has a total of 1,023 zones of which 6 are external. No new zones were added as part of the model update as the number of zones was adequate. Tables 1 and 2 show the zones by jurisdictions / geographic named areas and external stations.

Table 1 - TAZ Numbering Range

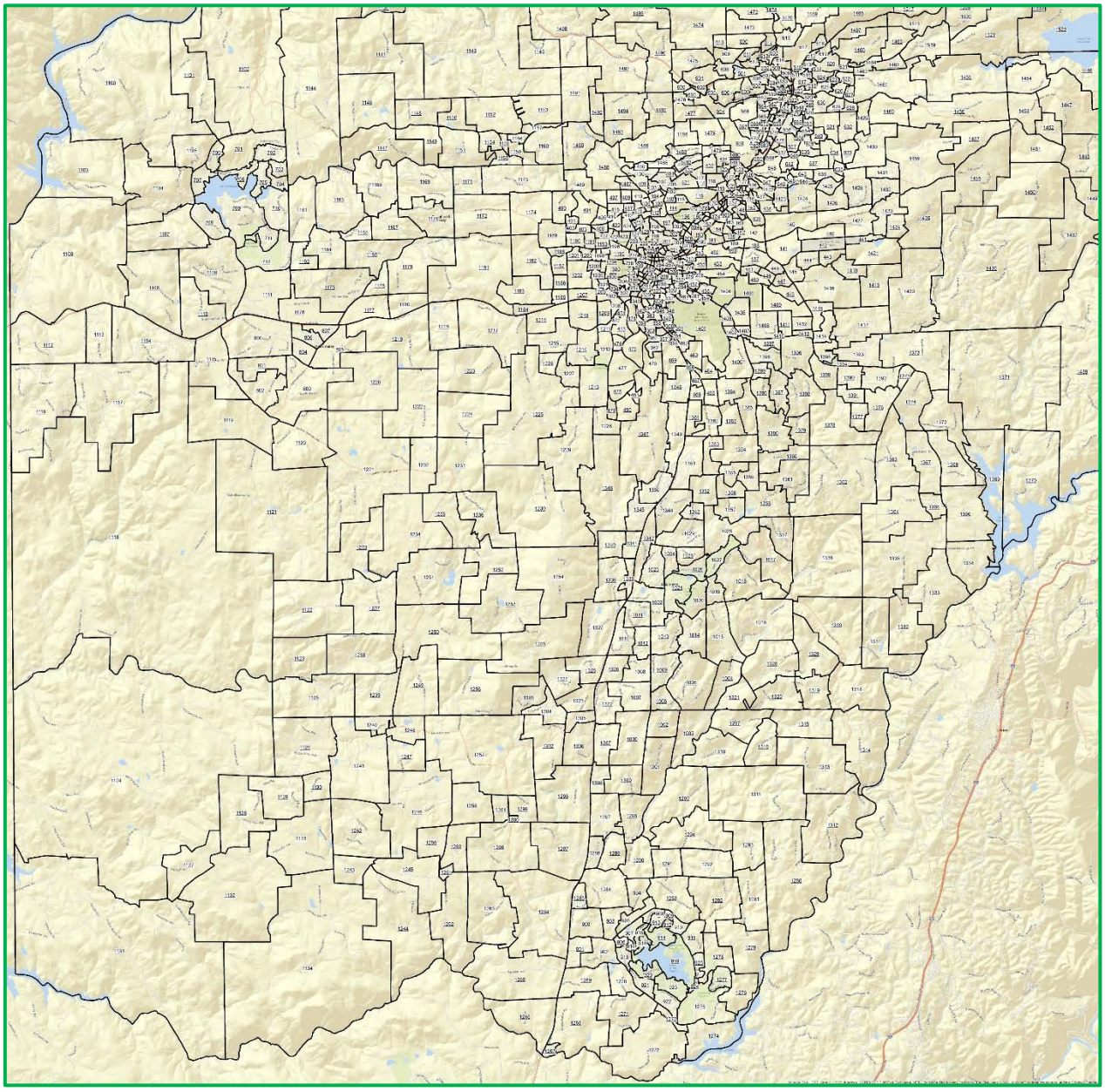
Jurisdiction	TAZ Range	Number of TAZs
Grass Valley	100 - 364	265
Grass Valley SOI	400 - 481	82
Nevada City	500 - 585	86
Nevada City SOI	600 - 650	51
Lake Wildwood	700 - 712	13
Penn Valley	800 - 807	8
Lake of the Pines	900 - 925	26
Alta Sierra	1000 - 1029	30
Unincorporated County	1100 - 1555	456
Total		1,017

Table 2 - External Stations

ID	Description
2001	SR20 - West of Mooney Flat Road / Lombardi Road (Yuba County)
2002	SR49 - North of Heron Road (Sierra County)
2003	SR20 - East of Zeibright Road (Western Nevada County)
2004	SR174 - Southeast of Redberry Road (Placer County)
2005	Dog Bar Road - South of Springfield Drive (Placer County)
2006	SR49 - South of Linnet Lane (Placer County)

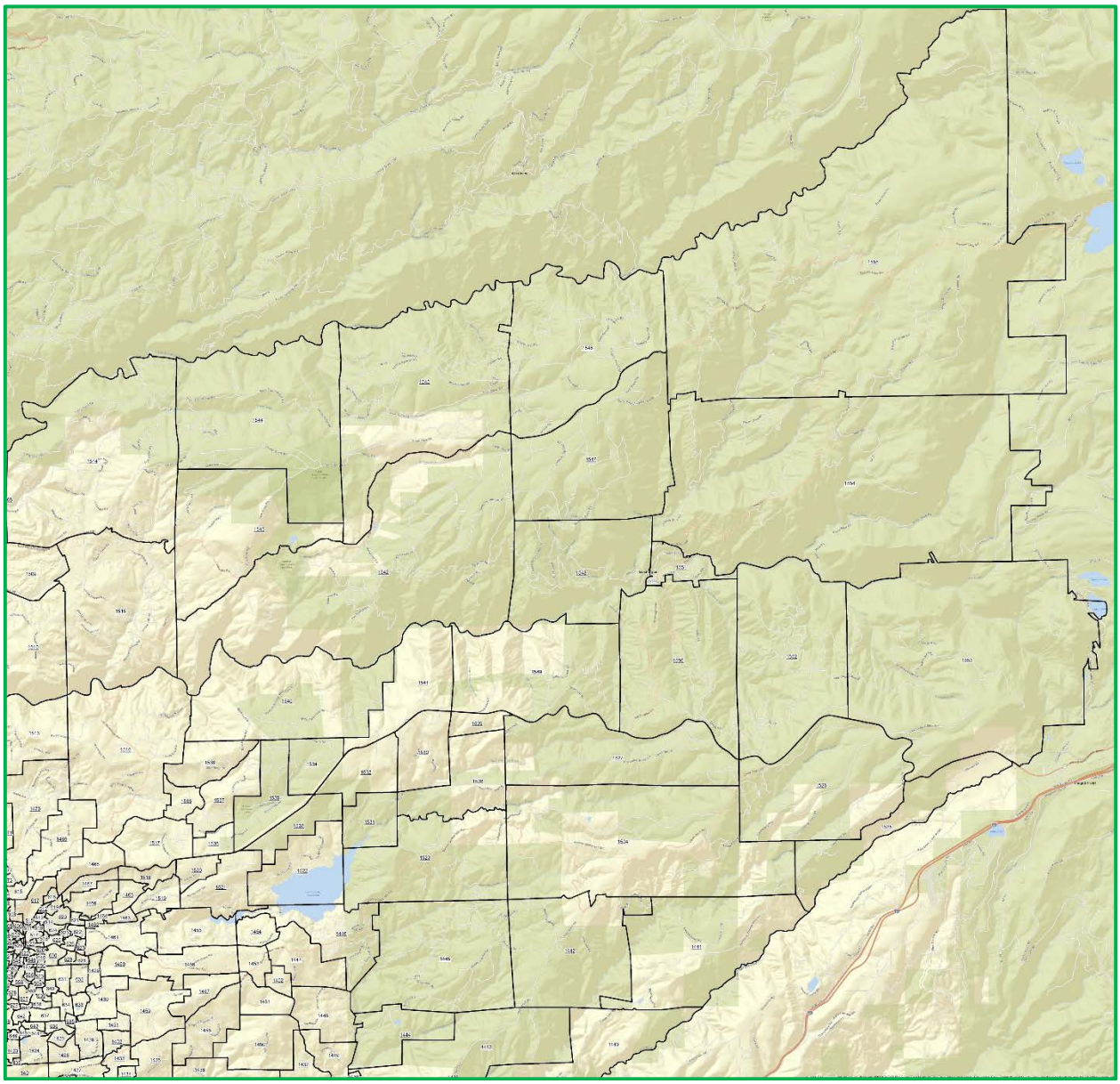
Figures 1 and 2 show the TAZ structure for the NCTC Model.

Figure 1 - NCTC Model TAZ Map (West Side)



The TAZ maps will be available on the NCTC's online mapping tool, mentioned in the User's Guide.

Figure 2 - NCTC Model TAZ Map (East Side)



Apart from land use and demographic variables, the model has several zone-specific inputs such as occupancy factors and area types. The previous model divided the study area into Area Types based on established boundaries of named geographic areas. Each jurisdiction such as Grass Valley, Nevada City or populated area such as Lake of Pines, Alta Sierra, etc. was categorized as a different area type. Area types are typically used in trip generation modeling to specify different trip-making behaviors of people that reside in different places. For example, it is believed that people that reside in city centers make a different number of trips than people that reside in rural areas. Most models, including the current model uses a different trip rate for each area type. Further, area types and functional classes of roads are used to define speed and capacity of a roadway. For example, a freeway in a rural area has a higher speed than a freeway that goes through an urban area or city center.

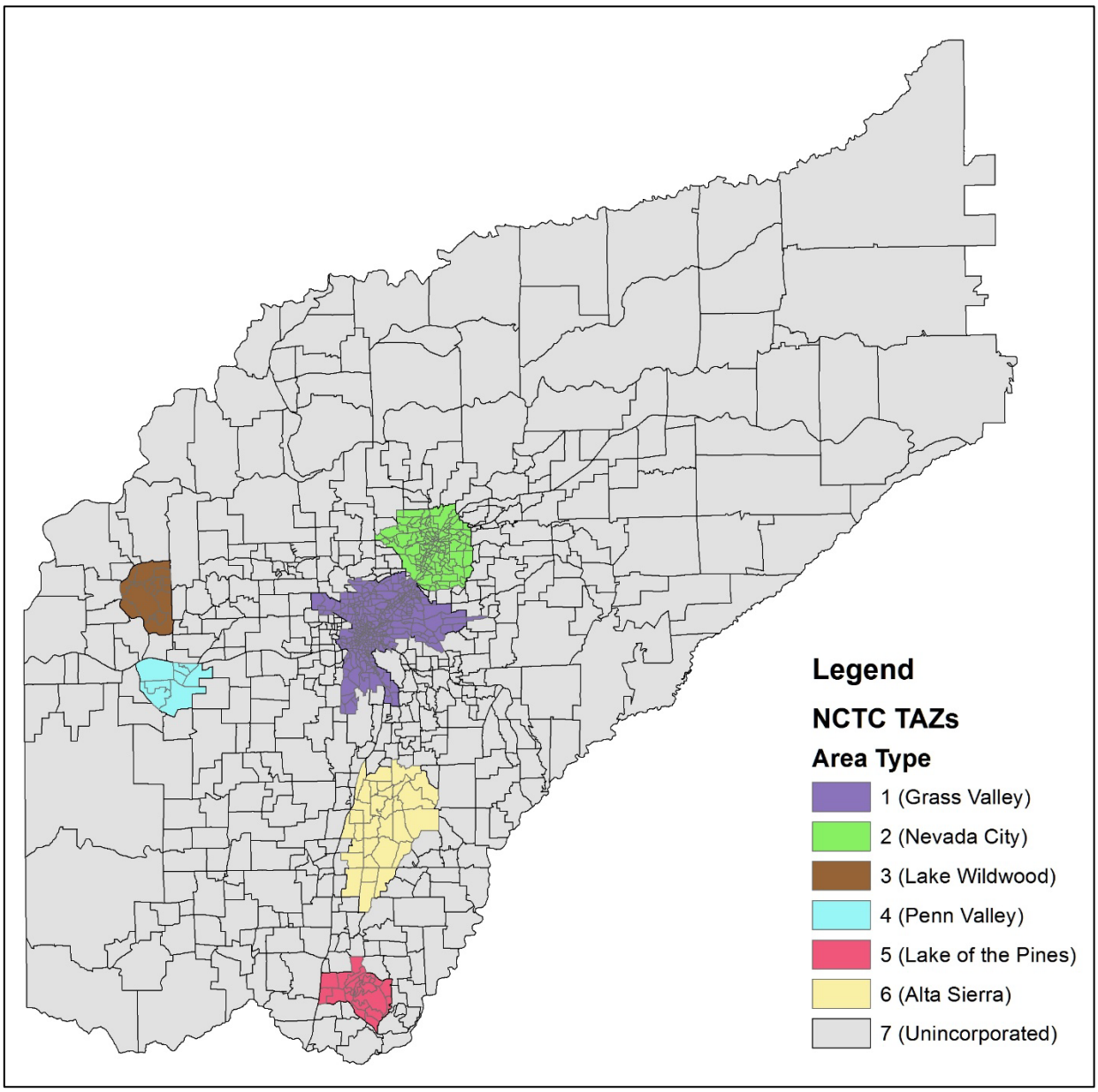
Based upon feedback from the model development team and local knowledge of travel patterns, the old definition of area type assigned by geographic area was not seen as the most accurate method to model the above-mentioned parameters. Dividing area types based upon density and classification of zones (City, urban, rural, etc.) is seen as a more appropriate modeling method than simply using jurisdictional boundaries.

Zones in the updated model are divided into 4 area types, which range from the areas with the highest residential and employment density to the lowest:

- 1 - Zones in City Center areas
- 2 - Zones in Urban areas
- 3 - Zones in Suburban areas
- 4 - Zones in Rural Areas

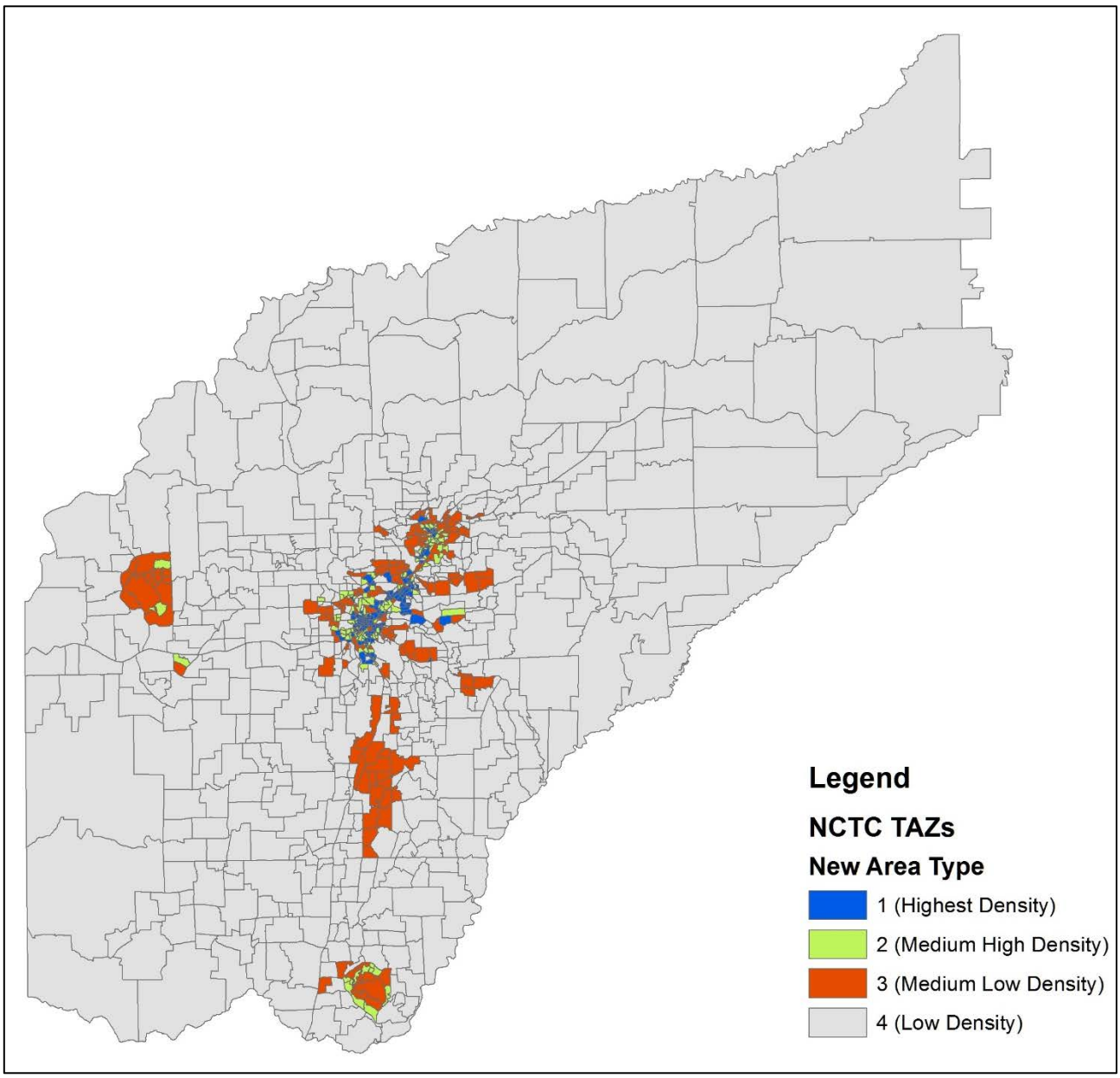
Figures 3 and 4 below show the Area Type as defined by geographic area in the old model and as revised based on zone residential density in the updated model.

Figure 3 - Area Type Designation (Old Model)



The previous model had area types based on geographical named locations. For example, Area Type 1 corresponded to Nevada City, Area Type 2 corresponded to Grass Valley, and so on.

Figure 4 - Area Type Designation (New Model)



The new Area Type designations now use population density. Area Type 1 is the densest part of the county, while Area Type 4 is the rural part of the county.

2.2 LAND USE

Land use data is one of the primary inputs to every model and is a key component for trip generation. The model update's primary source of land use data comes from Nevada County's parcel land use database, which is regularly updated. NCTC, Nevada County, Nevada City, and Grass Valley reviewed land use designations to most accurately reflect 2018 conditions. Aerial review by TJKM staff using satellite imagery from Google Maps for residential and non-residential uses were done on selected zones to verify the existing conditions.

The land use database was then aggregated into the model's traffic analysis zone (TAZ) structure.

Table 3 describes the model land use categories used.

Table 3 - Land Use Categories

Lane Use Type	Model LU	Units
Single Family Dwelling Unit	SF	Dwelling Units
Multi-Family Dwelling Unit	MF	Dwelling Units
Mobile Home Unit	MH	Dwelling Units
Senior Housing	SEN	Dwelling Units
Office	OFF	Thousand Square Feet
Medical Office	MEDOFF	Thousand Square Feet
Hospital	HOSP	Beds
Light Industrial	LI	Thousand Square Feet
Warehouse	WARE	Thousand Square Feet
Church	CHURCH	Thousand Square Feet
Public/Quasi-Public	PQP	Thousand Square Feet
Park	PARK	Acres
Retail	RET	Thousand Square Feet
Golf Course	GOLF	Holes
Restaurant	REST	Thousand Square Feet
Fast Food (High Turnover)	RESTHI	Thousand Square Feet
Gas Stations	GAS	Pumps
Hotel/Lodging	LODGING	Rooms
K-8 School	K8	Students
High School	HIGHSCH	Students
College/University	COLL	Students

Table 4 lists the 2018 land use by geographic named areas.

Table 4 - Base Year 2018 Land Use Table

Landuse Variable	Nevada City	Grass Valley	Alta Sierra	Lake of the Pines	Lake Wildwood	Penn Valley	Unincorporated County	Total County
Single Family	1,849	4,180	3,078	2,076	2,813	586	17,186	31,768
Multi-Family	294	1,799	93	2	5	42	187	2,422
Mobile Home	35	425	-	24	-	165	891	1,540
Senior Housing	-	1,101	-	-	-	-	0	1,101
Office	290	865	-	2	-	22	77	1,256
Medical Office	11	269	-	-	-	2	1	284
Hospital (Beds)	-	228	-	-	-	-	-	228
Light Industrial	161	1,289	-	22	-	67	158	1,696
Warehouse	-	354	-	-	-	-	48	402
Church	57	238	-	46	-	10	39	392
Public/Quasi-Public	280	14	-	8	-	16	21	338
Park	9	127	-	-	-	81	625	842
Retail	357	2,314	-	102	-	69	250	3,092
Golf course	-	9	18	18	18	-	18	81
Restaurant	17	102	-	16	-	9	30	174
Fast Food Restaurant	22	53	-	-	-	-	-	74
Gas Stations	48	87	-	12	-	22	32	201
Hotel/Lodging	223	297	15	-	-	-	38	573
K-8 School	1,736	644	308	796	-	350	2,970	6,804
High School	235	1,991	-	615	-	-	-	2,841
College / University	20	3,500	-	-	-	-	-	3,520

As can be seen from the above table, western Nevada County has approximately 36,800 dwelling units. A large number of people are scattered throughout the unincorporated area. Figure 5 shows the total number of dwelling units in each jurisdiction or geographic named areas. Grass Valley is the most populated area with 41% of total dwelling units followed by Alta Sierra (17%) and Lake Wildwood (15%) as shown in Figure 6. Based upon land use, Grass Valley also sustains the most employment square footage as shown in Figure 7. Retail square footage accounts for 40% of all employment square footage followed by light industrial and office employment as shown in Figure 8.

Figure 5 - Total Dwelling units in Nevada County

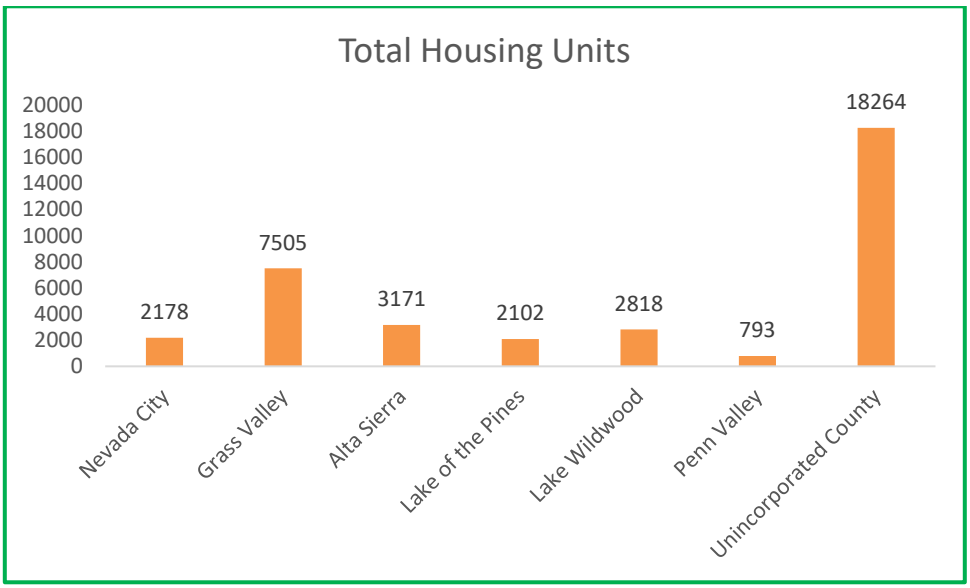


Figure 6 - Dwelling Units in the Geographic Named Areas

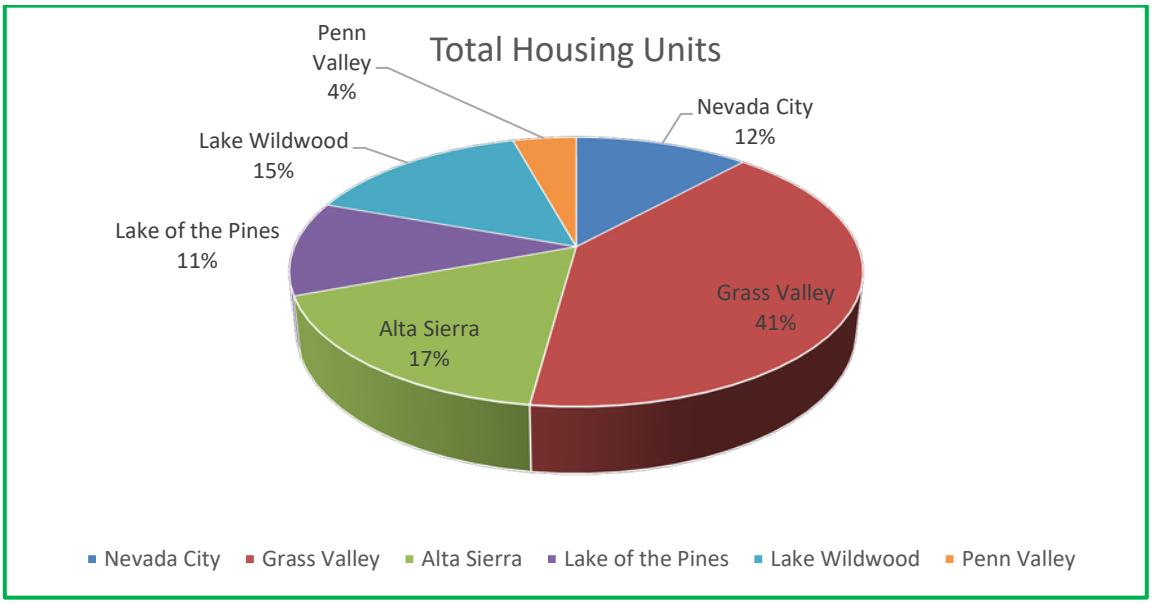
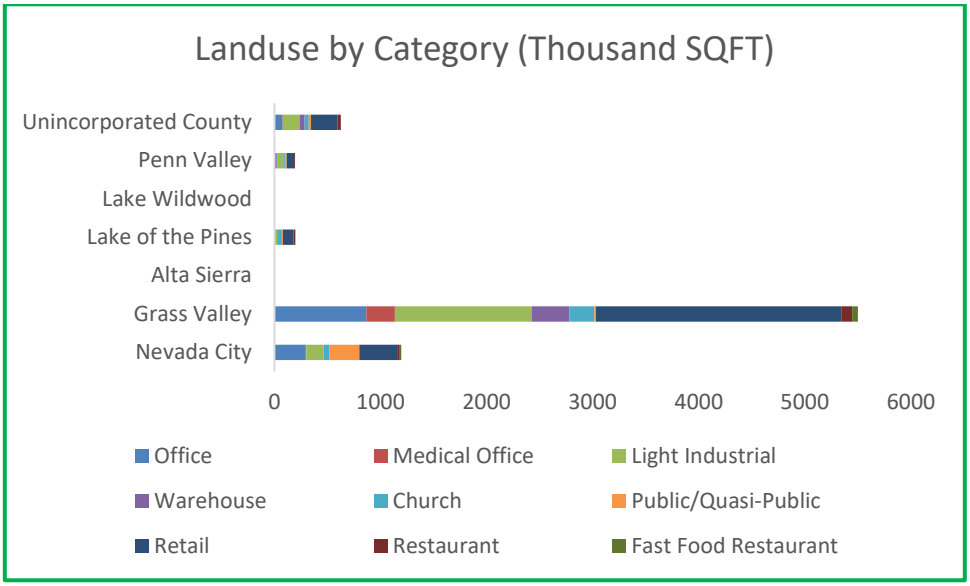
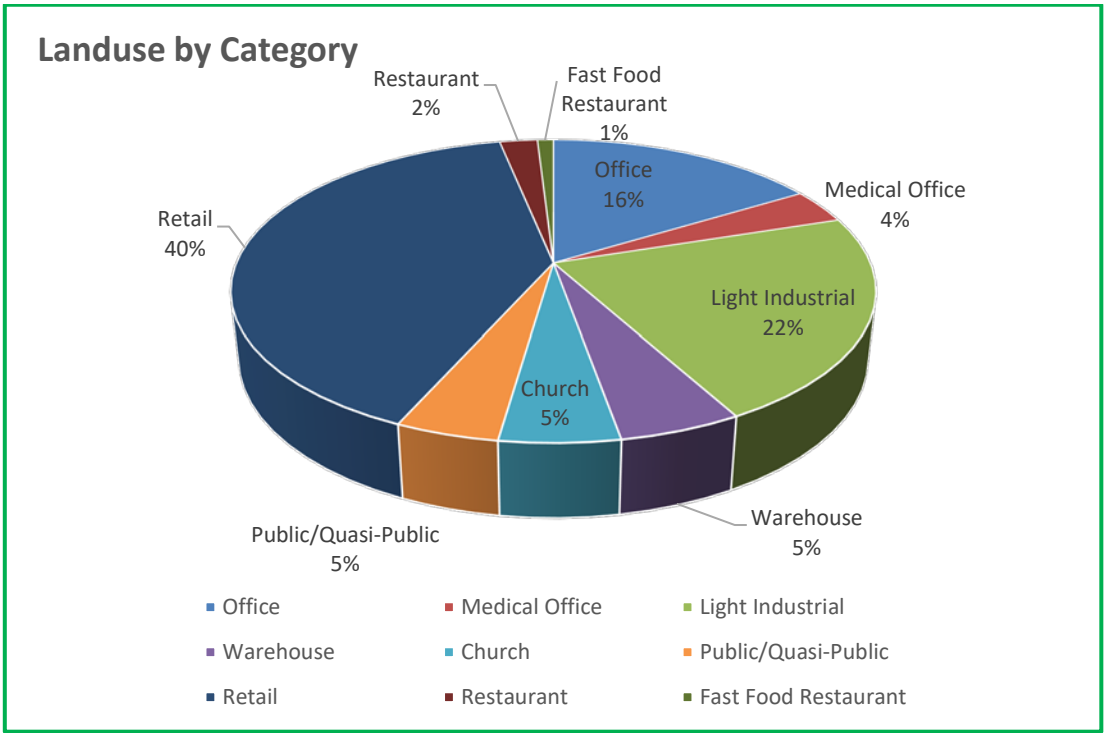


Figure 7 – Total Land use in the County by Geographic Named Areas



Note: Lake Wildwood and Alta Sierra are mostly residential with very little employment land use.

Figure 8 – Percentage of Land use by Category in the County



2.3 ROADWAY NETWORK

The roadway network for the base year model was developed from the Nevada County GIS centerline file provided by Nevada County. The model roadway network includes all freeways, arterials, collectors, local, and rural roads within the study area. Local streets and driveways are represented by zone centroid connectors that represent various land uses that load into the roadway network.

Table 5 lists the model's roadway functional classifications, its speed range, and lane capacity range.

Table 5 - Roadway Network Classification, Speeds, and Capacity

Roadway Functional Classification	Speed Range	Lane Capacity Range
Freeways	60 - 65	1,600 - 1,800
Ramps and Access Roads	40 - 65	700 - 1,800
Arterials (Principal & Minor)	35 - 50	700 - 1,100
Major Collectors	25 - 50	600 - 750
Minor Collectors	25 - 50	550
Local Streets	25 - 30	350 - 375
Centroid Connectors	25	10,000

For the 2018 Model update, TJKM received data from Grass Valley, Nevada City, and the unincorporated county in regards to speed limit changes, functional class, and added lanes. Such changes have been incorporated in the base year 2018 roadway network and the forecast year 2040 network.

Figures 9 and 10 show the functional classification types of the roadway network, along with the number of lanes (in each direction).

Figure 9 - 2018 Base Year Network Roadway Functional Classification

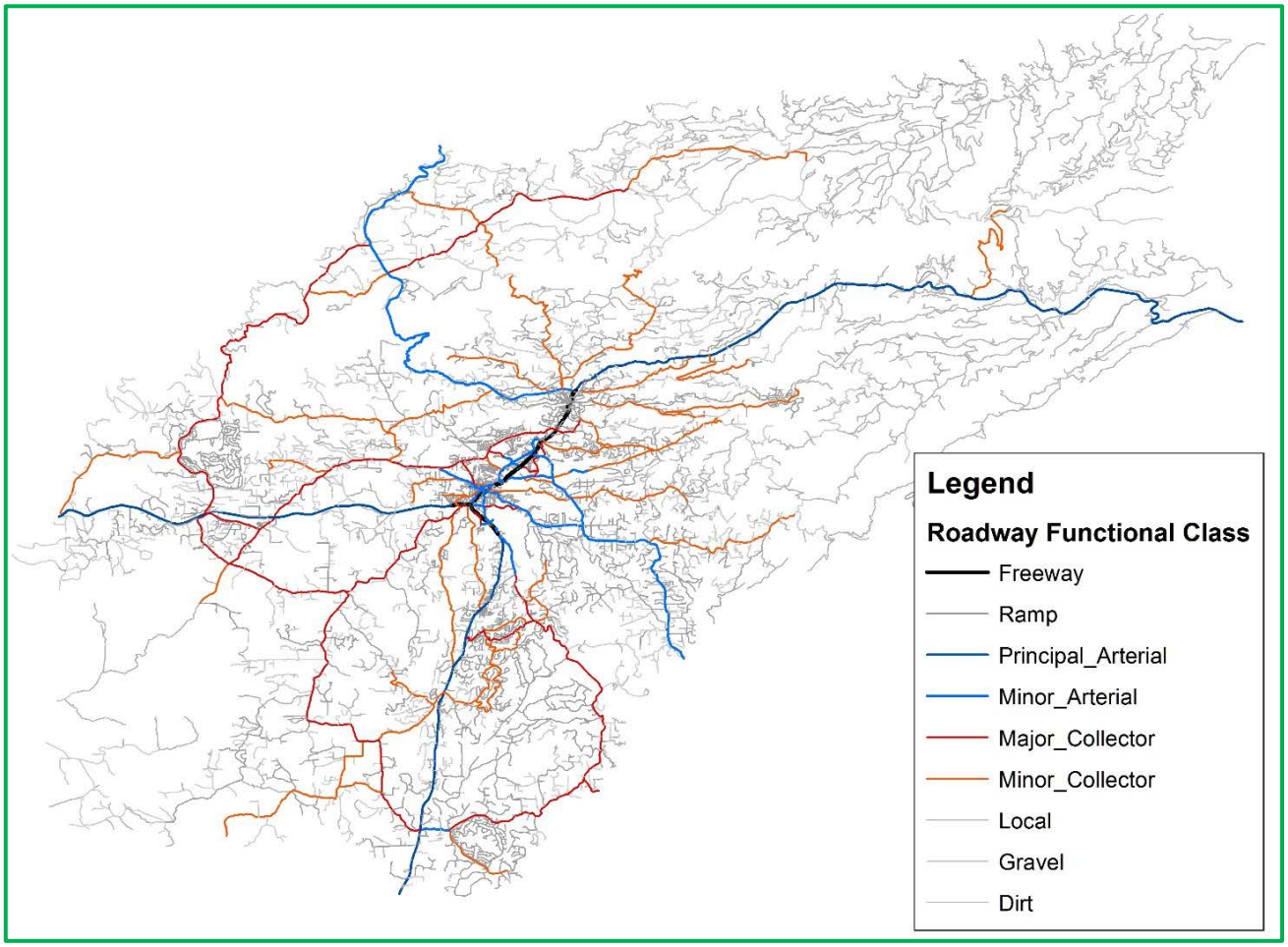
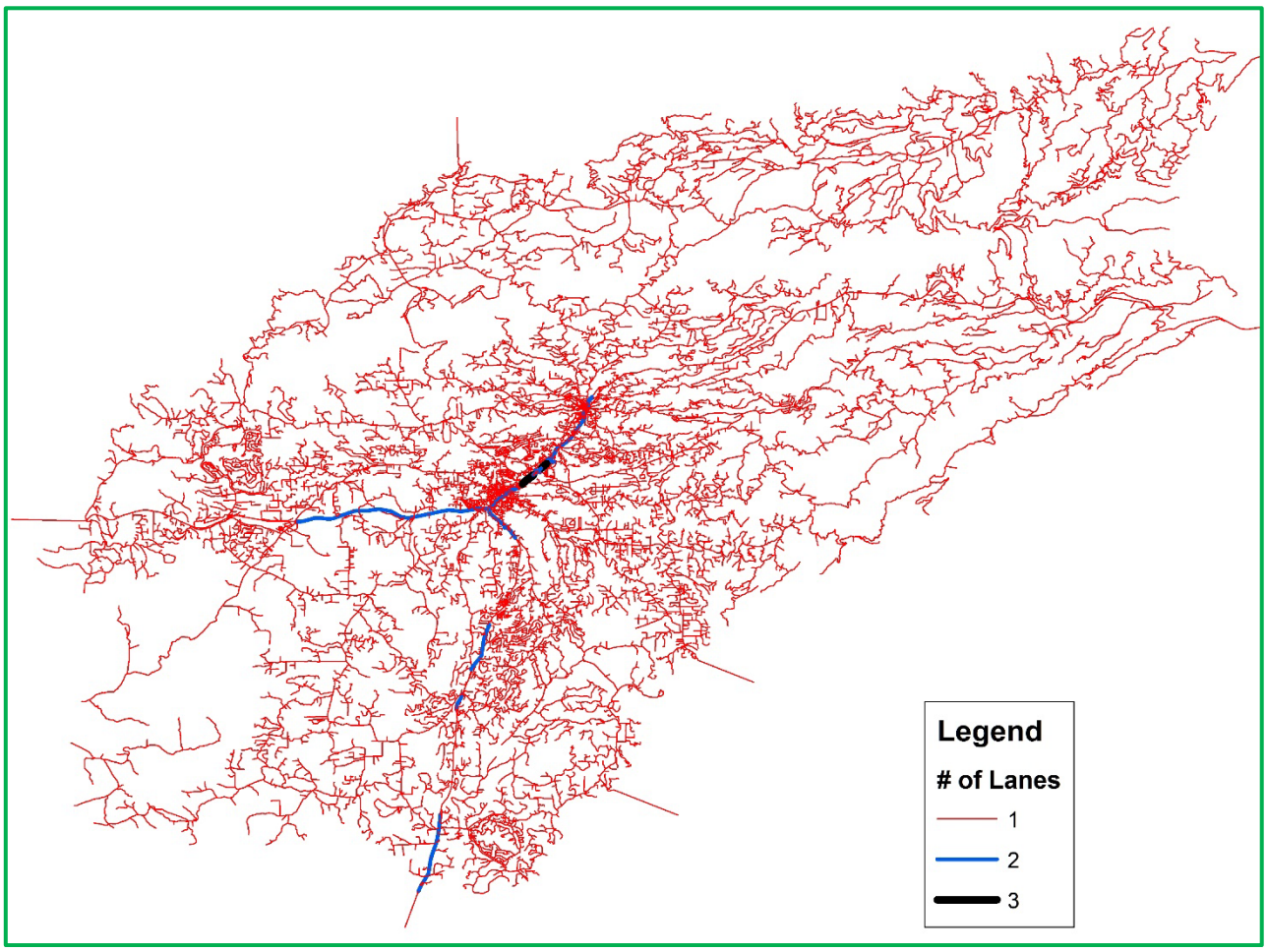


Figure 10 - 2018 Base Year Network Roadway Number of Lanes Per Direction



2.4 CALIFORNIA HOUSEHOLD TRAVEL SURVEY (CHTS 2012)

In 2012, California conducted a statewide household travel survey that has been used by Counties and transportation agencies to develop specific parameters for their regions. Caltrans contacted over 7000 households in Nevada County but only 188 households completed the survey.

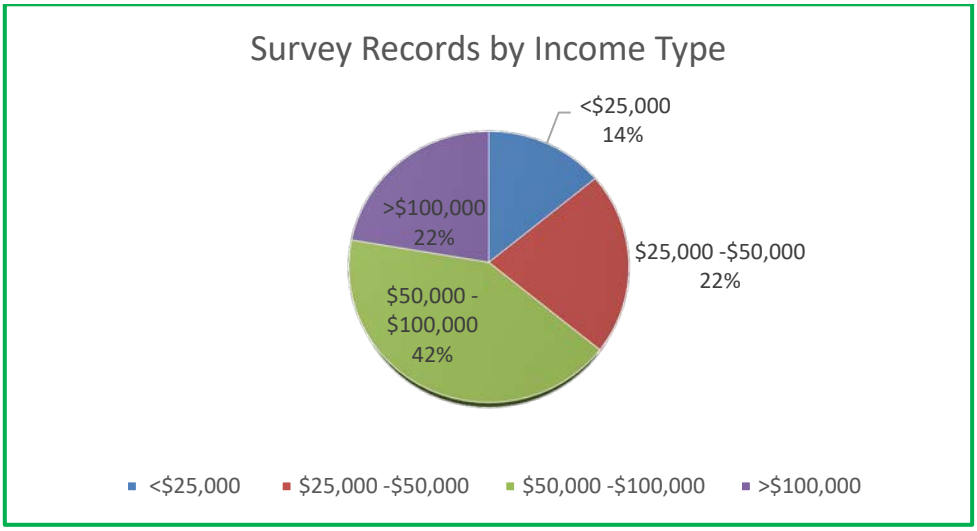
The households that completed the survey are mostly from the bigger towns such as Grass Valley, Nevada City and Truckee as shown in Table 6. Also, a number of these households are from the higher income class as shown in Figure 11. 64% respondents are from income class $50,000 and higher.

When the number of survey records are very low, the weight of the data for each survey is much higher, and thus using that data can introduce a lot of bias into model parameters. Therefore, county specific data was not used in the model development exercise.

Table 6 - CHTS Completed Surveys in Nevada County

City	Number of Completed Surveys
GRASS VALLEY	95
NEVADA CITY	39
TRUCKEE	25
PENN VALLEY	16
AUBURN	6
ROUGH AND READY	3
NORTH SAN JUAN	3
FLORISTON	1
Total	188

Figure 11 - CHTS Survey Households by Income Class



3. TRIP GENERATION MODEL

Trip generation is the step that calculates total number of vehicle trips produced and attracted to a zone. Productions are based on residential land use like number of dwelling units, while attractions are based on commercial land use such as different types of employment. Trips are typically stratified by purpose because production and attraction trip rates are different for different purposes. A household might have a single work trip but several other shopping and social trips in a day. Similarly, a single office job will attract a roundtrip to and from the office, but a single retail job will attract several shopping trips. Dividing trips into purposes helps the analyst incorporate nuanced trip rates associated with each purpose. The NCTC model has 5 trip purposes as listed below:

- Home based work (HBW)
- Home based other (HBO)
- Non home based (NHB)
- School Trips (SCHOOL)
- Sierra College trips (SIERRA)

Trip rates have been updated with data taken from the ITE Trip Generation Manual 10th edition but modified based on previous models developed, production-attraction balancing and assignment validation. Trip rates vary by area type as shown in Table 7. A full trip rate table by area type is shown in Appendix 1.

Table 7 - NCTC Model Average Trip Rates

Land Use Type	Land Use Unit	ITE Trip Rate (10th Ed)	Average Model Trip Rates
SF	DU	9.44	7.32
MF	DU	7.32	4.77
MH	DU	5	3.30
SEN	DU	4.27	2.73
OFF	KSF	9.74	11.63
MEDOFF	KSF	34.8	37.72
HOSP	BEDS	22.32	12.25
LI	KSF	4.96	7.38
WARE	KSF	1.74	3.68
CHURCH	KSF	6.95	9.73
PQP	KSF	28.8	105.09
PARK	Acres	0.78	2.38
RET	KSF	63.47	57.16
GOLF	HOLES	30.38	38.57
REST	KSF	83.84	93.71
RESTHI	KSF	112.18	202.00
GAS	PUMPS	172.01	28.76
LODGING	ROOMS	3.35	9.21
K8	STUDENTS	1.89	1.45
HIGHSCH	STUDENTS	2.03	1.70
COLL	STUDENTS	1.15	1.20

Trip Balancing Factor: For internal trips, i.e., trips that stay inside Nevada County, every trip produced in a residential zone has to be attracted to a place of business. While this makes intuitive sense, in a travel model, productions are based on household data and attractions are based on land use and employment data. If the trip rates are not in-sync, total internal productions will not closely match attractions. In that case, the trip generation balancing program is setup to proportionally increase or decrease attractions to match total Countywide productions.

One of the steps in model calibration is to check trip balancing and make sure attractions are not reduced or increased by more than 10%. Table 8 shows the productions and attractions before balancing and all of them are within the acceptable range.

Table 8 - Trip Generation Balancing (2018 Base Year)

Trip Purpose	Productions	Attractions	Factor
HBW	40,224	39,583	1.0
HBO	104,172	103,628	1.0
NHB	78,668	76,565	1.0
SCHOOL	14,546	12,677	1.1
SIERRA	5,318	4,224	1.3
Total	242,927	236,677	1.0

The model was also checked to confirm the correct distribution of trips by purpose as compared to the statewide trips (as the number of records in the survey from Nevada County were low) from the California Household Travel Survey. Table 9 shows trips by purpose. While there are some differences between trips by purpose, it is because of the unique nature of Nevada County as compared to the rest of the state.

Table 9 - Trips by Purpose

Trip Purpose	Model Share	2012 CHTS (Statewide Share)
HBW	16%	20%
HBO (includes school)	52%	48%
NHB	33%	31%
Total	100%	100%

4. TRIP DISTRIBUTION MODEL

The Trip distribution step of the modeling process seeks to ensure that productions are matched to attractions. For example, a home-based work trip that starts in the residential area is attracted to an office in the commercial part of the city or a shopping trip that starts at home is attracted to a mall in the nearby zone. Gravity models are the most common type of trip distribution models and this is what is used in the NCTC model.

Parameters in a gravity model are then adjusted to produce the right amount of short, mid-range and long trips so that the model trip lengths match the observed trip length. Table 10 and Figure 12 shows the average trip time for all purposes.

Figures 13 and 14 show the trip length distribution by purpose for all internal and external purposes. The model documentation did not have any observed data to calibrate these values. As part of the model update, these numbers were reviewed with NCTC staff based on their knowledge of the study area.

Table 10 - Average Travel Time by Purpose (2018 Base Year)

Trip Purpose	Average Travel Time (Minutes)
Home Based Work (HBW)	10.89
Home Based Other (HBO)	10.08
Non Home Based (NHB)	2.92
School (SCH)	8.82
Sierra (SIE)	16.53
Home Based Work Internal-External (HBWIE)	23.80
Home Based Other Internal-External (HBOIE)	23.57
Non-Home Based Internal-External (NHBIE)	23.99
Home Based Work External - Internal (HBWEI)	26.65
Home Based Other External - Internal (HBOEI)	25.96
Non-Home Based External - Internal (NHBEI)	26.02
Through Trips (XX)	48.37

Figure 12 - Average Trip Length (2018 Base Year)

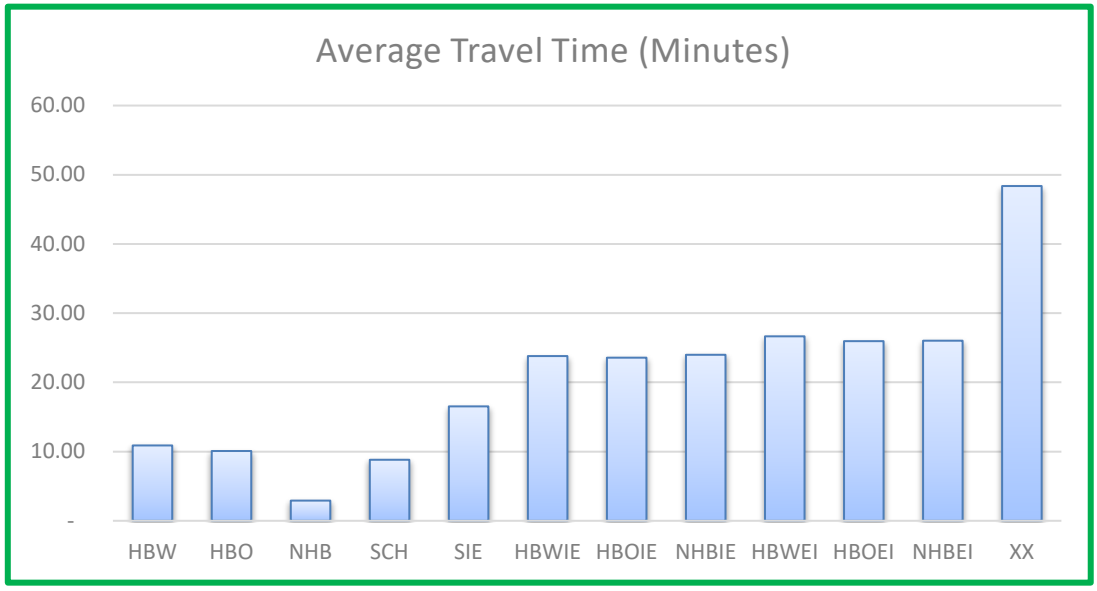


Figure 13 - Trip Length Distribution for Internal Trips (2018 Base Year)

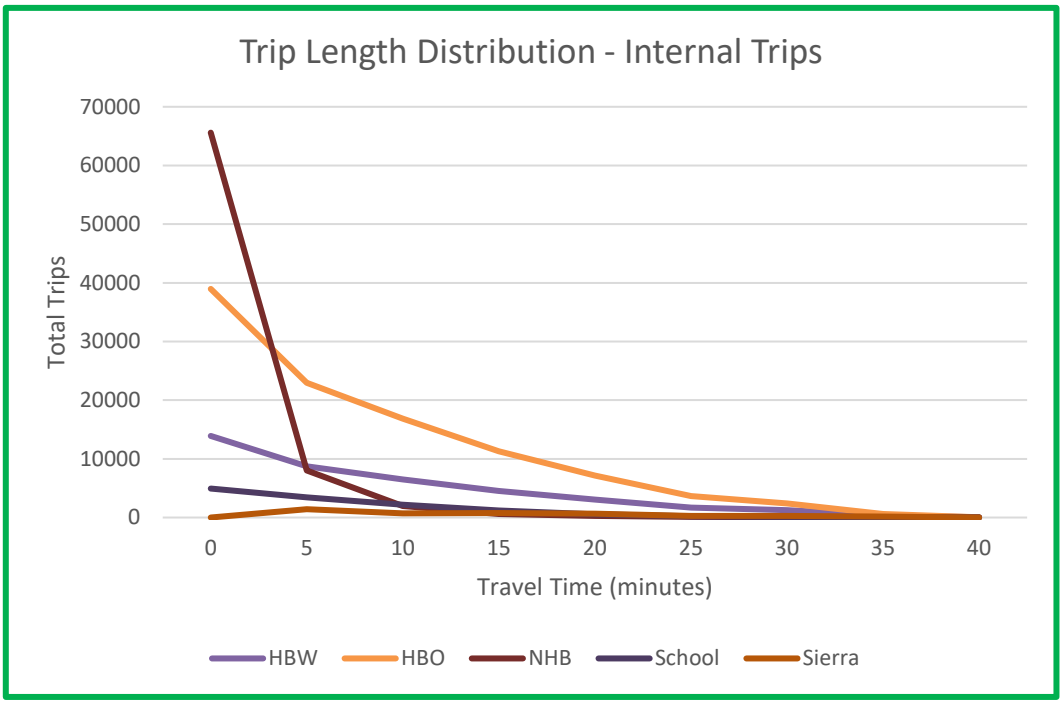
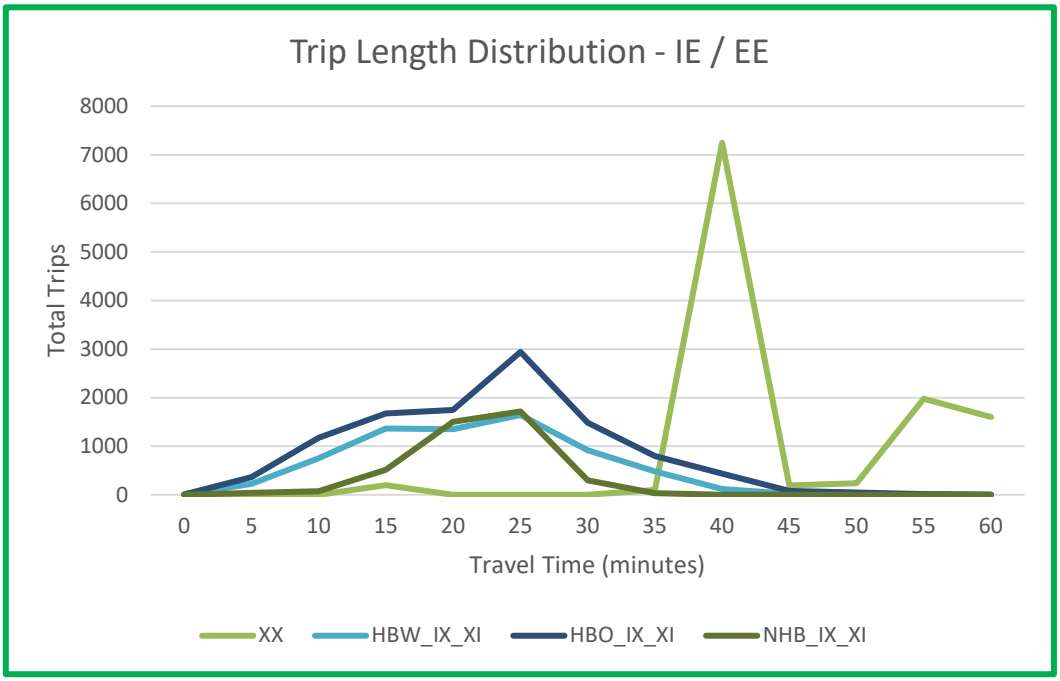


Figure 14 - Trip Length Distribution for Internal-External and Through Trips (2018 Base Year)

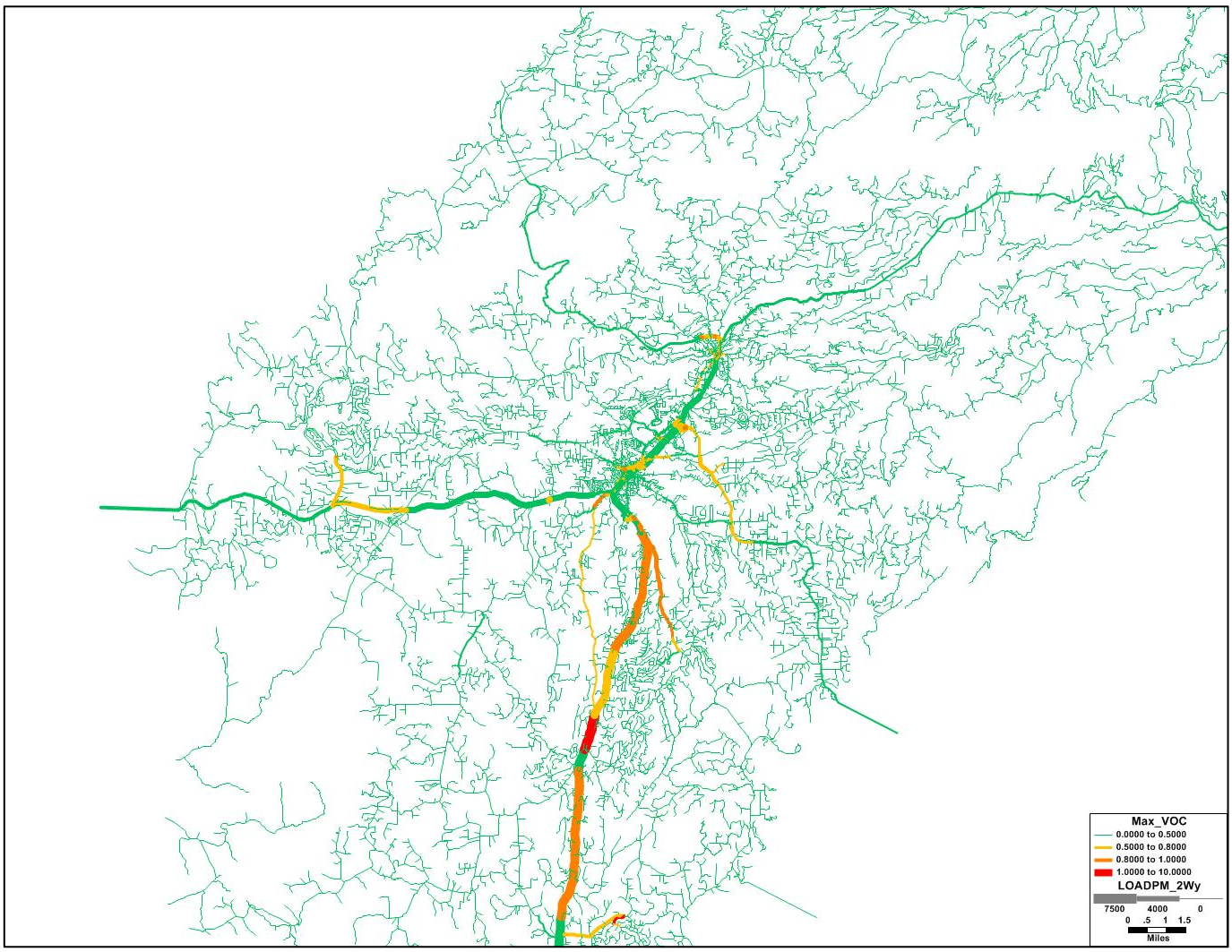


5. TRIP ASSIGNMENT MODEL

The Trip Assignment model estimates traffic volumes on each roadway in the transportation network. It also generates important performance indicators such as congested speed, congested travel time and vehicle miles travelled (VMT).

Figure 15 shows the bandwidth of the PM Peak Period Volumes and the V/C ratio which indicates congestion. A volume-capacity ratio of over 0.8 indicates that the volume is reaching capacity and that over 1.0 indicates that volume has exceeded capacity.

Figure 15 - Bandwidth Map showing PM Peak Volumes



Assignment results are validated by comparing volumes to observed traffic counts using various measures to ensure that the model matches traffic volumes within a % error on roads by facility type, volume group, screen line geography, etc. Following criteria were used:

- At least 75% of the roadway links should be within the maximum deviation as shown in table 14. **75% of links in the daily model meet this criterion.**
- A correlation coefficient of at least 0.88 - This looks at how many links have model volumes that match traffic counts. **The daily model has a correlation coefficient of 88% which is good.**
- The percent root mean square error (RMSE) below 40% - Aggregate measures showing percent error can be misleading because the links that are overestimated cancel out those that are underestimated giving a total error that is within an acceptable range. To avoid this over simplification, RMSE is used. Specifically, RMSE is the square root of the square of the error (model volume minus traffic count) divided by the number of counts. This measures whether a majority of the links are within acceptable range. **Both daily and peak hour models satisfied this criterion as shown in Tables 11,15 and 16.**
- Tables 12 and 13 show validation by area type and geographic named areas respectively. This measure ensures good performance from the model in all regions.

Table 11 - Assignment Validation by Roadway Functional Classification (2018 Base Year)

Facility Type	Observed Traffic Counts	2018 Estimated Volumes	Daily Validation (Percent RMSE)	Percent Error
Freeways	323,834	348,700	17%	8%
Principal Arterials	240,892	256,969	13%	7%
Minor Arterials	546,199	551,949	36%	1%
Major Collectors	342,817	348,034	45%	2%
Minor Collectors	163,425	145,808	93%	-11%
Local	113,964	90,092	57%	-21%
All	**1,731,132**	**1,741,552**	**42%**	**1%**

Table 12 - Assignment Validation by Area Type (2018 Base Year)

Area Type	Observed Traffic Counts	2018 Estimated Volumes	Percent Error
City Center	231,828	209,873	-9%
Urban	171,031	164,612	-4%
Suburban	546,444	548,698	0%
Rural	658,363	697,522	6%
Total	**1,607,666**	**1,620,705**	**1%**

Table 13 - Assignment Validation by Geographic Named Areas

Area Type	Observed Traffic Counts	2018 Estimated Volumes	Percent Error
Grass Valley	794,476	792,538	0%
Nevada City	144,778	139,561	-2%
Alta Sierra	43,638	41,549	-5%
Lake Wildwood	2,804	2,261	-19%
Penn Valley	32,436	27,992	-14%
Unincorporated C	481,954	513,423	7%
Grass Valley SOI	107,581	103,381	-2%
Total	**1,607,666**	**1,620,705**	**-7%**

Figure 16 - Scatter Plot for Daily Assignment and Error

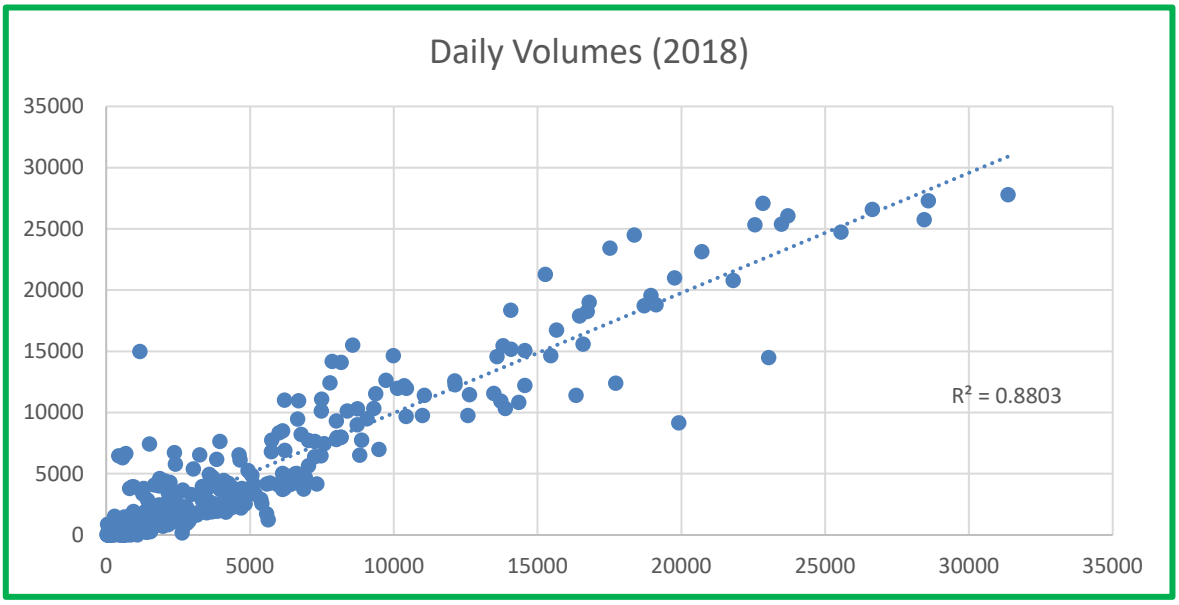


Table 14 - Link Validation Criteria

Number of total links	327
Links Meeting Criteria	246
%	75%
Target	75%
Target Met	**YES**

Table 15 - Assignment validation by Roadway Functional Classification - AM Peak Hour

Facility Type	Observed Traffic Counts	2018 Estimated Volumes	Daily Validation		Targets	
	Sum of Counts	Sum of Model Volumes	Percent RMSE	Percent Error	Percent RMSE	Percent Error
Freeways	6,594	7,812	40%	18%	40%	+/-15%
Principal Arterials	13,670	13,209	19%	-3%		+/-20%
Minor Arterials	8,630	9,439	46%	9%		+/-25%
Major Collectors	855	833	41%	-3%		+/-25%
Minor Collectors	395	216	45%	-45%		+/-30%
Local	1,373	1,241	50%	-10%		+/-30%
All	31,516	32,750	35%	4%	**40%**	**+/-15%**

Table 16 - Assignment validation by Roadway Functional Classification - PM Peak Hour

Facility Type	Observed Traffic Counts	2018 Estimated Volumes	Daily Validation		Targets	
	Sum of Counts	Sum of Model Volumes	Percent RMSE	Percent Error	Percent RMSE	Percent Error
Freeways	9,911	10,001	12%	1%	40%	+/-15%
Principal Arterials	17,341	17,618	13%	2%		+/-20%
Minor Arterials	14,119	13,644	27%	-3%		+/-25%
Major Collectors	1,121	1,108	8%	-1%		+/-25%
Minor Collectors	544	269	51%	-51%		+/-30%
Local	1,997	1,825	53%	-9%		+/-30%
All	45,033	44,465	20%	-1%	40%	+/-15%

6. DYNAMIC VALIDATION

Dynamic Validation is a validation step that looks at the sensitivity of the model to changes in input data such as land use and roadway network changes to see if the traffic volumes change as expected. Two tests were done:

- Test 1 - Adding 50 single family and 50 multi family dwelling units to zone 228 in Grass Valley as shown in Figure 17.
- Test 2 - Expand Hwy 49 to 2 lanes as shown in Figure 18

Figure 17 - Test 1: Increasing Dwelling units in Zone 228

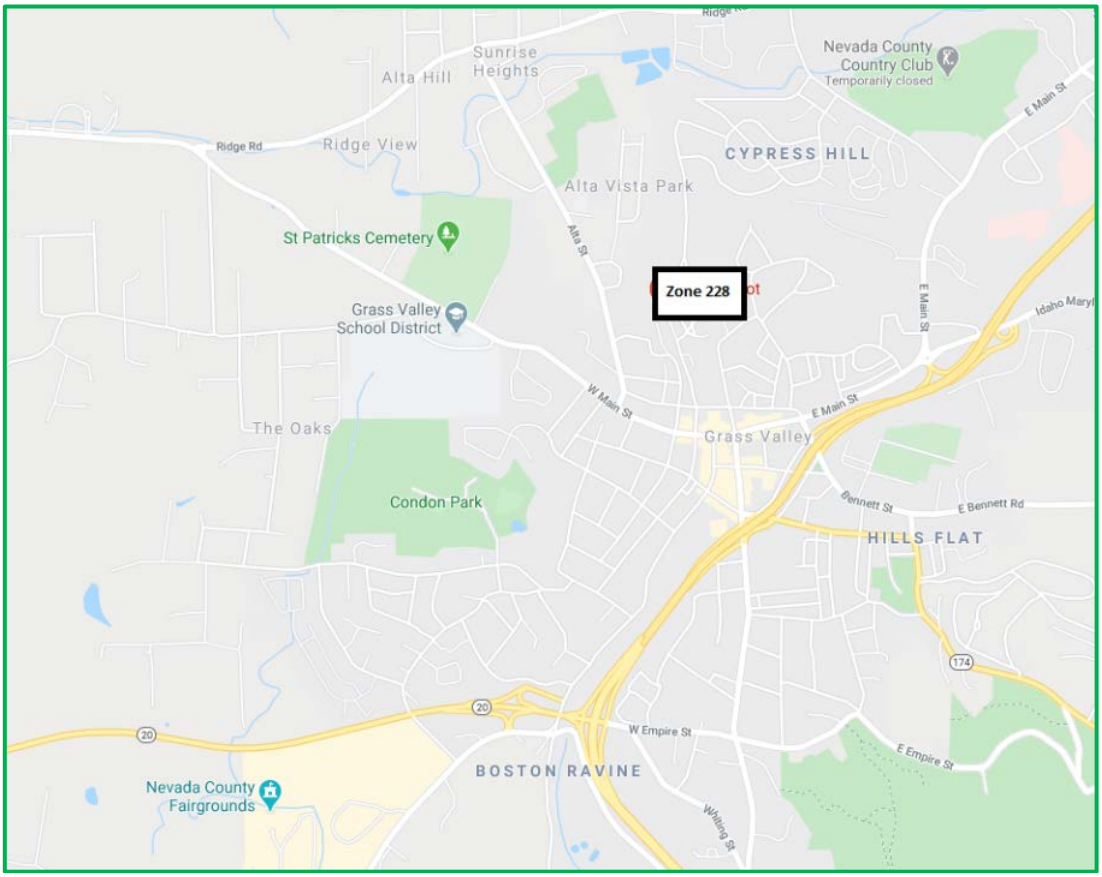
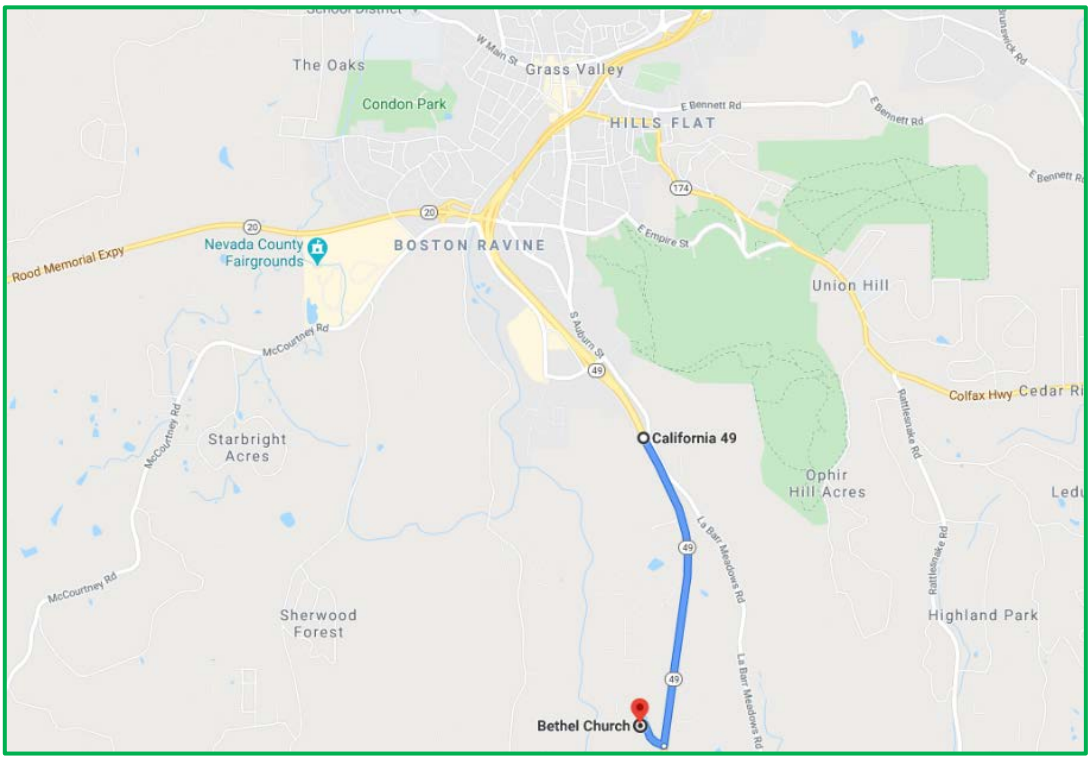


Figure 18 - Test 2: Increasing number of lanes in a stretch of Hwy 49



Results of Test 1: The expected result of adding extra dwelling units to zone 228 is that the number of trips in that zone would increase and resulting traffic along the area would increase for the daily time period and slightly for the PM peak.

The number of dwelling units were increased from 94 to 194 for zone 228, an increase of 106%. Total vehicle trips for the zone increased from 254 to 543, an increase of 114% which is in line with expectation. Traffic in the vicinity went up as can be seen from Figures 19 and 20. Figure 19 shows the original daily model traffic near zone 228 for the base scenario and Figure 20 shows traffic after 100 dwelling units are added.

Results of Test 2: This was a highway expansion test where the number of lanes were added on Hwy 49 in the section showed in Figure 18. This increased traffic volume on the highway as expected and shown in Figures 21 and 22. Figure 21 shows the original daily model traffic for the base case and Figure 21 shows traffic after number of lanes were increased.

Figure 19 - Traffic Volumes from the Base Model

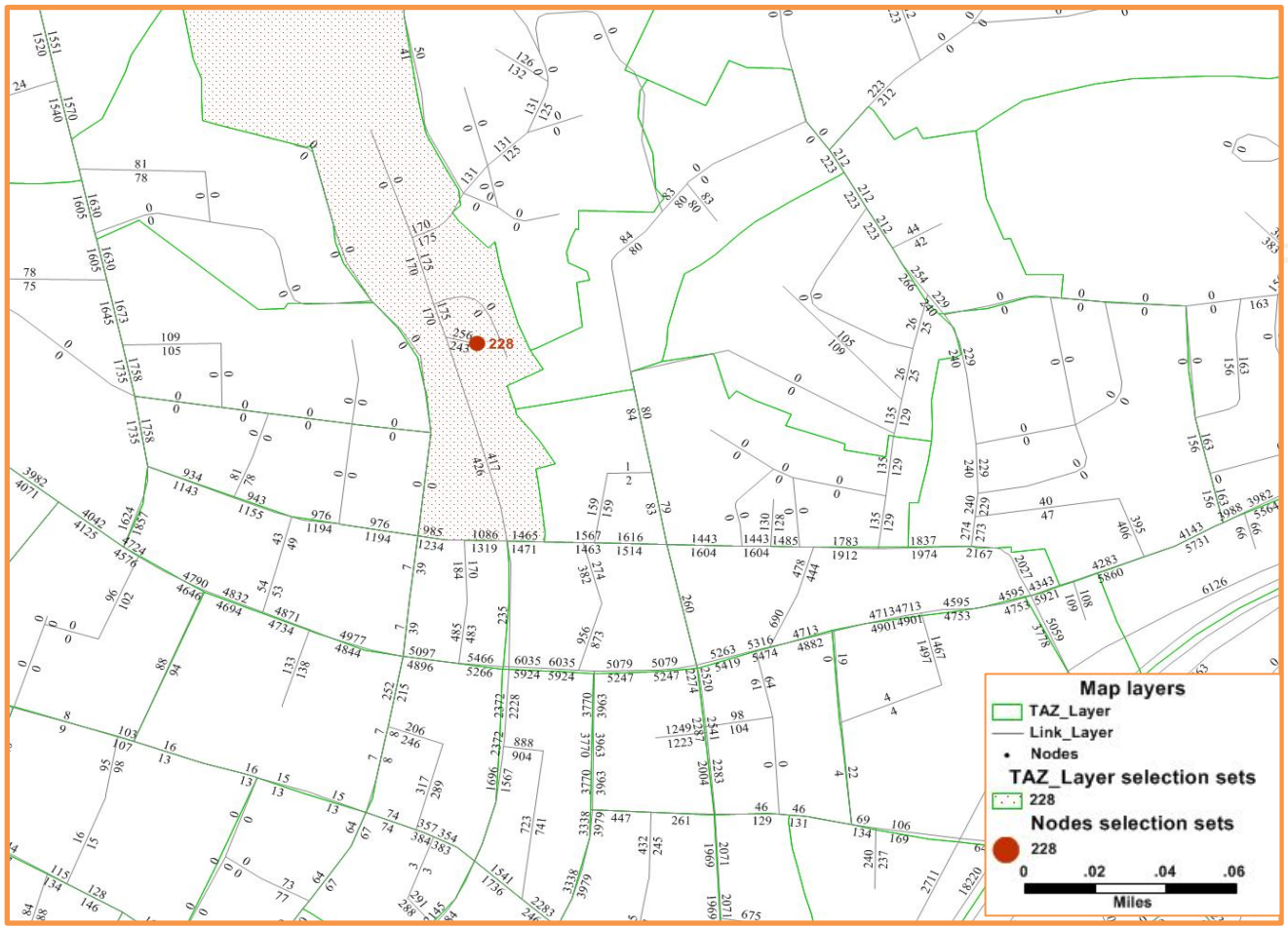


Figure 20 - Traffic Volume along zone 228, Test 1 with 100 dwelling units

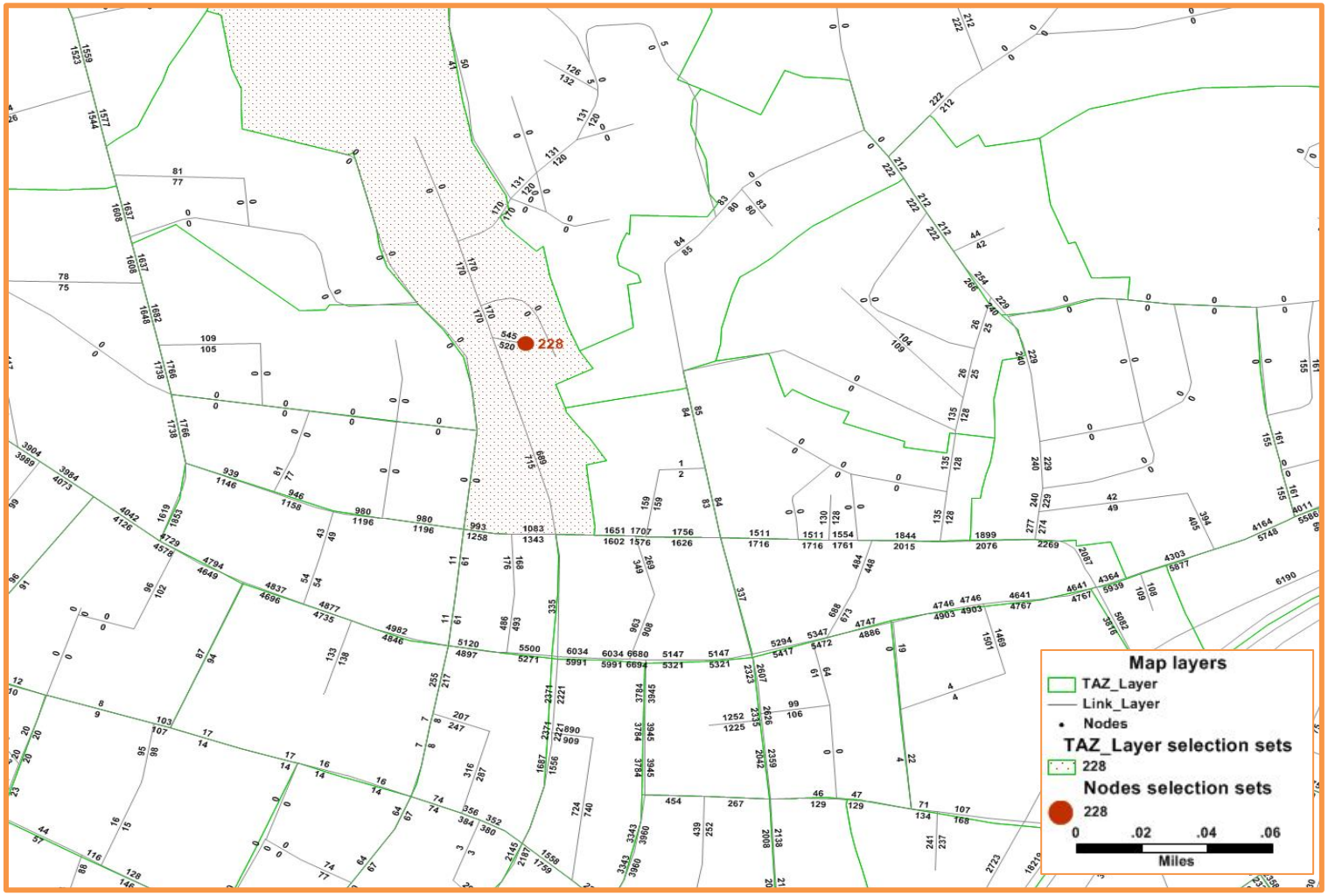


Figure 21 - Traffic Volumes from the Base Model for Hwy 49

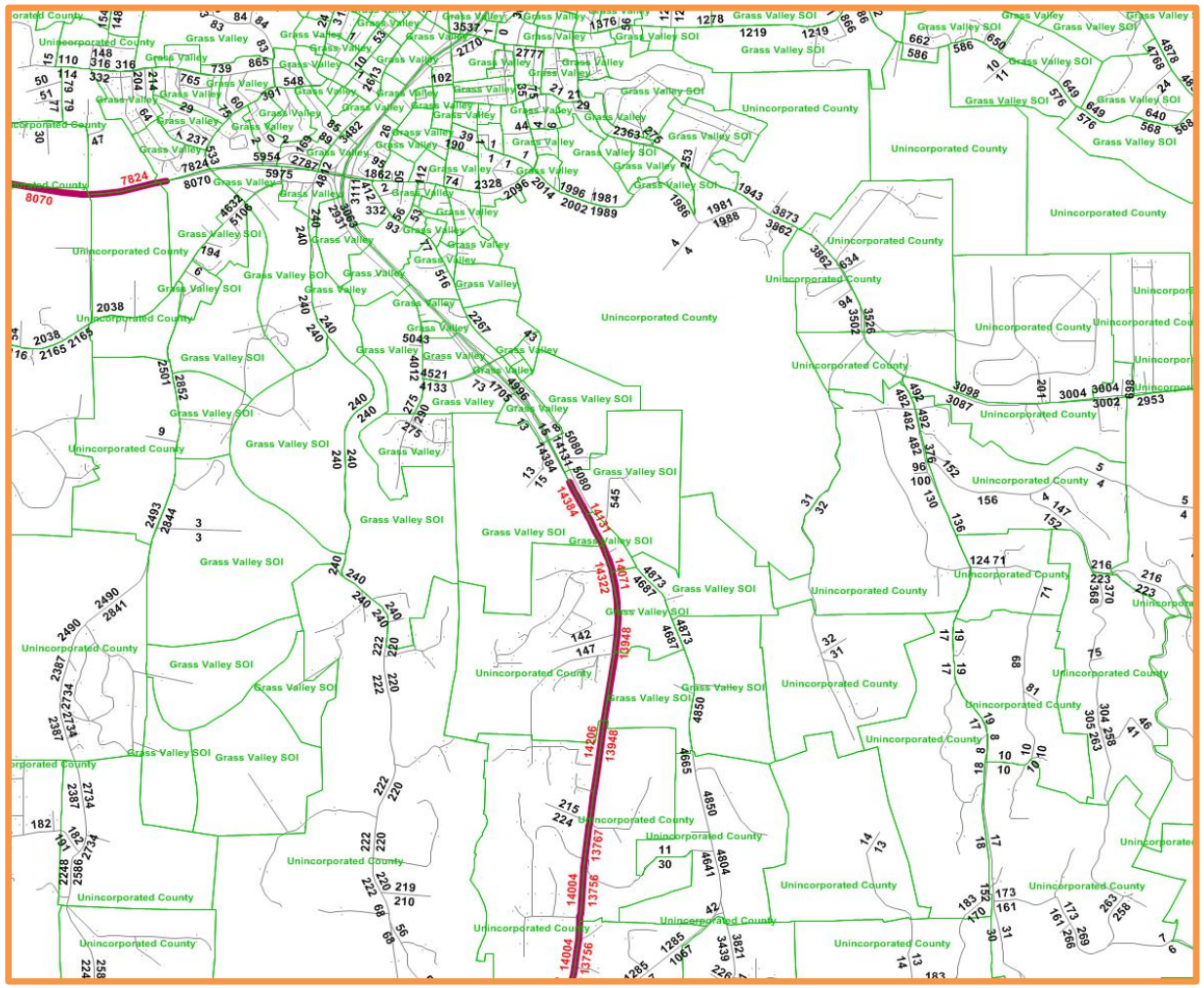
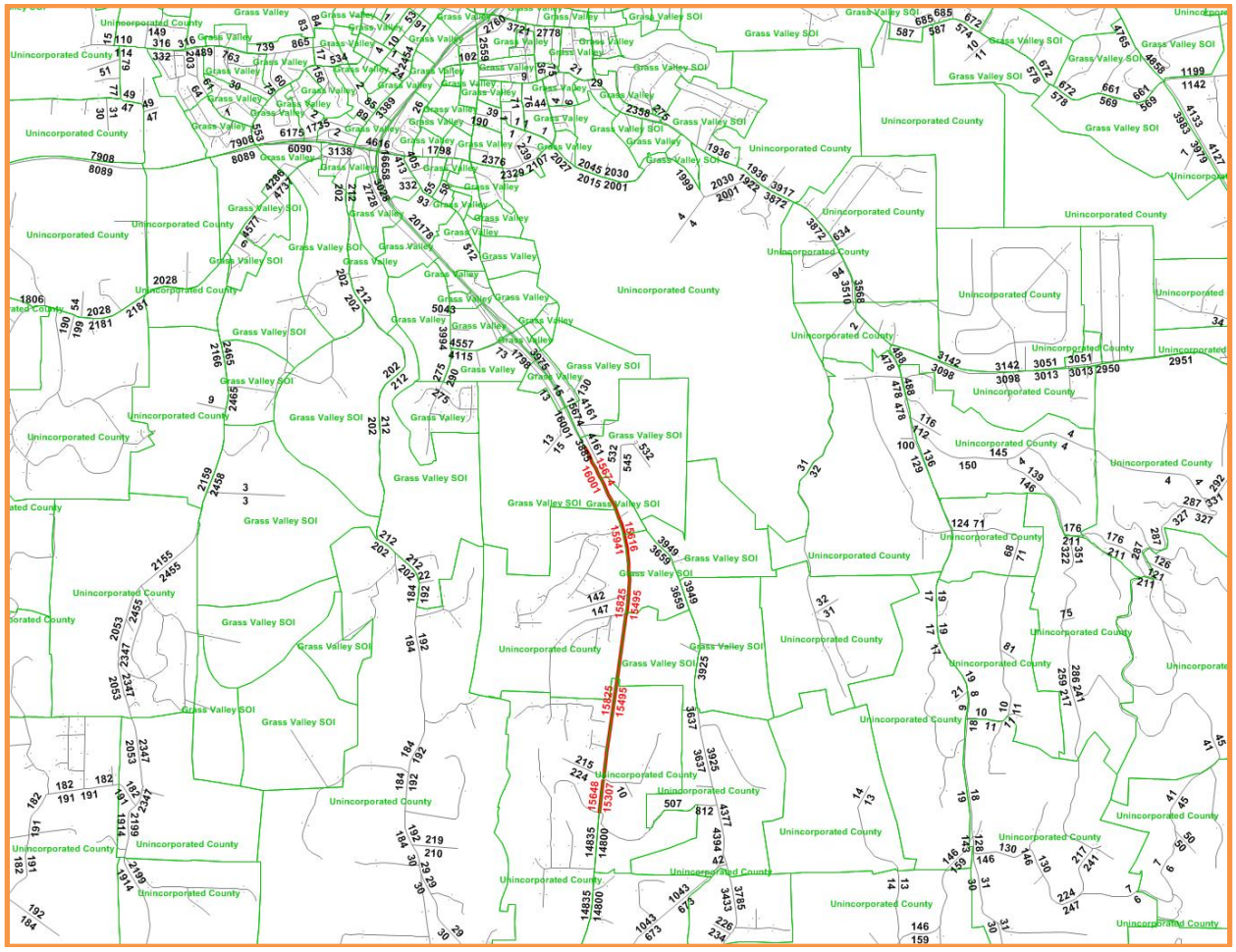


Figure 22 - Traffic Volumes from Test 2 for Hwy 49



7. 2040 FORECASTS

2040 forecasts were developed using the calibrated and validated model. Transportation networks and land use and demographics were updated to represent year 2040. TJKM presented various growth rate assumptions from different sources, such as the California Department of Finance and the Caltrans Economic Forecasts. Staff from NCTC, the County, Grass Valley, and Nevada City agreed on a finalized growth rate of **0.32%** for the forecast year 2040 which represents a reasonable growth rate in line with anticipated growth in the region from the sources described above balanced with the jurisdictions' General Plans and known upcoming development projects. Table 17 shows the land use forecasts.

Table 17 - 2040 Land Use Forecasts

Landuse Variable	Nevada City	Grass Valley	Alta Sierra	Lake of the Pines	Lake Wildwood	Penn Valley	Unincorporated County	Total County
Single Family	1,854	5,452	3,103	2,173	2,813	586	17,239	33,220
Multi-Family	365	2,249	93	243	5	167	280	3,402
Mobile Home	35	425	-	24	-	165	943	1,592
Senior Housing	-	1,101	-	-	-	-	200	1,301
Office	296	1,229	-	6	-	22	77	1,630
Medical Office	11	269	-	-	-	2	21	304
Hospital (Beds)	-	228	-	-	-	-	-	228
Light Industrial	174	1,446	-	22	-	67	158	1,866
Warehouse	-	365	-	-	-	-	48	413
Church	57	238	-	46	-	10	39	392
Public/Quasi-Public	280	44	-	8	-	16	31	378
Park	9	127	-	-	-	81	624	841
Retail	357	2,715	-	166	-	69	250	3,556
Golf course	-	9	18	18	18	-	18	81
Restaurant	17	102	-	16	-	9	30	174
Fast Food Restaurant	22	53	-	-	-	-	-	74
Gas Stations	48	87	-	12	-	22	26	195
Hotel/Lodging	863	297	15	-	-	-	38	1,213
K-8 School	1,736	695	308	796	-	350	3,418	7,303
High School	235	2,289	-	615	-	-	-	3,139
College	20	3,919	-	-	-	-	-	3,939

Table 18 compares the growth between the base year (2018) land use to the forecast year (2040) land use.

Table 18 - Land Use Growth Table

Landuse Variable	Base Year	Growth	Forecast Year
Single Family	31,768	1,452	33,220
Multi-Family	2,422	980	3,402
Mobile Home	1,540	52	1,592
Senior Housing	1,101	200	1,301
Office	1,256	374	1,630
Medical Office	284	20	303.5
Hospital (Beds)	228	0	228
Light Industrial	1,696	170	1,866
Warehouse	402	11	413.3
Church	392	-1	391.5
Public/Quasi-Public	338	40	378.2
Park	842	-1	841
Retail	3,092	464	3,556
Golf course	81	0	81
Restaurant	174	-1	173.5
Fast Food Restaurant	74	0	74.4
Gas Stations	201	-6	195
Hotel/Lodging	573	640	1213
K-8 School	6,804	499	7,303
High School	2,841	298	3,139
College / University	3,520	419	3,939

Table 19 compares the growth in productions and attractions from the trip generation step in the NCTC model.

Table 19 - Trip Generation Growth Between Base Year 2018 and Forecast Year 2040

	Base Year		Forecast Year		Growth	
Trip Purpose	Productions	Attractions	Productions	Attractions	Productions	Attractions
HBW	40,224	39,583	49,711	51,502	9,487	11,918
HBO	104,172	103,628	128,430	125,181	24,258	21,553
NHB	78,668	76,565	96,194	93,746	17,526	17,181
SCHOOL	14,546	12,677	17,942	13,745	3,396	1,068
SIERRA	5,318	4,224	6,527	4,727	1,210	503
Total	242,927	236,677	298,804	288,901	55,877	52,223

Tables 20 to 22 show the growth in volumes on the validation links between the forecast year 2040 and the base year 2018, sorted by facility type, geographic named areas, and area type. The volume is in line with the increase in population and employment.

Table 20 - Volume Growth on Validation Network Links (Facility Type)

Facility Type	2040 Estimated Volumes	2018 Estimated Volumes	Difference	Growth Rate
Freeways	366,208	348,700	17,508	0.22%
Principal Arterials	263,629	256,969	6,660	0.12%
Minor Arterials	605,342	551,949	53,393	0.42%
Major Collectors	379,750	348,034	31,716	0.40%
Minor Collectors	154,663	145,808	8,855	0.27%
Local	96,560	90,092	6,468	0.32%

Table 21 - Volume Growth on Validation Network Links (Geographic Named Areas)

Jurisdiction	2040 Estimated Volumes	2018 Estimated Volumes	Difference	Growth Rate
Alta Sierra	42,727	41,549	1,178	0.13%
Grass Valley	831,082	742,101	88,981	0.52%
Grass Valley SOI	179,272	163,932	15,340	0.41%
Lake of the Pines	119,686	114,928	4,758	0.18%
Lake Wildwood	2,252	2,261	(9)	-0.02%
Nevada City	100,076	99,598	478	0.02%
Nevada City SOI	40,728	39,963	765	0.09%
Penn Valley	28,527	27,992	535	0.09%
Unincorporated	526,030	513,423	12,607	0.11%

Table 22 - Volume Growth on Validation Network links (Area Type)

Area Type	2040 Estimated Volumes	2018 Estimated Volumes	Difference	Growth Rate
1 - City Center	281,398	245,537	35,861	0.62%
2 - Urban	208,997	187,342	21,655	0.50%
3 - Suburban	636,915	597,144	39,771	0.29%
4 - Rural	743,070	715,724	27,346	0.17%

The following figures show bandwidth maps of volume growth within Nevada County for PM Peak Period and the Volume/Capacity (MAX_VOC) ratio depicting congestion. The red color represents volumes exceeding capacity while orange shows volumes approaching capacity. The green color shows links that are uncongested where volume is less than half of the capacity and light orange shows links with slightly higher volumes than half the capacity. These maps highlight congested areas in the region that may need improvement.

8. CONCLUSION

The Nevada County Transportation Commission travel model is a regional model for Western Nevada County. The model has been updated, calibrated and validated using available sources of observed data and can be used for analyzing transportation projects and developments.

The NCTC model has a high level of detail in road network and traffic analysis zones. However, it has only been validated at a regional level. Additional fine tuning might be necessary before using the model for local projects impacting a small area, or only affecting a handful of intersections, etc.

Figure 23 - Base Year 2018 PM Peak Period Model Volumes

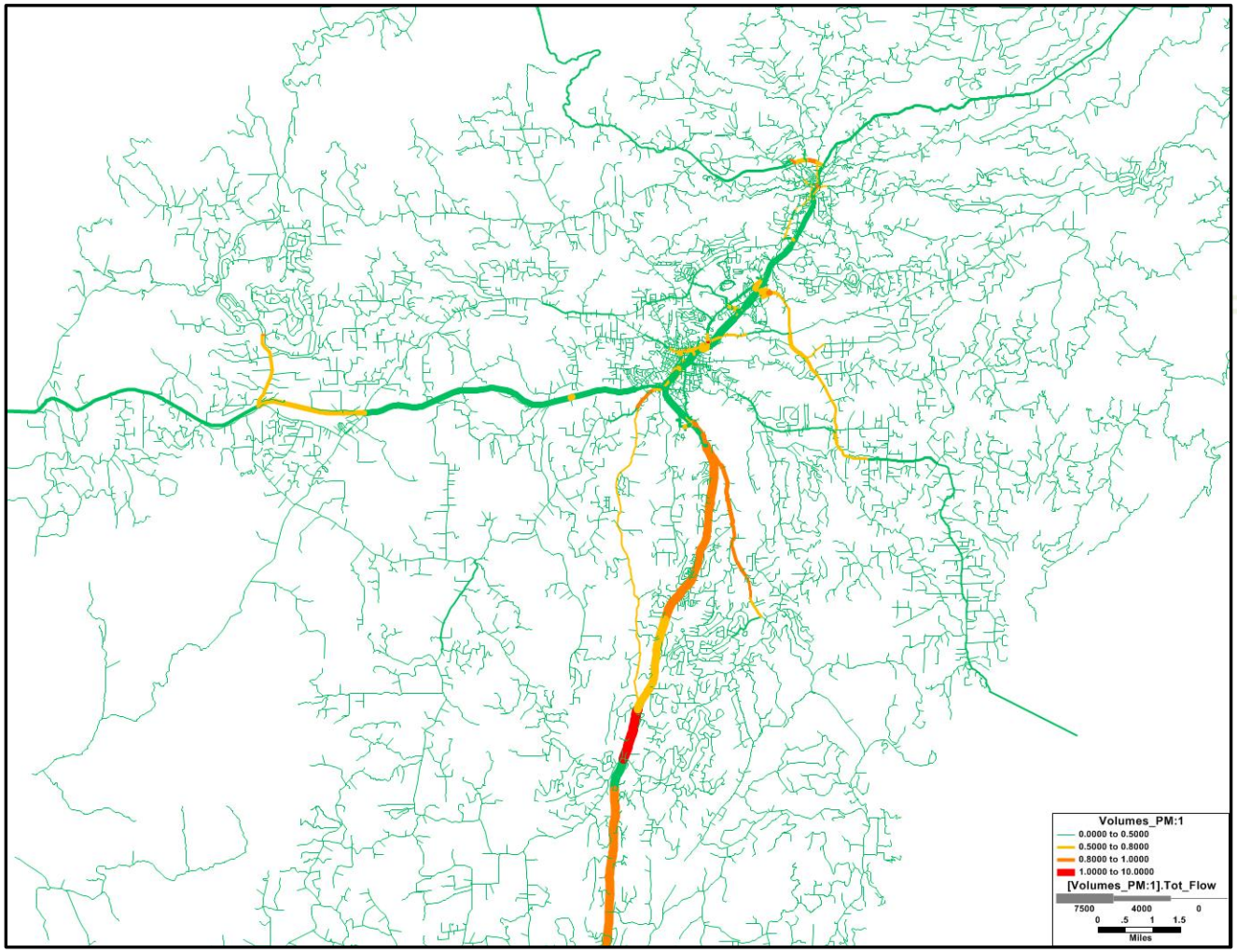


Figure 24 - Forecast Year 2040 PM Peak Period Model Volumes

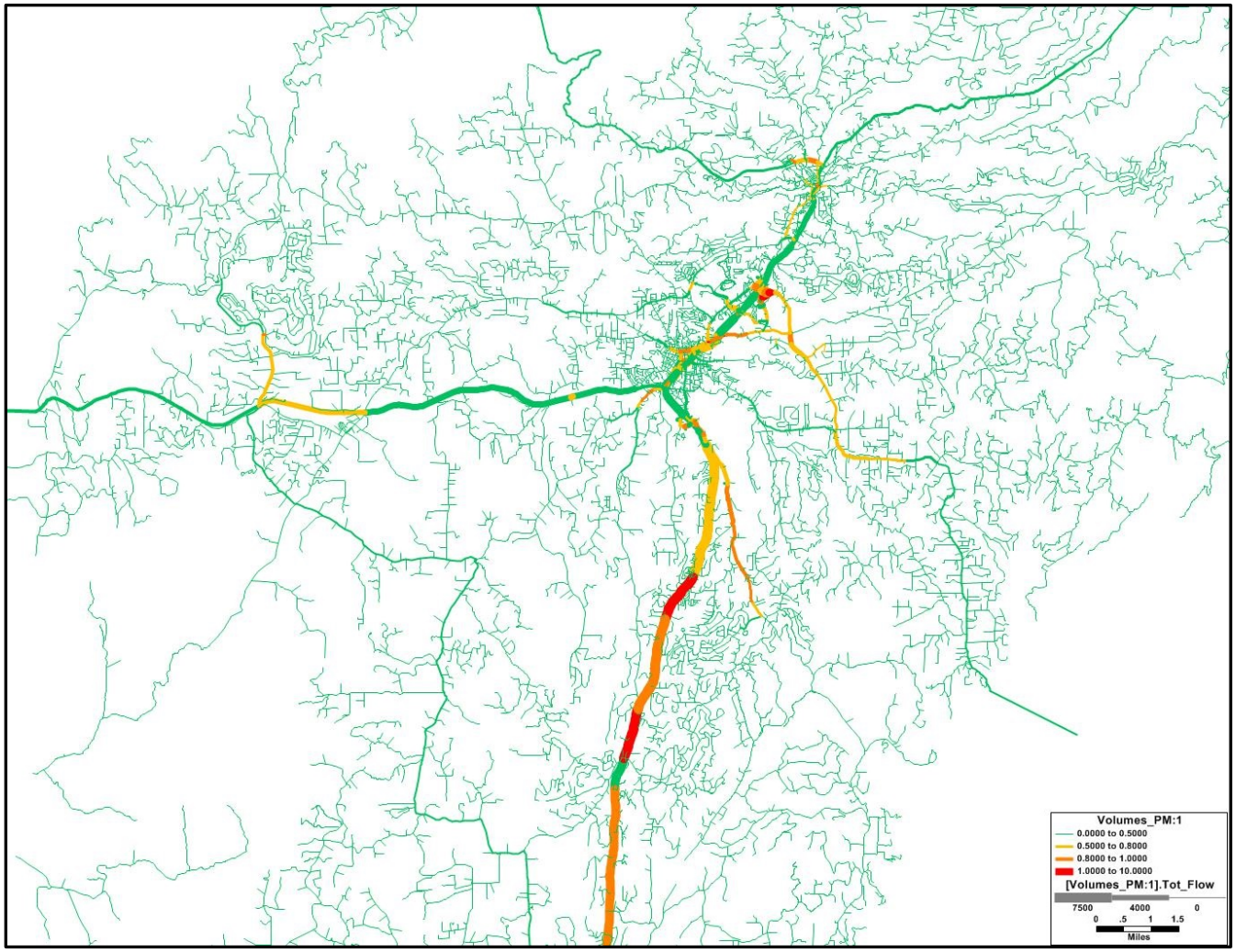


Figure 25 - Base year 2018 PM Peak Period Model Volumes Zoomed in to Grass Valley/Nevada City

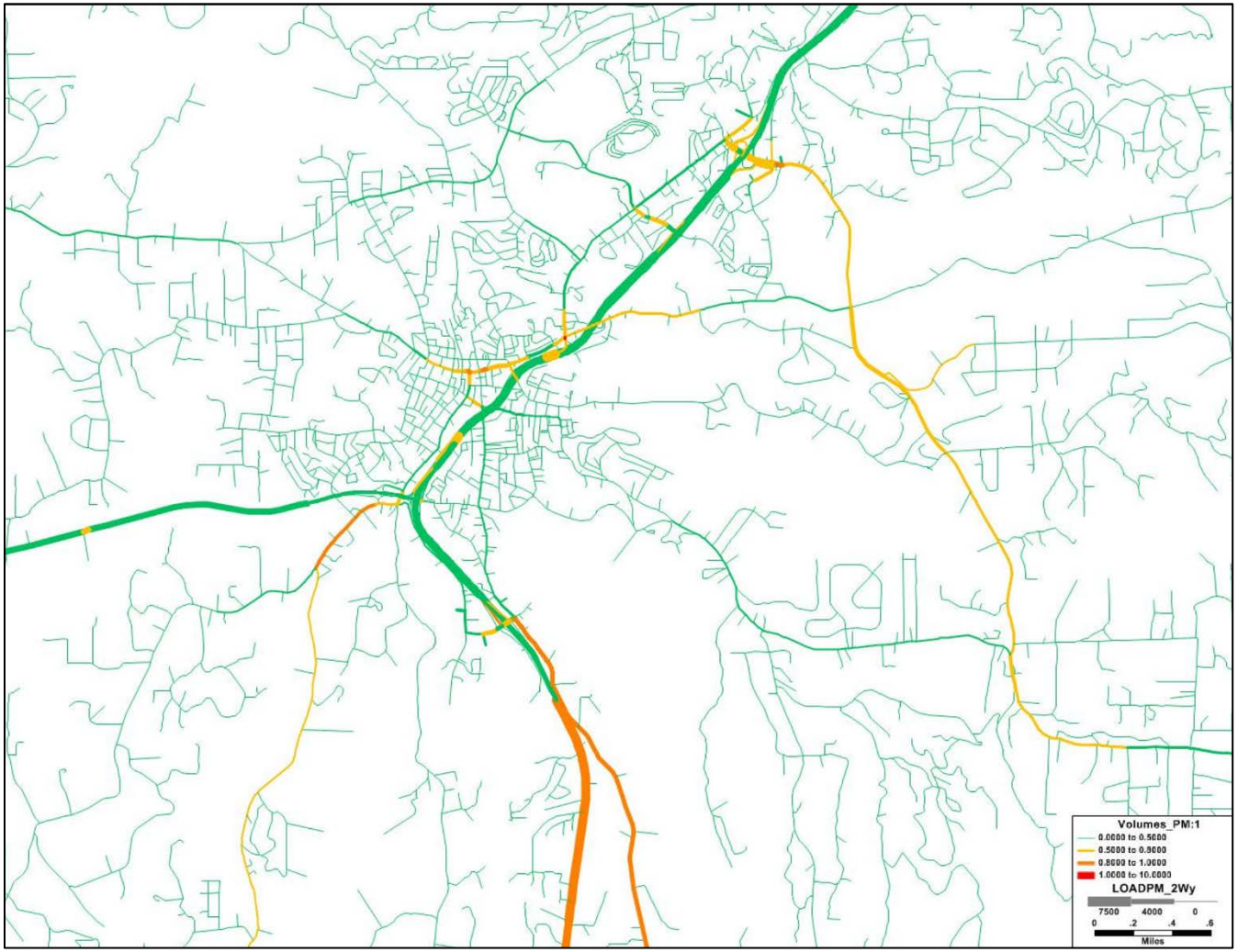
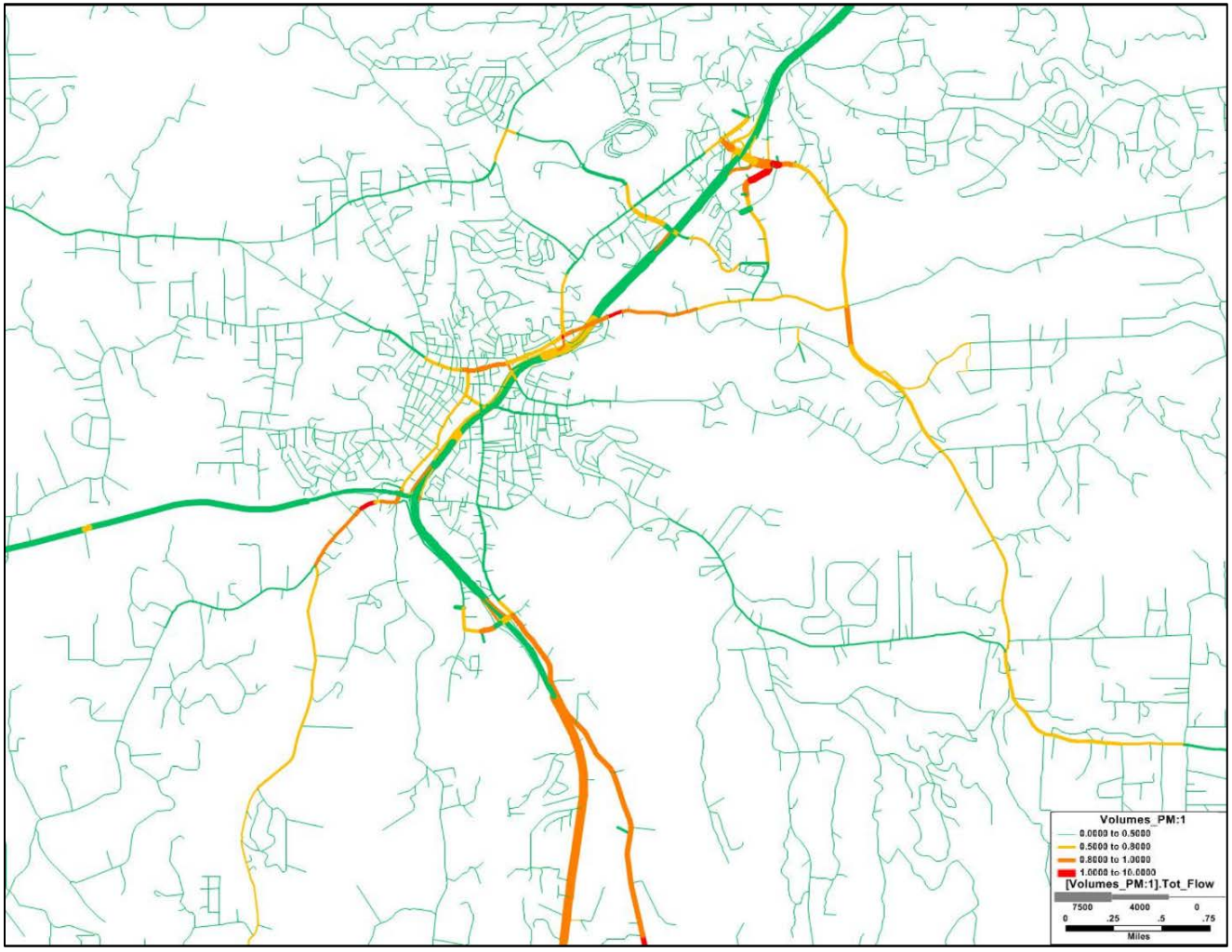


Figure 26 - Forecast Year 2040 PM Peak Period Model Volumes Zoomed in to Grass Valley/Nevada City



9. MODEL INTERFACE AND USER INFORMATION

The NCTC model uses TransCAD software, version 8.0, build 22185. It should also be able to work with older builds but version 8.0 is recommended. The model interface makes it very easy for a user to identify different model scenarios and input and output files associated with each scenario. Figure 27 shows the graphic user interface. A user can add, delete or modify scenarios, input and output files.

Figure 27 - Model Interface