FINAL

BCAG 2020 RTP Travel Demand Model

Model Development Report

Prepared for

BCAG
BUTTE COUNTY ASSOCIATION OF GOVERNMENTS

September 2020

FEHR & PEERS

RS18-3710

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1 Introduction

This report presents the Travel Demand Forecasting (TDF) model built for the Butte County Association of Governments (BCAG) in preparation for the 2020 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) Update. This report describes the model development process, including the data sources used to develop key model inputs.

General Discussion of the TDF Model

This section summarizes the answers to commonly asked TDF model questions and how BCAG can use the model.

What is a TDF model?

A TDF model is a computer program that simulates traffic levels and travel patterns for a specific geographic area. The program consists of input files that summarize the area's land uses, roadway network, travel characteristics, and other key factors. Using this data, the model performs a series of calculations to determine the number of trips generated, the beginning and ending location of each trip, the mode of travel for each trip, and the route taken by the trip. The model's output includes projections of traffic volumes on major roads and important metrics such as vehicle miles of travel (VMT) needed for emissions forecasts and environmental impact analysis.

How is a TDF model useful?

The TDF model is a valuable tool for preparing long-range transportation planning studies, like the RTP. The TDF model can be used to estimate the average daily traffic volumes on the major area roads in response to planned population and employment growth, changes in transportation infrastructure, and policy assumptions; it also provides a consistent platform to analyze different land use and transportation scenarios.

How do we know if the TDF model is accurate?

To be deemed accurate for projecting traffic volumes in the future, a model must first be calibrated to a year in which actual land use data and traffic volumes are available and well-documented. A model is accurately validated when it replicates actual traffic counts on the major area roads within certain ranges of error established in the *2017 California Regional Transportation Plan Guidelines* (California Regional Transportation Plan Guidelines. (2017). Sacramento, CA: California Transportation Commission.) and it demonstrates stable responses to varying levels of inputs.

The BCAG model has been calibrated and validated to 2018 base year conditions using observed traffic counts, census data travel survey estimates, and land use data compiled by BCAG staff.

Is the BCAG TDF model consistent with standard practices?

The BCAG model is consistent in form and function with standard travel forecasting models used in transportation planning. The model includes a land-use based trip generation module, a gravity-based trip distribution model, a capacity-constrained equilibrium traffic assignment process, and a new mode choice component that estimates transit, walk, and bike trips and generates auto trips for drive alone, shared ride with two people, and shared ride with three or more people. In addition to passenger travel, a separate truck trips model was developed. The travel model uses Version 6.4.3 with GIS of the Citilabs Cube Voyager transportation planning software, which is consistent with many of the models used by local jurisdictions in California and throughout the nation.

How can the TDF model be used?

The TDF model can be used for many purposes related to the planning and design of Butte County's transportation system. The following is a partial listing of the potential uses of the model.

- To update the RTP/SCS
- To estimate VMT for emissions analysis and SB 743 compliant transportation impact studies
- land use and circulation elements of city or county general plans
- To conduct a regional transportation mitigation fee program
- To evaluate the traffic impacts of area-wide land use plan alternatives
- To evaluate the shift in traffic resulting from a roadway improvement
- To evaluate the traffic impacts of land development proposals
- To determine trip distribution patterns of land development proposals
- To support the preparation of project development reports for Caltrans

What are the TDF model limitations?

The BCAG TDF Model has been developed for regional planning purposes within a trip-based model framework. The model conforms to the recommendations outlined in the 2017 California Regional Transportation Guidelines for Group B2 metropolitan planning organization (MPO), but does have limitations.

- The current structure has limited sensitivity to factors that may affect trip generation rates such as significant declines in economic activity. (e.g., COVID-19 effects). However, since the model has a land use occupancy component, economic cycles can be reflected in the assumed intensity of land uses within the model.
- Although the model network includes all local roadways, not all local roadways are assigned vehicle trips. Use of the model for local applications will require sub-area refinements and validation to ensure the model is appropriately sensitive to changes at this scale.
- Model parameters relying on household travel survey data are based on a small sample size. Future model updates would benefit from a larger sample of households in Butte County.

- The trip-based model structure does not allow for complete estimates of forecasts of vehicle trips (VT) or vehicle miles traveled (VMT) generated by residential households or individual persons. Vehicle trips are assigned at the TAZ level and any connection to individual land uses that originally generated the trips are lost. VT and VMT can be expressed as ratios such as VMT per capita or VMT per household. But these ratios are based only on dividing total VMT by the number of people or households in the model area. It does not indicate the level of VT or VMT being generated.

What updates were made to this version of the model?

The model base year was updated from 2014 to 2018 and the modeling platform was changed from TransCAD to Cube. Other updates and changes to the model are summarized below organized by new features and updates to previous features.

New Features

- *Trip Generation:* Replaced total vehicle trips generated with person trips and commercial truck trips
- *Trip Distribution:* Implemented employee salary and household income relationship for home-work trips
- *Interregional Travel:* Improved control over scenario evaluation of interregional inputs by implementing job salary and interregional parameters at a Traffic Analysis Zone (TAZ) scale rather than based on land use and trip purpose model wide.
- *Through Travel:* Values for trips traveling through the region were updated and separated by passengers and trucks.
- *Multimodal Network:* Enhanced network to include modes allowed to use the facility, distinguishing between drive-alone, shared ride, bike/pedestrian, transit, and commercial trucks.
- *Travel Cost:* Added auto operating cost based on all fuel types, travel cost per mile, and parking cost to Trip Distribution and Mode Choice
- *Trip Distribution*: Included cost and modes allowed on transportation facilities in trip distribution.
- *Mode Choice:* Implemented mode choice utility equation based on demographics, distance, cost, and built environment.

Updated Features

- *Land Use Inputs:* Updated base year 2014 data to represent base year 2018. Updated future forecasts to account for the Camp Fire and revised housing, student, and job totals.
- *Transportation Projects:* The transportation project list was updated to reflect the currently planned and programed projects.
- *Auto Operating Cost*: Auto operating cost was updated to include energy sources other than petroleum-based fuels.

What future updates would benefit the model for regional scenario planning?

- Refine economic factors at a more specific geography and forecast cross-classified socio-economics for each scenario for both residential and non-residential land use types.
- Continue to collect traffic count and transit ridership data, and land use development data (residential, school, and employees) to perform near-term forecasts post-Camp Fire and post COVID-19.
- Evaluate shifts in future assumptions such as autonomous vehicles, demographics, fuel price, and land use development patterns.
- Although the model passes the reasonableness checks, and static and dynamic validation, it is recommended that the model be validated in the study area before it used for local-scale projects. This is especially important in the near-term during the recovery of Paradise, since land use development and travel patterns may change significantly in a shorter amount of time than occurred pre-Camp Fire.

Study Area

The model area for the BCAG TDF Model encompasses Butte County, which includes the cities of Chico, Paradise, Oroville, Biggs, and Gridley. **Figure 1** shows the BCAG TDF model area. To represent travel into and out of Butte County, the model also includes 20 "external gateways" at major roads that cross the county line.

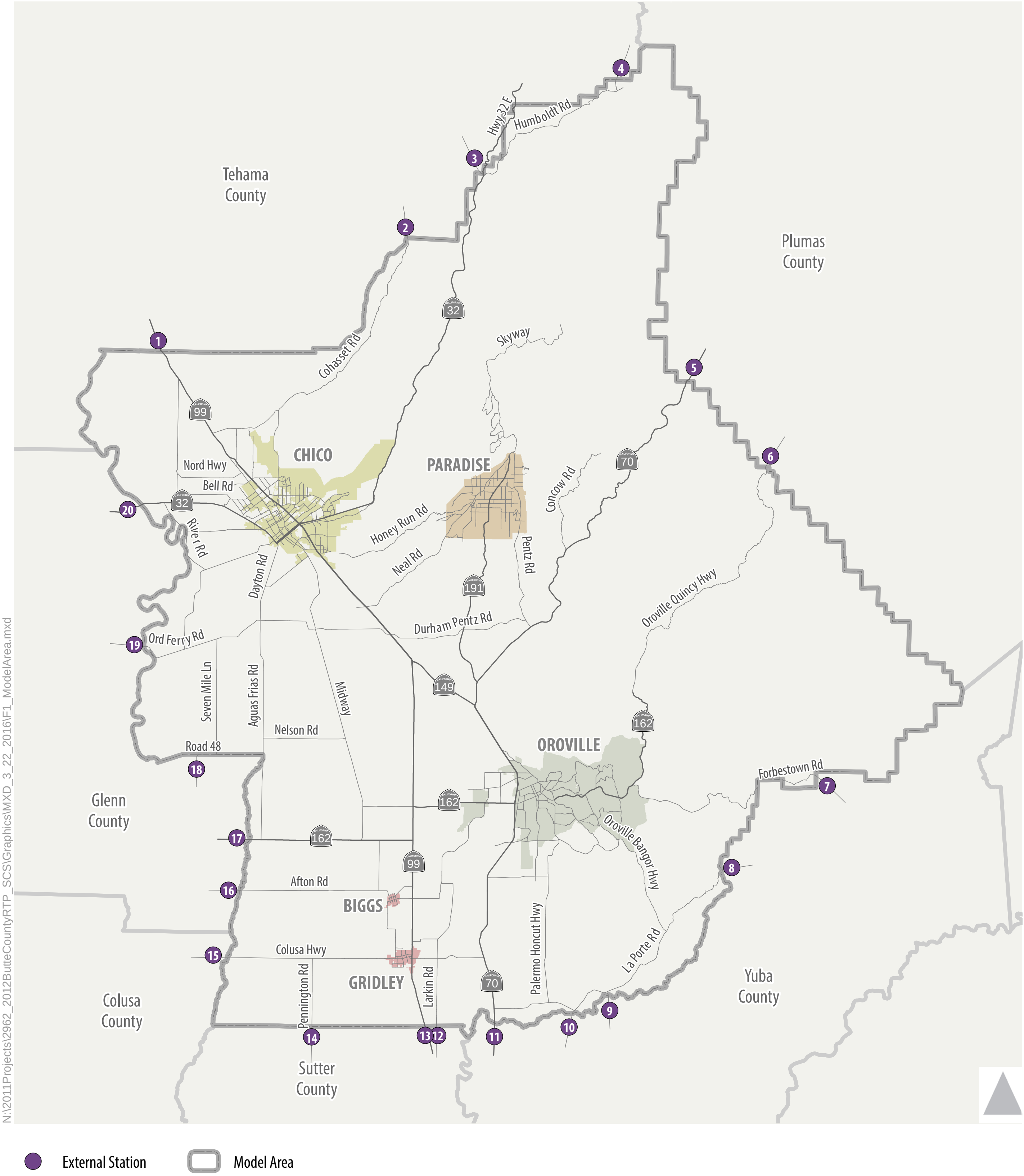


Figure 1

Model Area

N:\2011Projects\2962_2012ButteCountyRTP_SCS\Graphics\MXD_3_22_2016\F1_ModelArea.mxd

2 Model Input Data

This section describes the data collection, review processes, and refinement for developing the model input data of the model.

Data Collection

A data collection effort was undertaken at the outset of the model development process. Data sources included the land use, roadway network, and traffic count database from BCAG, Caltrans Traffic Data Branch for freeway counts, and CSU Chico for Geographic Information Systems (GIS) data. Additional data sources are listed below.

- 2018 Census Bureau data
- Department of Finance (DOF) housing estimates
- California Statewide Household Travel Survey (CHTS), 2012
- Employment Development Department (EDD) employment estimates
- Longitudinal Employer-Household Dynamics (LEHD) data
- StreetLight Origin-Destination Mobile Device Data (Big Data)
- California Statewide Travel Demand Forecasting Model
- Bike and pedestrian facilities
- Transit routes, stops, and schedules
- Traffic counts
- Transit ridership

Traffic Analysis Zone System

TAZs represent geographic areas containing land uses that produce or attract trip ends. Travel demand models use TAZs to connect land uses to the roadway network. The TAZ boundaries for the BCAG model were developed from the Butte County parcel layer and closely nest within city boundaries in Butte County.

The TAZ boundaries from the previous model were maintained for this update, except for a few locations where a TAZ was split into two zones for improved detail within plan area boundaries. The GIS data representing the TAZ and plan area boundaries were provided by BCAG.

This update to the BCAG model included refinement to the TAZ detail for improved organization by plan area with the zone identification numbering, as presented in **Table 1**. TAZ maps showing the zone boundary and zone number are shown in **Appendix A**.

Table 1: TAZ ID by Plan Area

Plan Area	Zone ID Range
Model Gateways	1-20 (21-99 Blank)
Biggs	100-122 (123-199 Blank)
Chico	200-519 (520-599 Blank)
Gridley	600-636 (637-699 Blank)
Oroville	700-816 (817-899 Blank)
Oroville – County	900-924 (925-999 Blank)
Paradise	1000-1117 (1118-1199 Blank)
Magalia	1200-1217 (1218-1299 Blank)
Unincorporated Butte County	1300-1557 (1558-1999 Blank)

Notes: Zone IDs that do not currently exist but are available for use in more detailed project analyses are noted in parentheses.
Source: Fehr & Peers, 2020.

The BCAG model TAZ system includes 916 zones in the model area covering Butte County, and 20 model gateways where major roadways provide access into the model area. The model gateways represent all major routes by which traffic can enter, exit, or pass through the model area. As noted in Table 1, there are blank zone IDs reserved for each plan area available for use in more detailed project analyses.

Land Use Data

Land use data is one of the primary inputs to the BCAG model and this data is instrumental in estimating trip generation. The model's primary source of land use data is BCAG's residential, school, and commercial parcel and footprint datasets (maintained in a GIS format). Each database provides information on the existing level of development within the county and is aggregated to the model's TAZs. These databases are maintained by BCAG staff in association with CSU Chico. The land use data in the model is divided into several residential and non-residential categories. The BCAG model has 17 land use categories, consistent with the previous model, which are described in **Table 2**.

Table 2: Model Land Use Categories

Land Use Type	Model Land Use ID	Units
Single Family Residential	SF_DU	Dwelling Units
Multi-Family Residential	MF_DU	Dwelling Units
Mobile Home Residential	MH_DU	Dwelling Units
Office	OFF_KSF	Thousand Square Feet
Medical Office	MED_KSF	Thousand Square Feet
Hospital	HOSP_KSF	Thousand Square Feet
Industrial	IND_KSF	Thousand Square Feet
Public/Quasi-Public	PQP_KSF	Thousand Square Feet
Park	PARK_AC	Acres
Neighborhood-Serving Retail	RET_KSF	Thousand Square Feet
Region-Serving Retail	RRET_KSF	Thousand Square Feet
Hotels	HOTEL_RMS	Rooms
K-12 School	K12_STU	Students
University	UNIV_STU	Students
Community College	CC_STU	Students
Casino	CASINO_SLT	Slots

Source: Fehr & Peers, 2020.

Socio-Economic Data

The Socio-economic Data (SED) represents the number of households by housing type (single family, multi-family, mobile home), number of residents, and household income level (low, medium, and high) for each TAZ. Additionally, the SED file contains the total square footage for the retail, regional retail, industrial, office, medical, hospital, and public/quasi-public land uses in addition to the number of hotel rooms, university students, community college students, K-12 students, park acreage, and the number of slot machines at the casinos.

The household information in the SED dataset was created by applying the household type proportions information from the U.S. Census Bureau. (U.S. Census Bureau (2018). American Community Survey 1-year Estimates. Retrieved from https://www.census.gov/data/developers/data-sets/acs-1year.html.) and applying them to the number of dwelling units in the land use datasets provided by BCAG. Through the application of these proportions the SED data contains the number of single family and multi-family dwelling units arranged by number of residents and household income category. The household income categories include:

1. Low: less than $35,000 a year
2. Medium: between $35,000 and $75,000 a year

3. High: greater than $75,000 a year

Additionally, the proportion of high, medium, and low-income jobs were calculated for each of the employment related land uses (retail, office, medical, etc.) for each TAZ. The U.S. Census Bureau Longitudinal Employer-Household Dynamics Quarterly Workforce Indicators (QWI)[1] dataset for 2018 was used to divide the employment land uses into the high, medium, and low-income categories. The average annual income was calculated for each North American Industry Classification System (NAICS) sector in Butte County using the QWI dataset. Each of the NAICS sectors were classified into a high (>$75,000), medium ($35,000 to $75,000), or low (<$35,000) category based on the estimated annual income. The NAICS sectors were then associated with one of the non-residential land use categories. **Table 3** below contains the relationship of NAICS sectors to the model land use with the corresponding income category. This relationship is currently used for both the 2018 base year and all forecast scenarios.

Table 3: Land Use Type by NAICS Sectors and Income Category

Land Use	Income Category	NAICS Sectors
Retail & Regional Retail	All Income Categories	44-45 Retail Trade, 72 Accommodation and Food Services
	Low (<$35,00)	44-45 Retail Trade, 72 Accommodation and Food Services
	Medium ($35,000 to $75,000)	-
	High (>$75,000)	-
Industrial	All Income Categories	21 Mining, 22 Utilities, 31-33 Manufacturing, 48-49 Transportation and Warehousing
	Low (<$35,00)	-
	Medium ($35,000 to $75,000)	21 Mining, 31-33 Manufacturing, 48-49 Transportation and Warehousing
	High (>$75,000)	22 Utilities
Office	All Income Categories	42 Wholesale Trade, 51 Information, 52 Finance and Insurance, 53 Real Estate Rental and Leasing, 54 Professional Scientific, and Technical Services, 55 Management of Companies and Enterprises, 56 Administrate and Support and Waste Management and Remediation Services, 71 Arts, Entertainment, and Recreation, 81 Other Services (except Public Administration)
	Low (<$35,00)	53 Real Estate Rental and Leasing, 56 Administrate and Support and Waste Management and Remediation Services, 71 Arts, Entertainment, and Recreation, 81 Other Services (except Public Administration)
	Medium ($35,000 to $75,000)	42 Wholesale Trade, 51 Information, 52 Finance and Insurance, 54 Professional Scientific, and Technical Services, 55 Management of Companies and Enterprises
	High (>$75,000)	-

[1] U.S. Census Bureau. Longitudinal Employer-Household Dynamics, Quarterly Workforce Indicators (QWI). 2018. https://lehd.ces.census.gov/data/#qwi

Table 3: Land Use Type by NAICS Sectors and Income Category

Land Use	Income Category	NAICS Sectors
Medical & Hospital	All Income Categories	62 Heath Care and Social Assistance
	Low (<$35,00)	-
	Medium ($35,000 to $75,000)	62 Heath Care and Social Assistance
	High (>$75,000)	-
Public/Quasi-Public	All Income Categories	22 Utilities, 61 Educational Services, 92 Public Administration
	Low (<$35,00)	-
	Medium ($35,000 to $75,000)	61 Educational Services, 92 Public Administration
	High (>$75,000)	22 Utilities

The total number of employees by NACIS sector was calculated for each TAZ using the Workplace Area Summary datasets from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics (LODES)[2] dataset for 2018. The proportion of employees in each NAICS sector was calculated for each Census Tract, and these values were allocated to the TAZs using a spatial join in ArcGIS. The TAZs were assigned the NACIS sector proportions based on which Tract their centroid fell within.

The employment totals were then used to estimate the proportion of employees in each NAICS sector. The NAICS sector proportions were then assigned to the TAZs using a spatial join in ArcGIS. TAZs were assigned the proportion values based on which Tract their centroid fell within. The sector proportions were then summarized to each land use and income category using the crosswalk detailed in Table 3. The same percentages file is currently used in all scenarios and can be changed for individual scenarios as appropriate.

Gateways Data

The gateways dataset represent travel beyond the model boundary and contains the initial number of productions and attractions associated with the gateway locations by trip purpose. The home-based work productions and attractions are broken down by income category.

[2] U.S. Census Bureau. Longitudinal Employer-Household Dynamics. LEHD Origin-Destination Employment Statistics (LODES). 2018. https://lehd.ces.census.gov/data/#qwi

Roadway and Bicycle Network

The model network combines the roadway and bicycle networks into one master network file. The master network is inclusive of all roadway and bicycle network links that existed in 2018 plus those planned to be added through 2040. The planned network links contain an attribute indicating the year it will be constructed. This attribute is used when creating a network representing a specific year between 2018 and 2040. Development of the master network included appropriately sorting and merging all the GIS data collected for the roadway and bicycle networks, reviewing current and historical aerial maps, and refining the network for implementation into the model structure. The model master network maintains a high level of detail of the roadway and bicycle facilities, keeping the true shape of each facility from the GIS centerline files.

The roadway and bicycle facilities included within the master network also focuses on the most used facility types. The master network facility classifications included in the model, consistent with the Butte County RTP/SCS, are described below.

Freeways

Freeways are high-capacity facilities that primarily serve longer distance travel. Access is limited to interchanges typically spaced at least one mile apart. State Route (SR) 70 and SR 99 are the major freeways in the Butte County. Portions of SR 149 that connect SR 70 and SR 99 are also designed to freeway standards.

High Occupancy Vehicle Lanes

High Occupancy Vehicle (HOV) lanes are dedicated facilities on freeways with access restricted to single occupant vehicles (i.e., vehicles with only the driver, no passengers). These facilities can be restricted by time-of-day. Currently, no HOV lanes exist within Butte County; this facility type is included in the available options for possible future projects and modeling.

Expressways

Expressways are high-capacity facilities that primarily serve intermediate distance travel between intercity destinations. Access is limited, but not to the extent of freeways, and travel lanes may or may not be divided. Portions of SR 70, SR 99, SR 149, and Skyway are classified as expressways in Butte County.

Arterials

Roadway segments classified as Arterials are major roads that provide connections within cities, between cities and neighboring areas, and through the cities (cut-through traffic) of Butte County. Arterials in Butte County typically have one or two lanes in each direction, with travel speeds of 30-40 miles per hour (mph). Examples of these arterials are East Avenue in Chico, Clark Road in Paradise, and Olive Highway in Oroville.

Collectors

Collectors (Major and Minor) are facilities that connect local streets to the arterial system, and may also provide direct access to local land uses. Collectors generally provide two travel lanes and typically have a posted speed limit of 25 mph or greater. Examples of these collectors are Ceres Avenue in Chico, Nunneley Road in Paradise, and Myers Street in Oroville.

Local Streets

Local Streets primarily feed collector roads and generally provide two travel lanes with a posted speed limit of 25-30 mph. The model network focuses on freeways, arterials, and collectors but does include most of the local streets represented in the Butte County GIS centerline file to provide access from traffic analysis zones to the larger network. If a project application needs to assess local roadway performance, the model has been designed such that detail can be added to improve its sensitivity related to these facilities. These types of changes would typically be performed as part of a specific project application.

Transit Only Facilities

Transit Only facilities represent any lanes or dedicated travel-ways for transit use, restricted to all other vehicles. Currently no transit only facilities exist within Butte County; this facility type is included in the available options for possible future projects and modeling.

Bicycle Only Facilities

Bicycle Only facilities represent Class I multi-use off-street paths, or paved trails separated from roadways. These facilities restrict vehicle access, and allow for shared use by cyclists and pedestrians.

Class II bike lanes or Class II bike routes are represented along a roadway and identified separately based on the bicycle facility type attribute.

The existing facilities were coded into the transportation network and coded with the appropriate functional type to prohibit use by other modes in both the accessibility calculation and in traffic assignment.

Pedestrian Facilities

Pedestrian facilities, such as sidewalks or multi-use paths, are not separately identified in this model. Access for pedestrians is assumed on all roadway and bicycle facilities, except for along freeways and expressways.

Table 4 shows each of the roadway and bicycle network facility types, along with the initial roadway speeds and capacities used for each roadway classification in the model.

Table 4: Model Roadway Facility Types

Facility Type ID	Facility Classification	Speed Range (MPH)	Lane Capacity Range (vphl)[1]
1	Freeway	55-65	1,750 – 2,000
2	Ramp: Freeway-to-Freeway	55-65	1,800
3	Ramp: Slip	20-45	1,500
4	Ramp: Loop	20-45	1,250
5	HOV	55-65	1,300 – 1,800
6	Expressway	35-55	800 – 1,100
7	Arterial	30-40	750 – 900
8	Collector	25-45	700 – 800
9	Local	25-30	600 – 700
10	Transit Only	25-55	NA
11	Bike Only	-	NA
100	Centroid Connector[2]	25	NA

1. vphl – vehicles per hour, per lane
2. Centroid connectors are abstract representations of the starting and ending point of each trip, and therefore should have no capacity constraints

Source: Fehr & Peers, 2020.

The structure of the master network assumes an initial "BASE" condition for the roadways and associated attributes based on facilities open to travel in 2018. Improvements to the roadway network over time are incorporated whenever there is a change, such as construction of a new roadway, removal of a roadway, or a change to the number of lanes, speed, bicycle facility type, or other attribute. The first improvement to a roadway (if applicable) is represented by the network link attributes identified under "IMP1" along with the implementation year specified. A second improvement to a roadway (if applicable) is represented by the network link attributes identified under "IMP2" along with the implementation year specified. These roadway and bicycle facility improvements are identified for all projects constructed by base year 2018, and all planned projects included within the 2020 RTP project list by future year 2040.

The roadway and bicycle master network database include the network link attributes identified in **Table 5** These attributes were checked using maps, aerial photographs, and other data provided by BCAG. In addition, the vehicle count data for the 312 roadway segments where traffic counts were collected in 2017/2018 are included at the relevant links for model validation.

Table 5: Master Network Link Variables

Attribute	Description	Example
A	A node	43
B	B node	11791
NAME	Roadway Name	SR 99
DISTANCE	Link distance in miles	30
DIST_ADJ	Link distance adjustment (e.g., at Model Gateways)	104
DIR	Overall direction under all years (Two-Way = 0, One-Way=1). If any year is two-way, then this attribute is set to two-way.	0
TERRAIN	Terrain (1=Flat, 2=Rolling, 3=Mountain)	1
JURISDICTION	Political jurisdiction where link is located	Oroville
PLAN_AREA	Planning area where link is located	Chico
SCREENLINE	Screenline by direction	43
BASE_AREATYP	Land use development affecting roadway capacity: Rural-1, Suburban-2, Urban-3, CBD-4	1
BASE_FACTYP	Facility type under Base Year (2018). See Facility Types tab for codes	11
BASE_DIR	Direction under base year (Two-Way= 0, One-Way = 1)	0
BASE_LANES	Number of directional through vehicle travel lanes under Base Year	1
BASE_CAPADJ	Vehicle lane capacity adjustment for Auxiliary lane under Base Year (factor for vehicle lane capacity adjustment: null, 0, or 1 = no adjustment, 0.9 = 90% capacity)	1
BASE_SPEED	Vehicle free-flow speed in miles-per hour under Base Year	50
BASE_TOLL	Code used for cost for vehicles on toll facilities under Base Year (could be used for VMT tax)	0
BASE_BIKETYP	Bicycle facility type under Base Year (2005). Class I path = 1, Class II bike lane = 2, Class III bike route =3, Class IV protected bikeway = 4. (Automatically Class I if BASE_FACTYP = Bike only)	
IMP1_PRJID	RTP Project ID number	0
IMP1_PRJYR	RTP Project Opening Year	0
IMP1_AREATYP	Land use development affecting roadway capacity: Rural-1, Suburban-2, Urban-3, CBD-4	2
IMP1_FACTYP	Facility type under Improvement 1 Year. See Facility Types tab for codes	0
IMP1_DIR	Direction under Improvement Year 1 (Two-Way= 0, One-Way = 1)	0
IMP1_LANES	Number of directional through vehicle travel lanes under Improvement 1 Year	0
IMP1_CAPADJ	Link Segment capacity adjustment (for Auxiliary lane) under Improvement Year 1 (factor for vehicle lane capacity adjustment: 1 = no adjustment, 1.15 = 115% of original link capacity)	1
IMP1_SPEED	Vehicle free-flow speed in miles-per hour under Improvement 1 Year	0
IMP1_TOLL	Code used for cost for vehicles on toll facilities under Improvement 1 Year	0
IMP1_BIKETYP	Bicycle facility type under Improvement 1 Year. Class I path = 1, Class II bike lane = 2, Class III bike route =3, Class IV protected bikeway = 4. (Automatically Class I if BASE_FACTYP = Bike only)	

Table 5: Master Network Link Variables

Attribute	Description	Example
IMP2_PRJID	RTP Project ID number	0
IMP2_PRJYR	RTP Project Opening Year	0
IMP2_AREATYP	Land use development affecting roadway capacity: Rural-1, Suburban-2, Urban-3, CBD-4	2
IMP2_FACTYP	Facility type under Improvement 2 Year. See Facility Types tab for codes	0
IMP2_DIR	Direction under Improvement Year 2 (Two-Way= 0, One-Way = 1)	0
IMP2_LANES	Number of directional through vehicle travel lanes under Improvement 2 Year	0
IMP2_CAPADJ	Link Segment capacity adjustment (for Auxiliary lane) under Improvement Year 2 (factor for vehicle lane capacity adjustment: 1 = no adjustment, 1.15 = 115% of original link capacity)	0
IMP2_SPEED	Vehicle free-flow speed in miles-per hour under Improvement 2 Year	0
IMP2_TOLL	Code used for cost for vehicles on toll facilities under Improvement 2 Year	0
IMP2_BIKETYP	Bicycle facility type under Improvement 1 Year. Class I path = 1, Class II bike lane = 2, Class III bike route =3, Class IV protected bikeway = 4. (Automatically Class I if BASE_FACTYP = Bike only)	
CNTID	Count ID	0
CNT_YR	Count Year	2017
CNT_SOURCE	Count Source (BCAG or Caltrans PeMS, or project specific)	BCAG
DAY_CNT_TOT	Daily Count Two-Way Total	0
AM1_CNT_TOT	AM Peak Hour Count Two-Way Total	0
PM1_CNT_TOT	PM Peak Hour Count Two-Way Total	0

Notes: BASE represents backcast calibration/validation year 2005, IMP1 represents the status after first improvement, and IMP2 represents the status after second improvement.
Source: Fehr & Peers, 2020.

In addition, the master network is also represented by nodes at the end of each roadway/bicycle link. The node attributes for the master network are presented in **Table 6**.

Table 6: Master Network Node Variables

Attribute	Description	Example
N	Node number	43
X	Y-coordinate of node in NAD_1983_StatePlane_California_II_FIPS_0402_Feet	6664944.483
Y	X-coordinate of node in NAD_1983_StatePlane_California_II_FIPS_0402_Feet	2248124.439
JURISDICTION	Political jurisdiction where node is located	Oroville
PLAN_AREA	Planning area where node is located	Chico
STUDY_INT	Study location number used to record turning movements when non-zero	1

Source: Fehr & Peers, 2020.

Transit System

Rather than coding detailed transit routes, stops, and access, the transit system is represented by zones that have access and the frequency (in the form of headway) for adjacent transit routes. The TAZ dataset contains information on the peak and off-peak frequency of transit service for each TAZ. The frequency of transit service was determined for each of the TAZs using a GIS layer representing the bus stop locations throughout Butte County and 2018 B-Line schedules. TAZs that occurred within a quarter mile of a bus stop location were considered to be served by that bus stop. The frequency of peak and off-peak transit service was determined for each bus stop, and this information was assigned to TAZs that were within a quarter mile of the stop. If a TAZ was served by more than one bus stop, then the values from the bus stops with the most frequent service were assigned to the TAZ. The 2018 transit frequency values were updated for future scenarios based on information provided by BCAG.

As with most regional models, the transit system only includes routes and stops within Butte County. The primary reason is the sensitivity to transit of stop location relative to land uses outside of the travel model not being available or being too costly to obtain and model. Other common reasons for not including transit outside of the model region are the inability to accurately include number of stops, travel time, or transfers beyond the model boundary and the relatively low number of riders for a high level of effort.

Roadway Vehicle Counts

BCAG provided count data of vehicle traffic volumes on 312 roadway segments throughout the model area. Vehicle counts were conducted over a three-day period mid-week (Tuesday through Thursday) in September 2017 or October 2018. The data also include breakdown by travel speed and number of heavy vehicles. The roadway vehicle count data was used for validation of the base year model.

Multimodal Trip Generation Counts

Fehr & Peers collected vehicle, bicycle, and pedestrian volumes at several locations throughout Butte County to develop refined trip generation rates for various model land use categories. Multimodal trip generation counts were conducted in October 2018.

Transit Routes and Ridership

BCAG provided transit stop, route, and ridership information for B-Line Transit, the local and regional transit service provider in the base year 2018. BCAG also provided the list of future transit projects as identified in the 2020 RTP and previous 2016 RTP.

2012 California Household Travel Survey (CHTS)

The California Household Travel Survey (CHTS) was conducted in 2012 and 2013 in 58 counties.[3] The CHTS is a combination of travel diary and GPS data, which allowed for under-reported information such as walking trips, non-home-based trips, and stops along a long trip. The CHTS is publicly available on nrel.gov at a granular level.

Preparation and Cleaning of CHTS Data

The publicly available version of the 2012 CHTS required a substantial amount of preparation, including re-weighting, before it was suitable for model development. Fehr & Peers has done extensive data preparation, including statewide and county weights, to create tailored summaries. Examples are residential VMT, trip length, and mode share summaries. These can be found in the 2018 Base Year Validation spreadsheet and in **Appendix B.**

Identification of Trip Purposes

The 2012 CHTS data does not describe trip purposes directly; instead, it contains a "place" file whose attributes include a listing of up to three activities the respondent participated in at that place. A small list of place purposes was distilled from this activity information: HOME, WORK, COLLEGE, K12, SHOP, or OTHER. In this project, we summarize total person trips starting and ending within Butte County for all trip purposes.

Estimation of Survey Weights

Surveys capture the characteristics of an entire population by randomly sampling a small proportion of the population. Often, a perfectly random sample is hard to achieve — some groups are difficult to survey and are under-represented, other groups are over-represented. To balance this bias, estimated sample weights "reshape" the sample. Fehr & Peers estimated household sample weights for the CHTS to balance the survey sample to match county-level percentages for several variables as reported in the 2012 ACS 5-year estimates (U.S. Census Bureau (2018). American Community Survey 5-year Estimates. Retrieved from https://www.census.gov/data/developers/data-sets/acs-5year.html.). Listed below are variables used as controls for the re-weighting.

- Household size (one to seven or more).
- Household income (nine income categories).
- Number of workers per household (zero to three or more).
- Number of vehicles owned per household (zero to four or more).
- Household residential unit type (three categories).
- Household size (one to five or more) cross-classified by household income (five categories).

[3] https://dot.ca.gov/programs/transportation-planning/economics-data-management/transportation-economics/ca-household-travel-survey

- Household size (one to five or more) cross-classified by number of vehicles per household (zero to four or more).
- Household size (one to five or more) cross-classified by number of workers per household (zero to three or more).

The survey weights must be correctly applied to yield accurate summaries. There are three types of weights included with the cleaned CHTS data:

- Household-level weights (hhweight, hhexpweight, and hhexpweight_weekday)
- Trip-level weights (tripweight, tripexpweight, and tripexpweight_weekday)
- Trip correction factor (tcf)
- The relationship among the three weighting factors is:
  - *Tripweight = hhweight * tcf*
  - *Tripexpweight = hhexpweight * tcf*
  - *Tripexpweight_weekday = hhexpweight_weekday * tcf*

To use CHTS data accurately, one or more of these weights must be applied. A trip weight is used to weight trips relative to one another, and it is useful for computing percentages. At the same time, the tripexpweight factors provide estimates of the total number of trips. In this project, we implemented the tripexpweight_weekday weighting factor.

Place Type

In addition to locating households and trip ends using census tracts, Census Designated Places (CDPs), and counties, each household location and a trip end is assigned a place type category. The place type is based on the number of jobs and the working-age population accessible from the household or trip end.

CHTS Summaries for Validation

The CHTS data were summarized for trips starting and ending within Butte County for model validation purposes. The type of information from the CHTS used for validation are listed below.

- Mode share
- Mode share by trip purpose
- Total Households (for comparison and statistical purposes)
- VMT per household (and by trip purpose) for validation
- Daily vehicle trips per household (and by trip purpose) for trip generation
- Average vehicle trip length (and by trip purpose) for validation
- Average person trip length (and by trip purpose) for validation
- VMT and Person Miles Traveled (PMT) per capita/household for validation

The "simple" and "flat" summaries contain one record per geography which is suitable for joining to GIS. The "simple" summary includes a smaller number of metrics, while the "flat" summary contains many more details. The "filterable" summary provides many records per geography and is viewable in Excel.

In this project, we created a summary of trips that only start and end within Butte County. The methodology is summarized below:

- The code is CHTS_nonhighway_validation.R
- The trip unit is "personTrips"
- Region name countyList is set for 6007 which is Butte County
- Input files are households_clean.csv and trips_clean.csv for households and trips variables, respectively.
- For the home and work tracts, the geoglookup variable is set to geoglookup_full.csv
- The output is written in the CSV format.

A high level summary of the survey records is shown below for both the SACOG region and Butte County. Detailed tables with metadata are in **Appendix B**.

Code	Name	Type	lookup	Total Households	Total person trips
3	SACOG	region	SACOG region	816,939	6,803,865
6007	Butte	county	Butte County	85,074	664,437

Interregional Travel

The travel model generates total person and commercial vehicle trips that travel completely internal to Butte County, and interregional trips that travel to, from, and through Butte County. These trip types are referenced as follows in the remainder of this document.

- Internal-internal (I-I) trips that originate and terminate within the model area.
- Internal-external (I-X) trips that originate within but terminate outside of the model area.
- External-internal (X-I) trips that originate outside and terminate inside of the model area.

To estimate base and future year data for the interregional trips, the California Statewide Travel Demand Model (CSTDM), California Statewide Freight Forecasting Model (CSFFM), and mobile device data were used. Mobile device trip estimates were obtained from StreetLight data to refine the gateway values for the base year, and the growth from the CSTDM and CSFFM were applied to the refined base year interregional data.

California Statewide Travel Demand Model

The 2016 RTP/SCS model utilized the CSTDM to estimate base year and future year interactions with the gateways and for through trips. Since the latest version of the model has not been released, the same through trips and interregional factors from the 2016 RTP/SCS model were used as the starting point for calibration and then refined based on mobile device data, count data, and the updated trip generation for passengers and commercial vehicles. Similar to the CSTDM forecast for passengers, the CSFFM was used to estimate the interregional commercial vehicles travel.

Mobile Device Data (Big Data)

Travel patterns are typically expressed in terms of origins and destinations – origins being locations where trips begin, and destinations being locations where trips end. In its most basic form, a travel pattern is an origin-destination pair that represents a direct trip from one location to another. Work commute trips are among the most common origin-destination pairs, typically from a residence to a place of employment in the morning, and then back to home at the end of a work day.

StreetLight aggregates anonymized location data collected from GPS devices in smartphones and car/truck navigation systems and estimates the distribution and quantity of trips between or through geographic areas. Conventional approaches to estimating trip distribution rely on travel demand models. The use of StreetLight data, however, casts a snapshot of origin-destination information grounded in the actual travel behavior of roadway users. The use of GPS data was to capture the auto travel separate from the commercial vehicle travel, and was appropriate for distribution of internal-external (IX) and external-internal (XI) personal and commercial vehicles (medium and heavy trucks), and external-external (XX) personal and commercial vehicles since the model does not reflect interregional transit.

Travel Cost

In addition to travel time, the cost of travel influences auto ownership, trip distribution, mode choice, and route choice. Although the model allows for a link-based cost, BCAG does not have existing or planned roadway user fees based on distance traveled or for using specific roadways. If such facilities are expected in the future, this feature should be calibrated prior to use.

Parking Cost

The average parking cost per trip ($ 2018) is stored as a zonal attribute and is used in both trip distribution and mode choice. The primary locations with parking cost are downtown Chico and near Butte College and CSU Chico.

Auto Operating Cost

Auto operating costs are a major influence on travel. Auto operating costs include fuel price, maintenance costs, and tire replacement costs. The California Air Resources Board (CARB) has developed a spreadsheet that takes these factors into account for each MPO and for predetermined evaluation years. The spreadsheet was used to develop costs for the years corresponding to the base year and future scenario years and the model interpolates the values for other model years. A significant change to previous auto operating costs is the inclusion of all fuel types in the weighted average cost rather than petroleum-based fuels only. **Table 7** shows the presumed auto operating costs applied in the model.

Table 7: BCAG Auto Operating Costs

Year	Cost[1]
2018	$0.2103
2020	$0.2084
2030	$0.1987
2035	$0.1892
2040	$0.1846

1. Costs represented in 2018 dollars. Model input file is in cents and contains interpolated values for years between those listed in the table.

Source: California Air Resources Board spreadsheet tool, 2020.

Accessibility

The BCAG TDF model includes two accessibility pre-processors. These are Python scripts, operating on the input TAZ and network shapefiles to produce accessibility metrics.

- Intersections.py produces a count of the number of intersections per TAZ.
- RoadwayMiles.py produces the sum of walkable network miles.

These script outputs, in data base format (DBF), are used during the model input preparation stage to calculate the accessibility metrics shown in **Table 8** at the TAZ level.

A third input file, VMTseed, contains an estimate of the average commuting VMT generated per worker in the TAZ. The starting estimates can be approximate because this estimate is updated throughout the model process.

During the input preparation phase of the model, TAZ-level accessibility metrics and built environment ("D variable") metrics are produced. These metrics are updated as the model runs through its feedback loops. Some of the accessibility metrics are implemented later in the model; others are provided as model outputs. Table 8 below shows key accessibility metrics used in the model.

Table 8: Accessibility Metrics

Metric	Description	Where used
EMP_30AUT	Jobs within 30 minutes by auto	Place Type calculation
WRK_30AUT	Working-age population within 30 minutes by auto	Place Type Calculation
ATYPE	Place Type categorization of job+worker to five categories. (See Table 9 below).	Trip Generation
LOG_EMPD	Log of employment density (jobs per developed acre)	Auto Ownership, Mode Choice
INTDEN	Intersection density (intersections per square mile)	Auto Ownership, Mode Choice
EMP_30TRN	Jobs within 30 minutes by transit	Auto Ownership, Mode Choice
COMMUTECOST	Average annual commute cost	Auto Ownership

Source: Fehr & Peers, 2020.

Place type is calculated from the sum of jobs within 30 minutes by auto- and working-age populations, and categorized into the five categories listed in **Table 9** below. Although the sample size was insufficient to estimate and calibrate trip generation rates by Place Type, the accessibility is used in Mode Choice and can be a future enhancement to Trip Generation.

Table 9: Place Types

Place Type Category	Alternate Name	Description of Placetype based on Total Service Population[1]
1	POP1	Under 40,000 jobs + working-age population within 30 minutes by auto
2	POP2	Between 40,000 and 100,000 jobs + working-age population within 30 minutes by auto
3	POP3	Between 100,000 and 200,000 jobs + working-age population within 30 minutes by auto
4	POP4	Between 200,000 and 450,000 jobs + working-age population within 30 minutes by auto
5	POP5	Over 450,000 jobs + working-age population within 30 minutes by auto

1. Service population is based on occupied commercial and residential development where total jobs is calculated using jobs per square foot conversion factors and working age population is based on household demographics of residents 18-65 years of age.

Source: Fehr & Peers, 2020.

Data Quality Checks

The input data were reviewed and compared using statistical methods or reasonableness checks prior to calibration and validation of the model. Survey data were evaluated statistically to determine if there was a sufficient sample to use for calibration or validation, resulting in the combination of multiple sources of data for calibration to provide a larger data set and using Butte County only data for validation at an appropriate level to match the samples. Traffic count data were compared between the multiple days to identify potential outliers. If there were outliers nearby locations were compared to determine which count was most reasonable to use as a single day observation, while those without outliers were averaged. Roadway, transit, and bike/pedestrian networks and TAZ boundaries were reviewed visually using color themed maps. Land use control totals by category and totals by jurisdiction were reviewed. Transit system data were compared to published route maps and schedules.

3 Model Estimation, Calibration, and Reasonableness Checks

This section describes the model estimation, calibration, and reasonableness checks performed during the update to the model.

Model estimation is the term used to describe the process by which model inputs (e.g., trip rates, friction factors, I-X/X-I percentages) are derived from sources like survey and count data for application in the model calculations.

Model calibration refers to the adjustment of the model parameters to better replicate observed travel behavior and traffic volumes in the region. Calibration improves model accuracy and is a required step to ensure that the model reflects existing data, is sensitive to the type of projects it will be applied, and meet the validation criteria described in the following section.

Reasonableness checks refer to testing of individual model components to ensure they closely replicate observed data prior to the result being used in a downstream process.

The sections below describe the calibration from the previous model or other similar models followed by the resulting reasonableness check for each model component. For new model components, the sub model structures and parameters were borrowed from recent work in the San Joaquin Valley as a starting point for local area calibration.

Trip Generation and Trip Balancing

Trip generation relates to the number of person trips going to/from a site based on the type of land use intensity and diversity of that particular site. With the new functionality of person trips rather than total vehicle trips, separating home-work trips by income for the household and salary for the worker allowed for matching of home and work location.

The person trip generation portion of the model follows the following process:

- Daily person trip generation rates for each land use type
- Trip purpose percentages of daily person trip generation rates
- Interregional (IX and XI) trip percentages by trip purpose
- Trip productions and attractions balanced by trip purpose and income level

Trip Generation Rates

The trip generation capability existed previously and generated total vehicle trips. The new functionality replaced total vehicle trips generated with person trips and commercial truck trips. Developing person trip rates started with the 2016 RTP/SCS calibrated total vehicle trips by purpose and implemented the process described below.

- Remove trucks trips (from traffic counts)
- Convert to person trips in autos (based on occupancy – from CHTS)
- Convert mode share and persons in autos to get overall person trips

Residential Person Trip Generation

The previous update of the BCAG model for the 2016 RTP/SCS enhanced the residential trip generation sub-model from one that relied exclusively on land use as the independent variable to one that considered land use, demographic, and socio-economic factors in a cross-classified formulation. The trip generation rates for single family and multi-family homes were expanded to represent the different trip making characteristics of a variety of households within Butte County. For this model update, since the cross-classified socio-economic factors for each residential unit type are not being forecast, the number of workers per household was removed to simplify the land use inputs for model users. The cross-classification is based on household size (1, 2, 3, or 4+) and household income (<$35K, $35K-$50K, $50K-$75K, >$75K).

Table 10 contains the cross-classified residential vehicle trip rates for occupied single family, multi-family and mobile homes. The rates were estimated using the 2012 CHTS data and adjusted during the model calibration. This survey was conducted statewide and provides a complete summary of daily household trip making.

Table 10: Residential Daily Person Trip Generation Rates

Household Type	Household Size	Income			
		< $35K	$35K – $50K	$50K – $75K	> $75K
Single Family	1	2.03	2.03	2.46	2.46
	2	3.85	3.85	3.90	3.90
	3	5.73	5.73	5.36	5.36
	4	7.68	7.68	8.51	8.51
	5	11.43	11.43	14.04	14.04
Multi-Family	1	1.14	1.14	2.46	2.46
	2	3.64	3.64	3.90	3.90
	3	5.73	5.73	5.36	5.36
	4	8.09	8.09	8.51	8.51
	5	11.43	11.43	14.04	14.04
Mobile Home	1	1.14	1.14	2.46	2.46
	2	3.64	3.64	3.90	3.90
	3	5.73	5.73	5.36	5.36
	4	8.09	8.09	8.51	8.51
	5	11.43	11.43	14.04	14.04

Note: To account for land use density, in addition to the trips by income and household size, the total households per zone generate an additional 0.89 trips per household.
Source: Fehr & Peers, 2020

Non-Residential Person Trip Generation

The primary source for non-residential person trip generation rates in the model was the 2016 RTP/SCS model, with the vehicle trips converted to person trips using the mode split and persons per vehicle from the 2012 CHTS. The 2016 RTP/SCS model was based on ITE 9th Edition Trip Generation[4] vehicle trip generation rates, which contains national averages of vehicle trip generation rates for a variety of land uses in what are generally suburban locations. The 2016 RTP/SCS model vehicle trip rates based on the 9th Edition were used rather than starting with rates from the 10th Edition since the travel model rates had been previously calibrated to reflect travel in Butte County, unlike the national data provided directly by ITE. The rates from the 2016 RTP/SCS model were calibrated for major non-residential land uses such as prominent retail centers and institutions within Butte County using a methodology similar to that explained above for residential uses. **Table 11** displays the final non-residential trip rates.

[4] *Trip Generation* (9th edition.). (2012). Washington, D.C.: Institute of Transportation Engineers.

Table 11: Non-Residential Land Use Daily Person Trip Generation Rates

Land Use Type	Model LU	Units	Person Rate
Office	OFF_KSF	Thousand Square Feet	12.56
Medical Office	MED_KSF	Thousand Square Feet	33.79
Hospital	HOSP_KSF	Thousand Square Feet	18.91
Industrial	IND_KSF	Thousand Square Feet	9.09
Public/Quasi-Public	PQP_KSF	Thousand Square Feet	8.00
Park	PARK_AC	Acres	1.89
Neighborhood-Serving Retail	RET_KSF	Thousand Square Feet	32.63
Region-Serving Retail	RRET_KSF	Thousand Square Feet	40.82
Hotels	HOTEL_RMS	Rooms	6.23
K-12 School	K12_STU	Students	1.54
University	UNIV_STU	Students	1.71
Community College	CC_STU	Students	1.23
Casino (Special Generator)	CASINO_SLT	Slots	5.18

Source: Fehr & Peers, 2020.

Commercial Truck Trip Generation

Along with generating person trips rather than total vehicle trips, the commercial truck trips were separated from passenger travel. The trip generation is based on the CSFFM and calibrated to local conditions. The trip generation for aggregated non-residential sectors is shown below in **Table 12**.

Table 12: Commercial Truck Daily Trip Generation

Model Industry/Commodity	NAICS 2007	Daily Trip Rate
Total Households	NA	0.61
Total Employees	NA	0.52
Ag/Farm/Fish	11	0.16
Mining	21	0.20
Construction	23	0.20
Manufactured Products	31-325	0.25
Manufactured Equipment	326-33	0.17
Transportation/Communication/Utilities	22, 48 ,492, 493, 51	0.17
Wholesale	42	0.17
Retail Trade	44-45	0.17
Finance, Insurance, Real Estate, Service	52-56, 62, 71, 72, 81	0.07
Education/Govt	491, 61, 92	0.07

Person Trip Purposes and Income

Trip generation rates are initially defined for total trips and later split by trip purpose. Each trip has two ends, a "production" and an "attraction." By convention, trips with one end at a residence are defined as being "produced" by the residence and "attracted" to the other use (workplace, school, retail store, etc.), and are called "Home-Based" trips. Trips that do not have one end at a residence are called "Non-Home-Based" trips.

There are seven primary trip purposes used in the BCAG model.

- *Home-Based Work (HBW):* trips between a residence and a workplace, separated into low, medium, and high to improve the commute location by matching jobs and household income
- *Home-Based Shop (HBS):* trips between a residence and a store
- *Home-Based Other (HBO):* trips between a residence and any other destination
- *Non-Home-Based (NHB):* trips that do not begin or end at a residence, such as traveling from a workplace to a restaurant, or from a retail store to a bank
- *School (SCHOOL):* trips to and from a school (K-12)
- *University (UNIV):* trips to and from a community college or university
- *Casino (CASINO):* trips to and from a casino

The 2012 CHTS data was used to determine the appropriate proportion of trips that represent each purpose. The University trip purpose category was added as part of this model update to better represent the travel patterns of students attending CSU Chico and Butte College.

Interregional (IX and XI) Trip Percentages

The interregional factors are based on CHTS for each trip purpose and refined based on StreetLight data to have an improved geographic sensitivity. Each TAZ incorporates an IX and XI percentage for each trip purpose.

Internal/External Trips Interactions

One of the important inputs to a travel model is an estimate of the amount of travel between the study area and neighboring areas outside the model. These I-X/X-I, trips. and have one trip end in the county with the other trip end outside the county. The I-X/X-I percentages were initially estimated for each model trip purpose using the 2012 CHTS data. These estimates were then refined using the county's external station counts. **Table 13** summarizes the proportion of IX and XI trips by purpose for the base year.

Table 13: Percent of Trips by Purpose That are Interregional

Purpose	Model	CHTS
Home-Based Work (HBW)	15.3%	15.9%
Home-Based Other (HBO)	7.2%	8.8%
Non-Home-Based (NHB)	10.4%	11.4%

Source: Fehr & Peers, 2020.

After the number of I-X/X-I trips are estimated, these trips are distributed to the stations around the perimeter of the model area using external station weights. External station weights are based on counts collected at each external station (these are roadway segments at the border of the model area). The number of through trips at each station was subtracted from the count and the remainder was filled in by I-X/X-I trips estimates. The resulting external station weights are presented in **Table 14**.

Table 14: External Station Weights

ID	Description	Weight
1	Hwy 99 – north of Butte County Line	17.0%
2	Cohasset Rd – north of Musty Buck Rd	0.2%
3	Hwy 32 – north of Humboldt Rd	0.9%
4	Humboldt Rd – north of Jonesville Rd	0.01%
5	Hwy 70 – north of Butte County Line	1.7%
6	Oroville Quincy Hwy – north of Haskins Valley Rd	0.4%
7	Forbestown Rd – east of Reservoir Rd	1.1%
8	La Porte Rd – northeast of Robinson Mill Rd	0.4%
9	Loma Rica Rd – south of La Porte Rd	0.3%
10	La Porte Rd – south of Butte County Line	0.2%
11	Hwy 70 – south of Butte County Line	18.0%
12	Larkin Rd – south of Butte County Line	4.9%
13	Hwy 99 – south of Butte County Line	24.0%
14	Pennington Rd – south of Rutherford Rd	0.6%
15	Colusa Hwy – west of Cherokee Canal Rd	1.2%
16	Afton Rd – west of Aguas Frias Rd	0.2%
17	Hwy 162 – west of Butte County Line	2.3%
18	Road Z – south of Road 48	0.1%
19	Ord Ferry Rd – west of Hugh Baber Ln	4.9%
20	Hwy 32 – west of Butte County Line	21.3%

Source: Fehr & Peers, 2020.

Through Trips

Through trips (also called external-external, or X-X trips) are trips that pass through the study area without stopping inside the study area. The major flows of through traffic in Butte County use Hwy 99, Hwy 70, and Hwy 32, with lower volumes of through traffic using other arterials. The CSTDM was the starting point for passenger vehicle trips and the CSFFM for commercial vehicles. The size of these flows was calibrated using StreetLight data and traffic counts collected as part of the model update.

Trip Productions and Attractions Balancing

Local trips (internal-to-internal, or I-I) are trips that both start and end in the model area. One of the basic requirements of any travel model is that the total number of local trips produced is equal to the total number of local trips attracted. It is logically assumed that if a journey begins, it must have an ending somewhere else. If the total productions and attractions are not equal, the model will typically adjust the attractions to match the productions, thus ensuring that each departing traveler finds a destination. While it is never possible to achieve a perfect match between productions and attractions prior to the automatic balancing procedure, a substantial mismatch in one or more trip purposes may indicate an error in the model land use inputs or trip generation.

Table 15 summarizes the local trip productions and attractions from the model for each trip purpose, prior to the application of the automatic balancing procedure. Guidelines published by the Travel Model Validation and Reasonableness Checking Manual [5] and the National Cooperative Highway Research Program (NCHRP) Report 716 [6] suggest that, prior to balancing, the number of productions and attractions should match to within plus or minus 10% (i.e., the production-to-attraction ratio should be within the range of 0.90 to 1.10). The results shown in Table 15 indicate that the 2020 base year model meets the published guidelines for all trip purposes.

Table 15: Person Trip Production to Attraction Ratios by Purpose

Trip Purpose	Production/Attraction
Home-Based Work (HBW)	1.01
Home-Based Shop (HBS)	0.99
Home-Based Other (HBO)	1.06
Non-Home-Based (NHB)	1.03

1. The trip purposes listed are the broad categories applied in most every travel model. The more specific BCAG trip purposes are subsets of these broader trip purposes, and have been aggregated here for ease of comparison. The School, Casino, and University purposes are subsets of the HBO trip purpose.
Source: Fehr & Peers, 2020.

Trip Generation Sensitivity

The BCAG TDF model contains enhancements added as part of the previous update to better capture local trip making characteristics and provide the ability to test certain policy options for future development scenarios. These new features with this model update include adjustments for residential and non-residential vacancy rates and adding sensitivity for aging population, the cost of travel, smart growth development, and changes to the transit system.

[5] *Model Validation and Reasonableness Checking Manual* (2nd edition). (2001). Washington, D.C.: U.S. Dept. of Transportation, Federal Highway Administration, Federal Transit Administration, Assistant Secretary for Transportation Policy.

[6] *Travel Demand Forecasting: Parameters and Techniques* (Report 716). (2012). Washington, D.C: Transportation Research Board.

Vacancy Rates

The trip generation sub-model has the ability to reflect varying levels of occupancy for residential and non-residential buildings. However, for this update, BCAG staff elected to provide land use information already adjusted for vacancy. Therefore, the vacancy rate adjustment factors were set to 1.0.

Aging Population

It has long been recognized that households with older residents generate fewer vehicle trips than households where the residents are younger. The reason behind the reduced trip generation is generally thought to be due to the reduced number of work trips, fewer activities requiring travel, and the fact that a portion of this age group cannot drive.

In previous TDF model versions, a scenario testing adjustment tool was developed to account for the impact an aging population would have on trip generation. However, detailed age distribution forecasts were not available at a subarea level within the county, so the tool was not applied to the future year models. For this model update, there is an age of head of household adjustment that applies for each trip purpose and multiplies by the calibrated trip rate to test for potential increases or decreases in travel relative to age. The factor is currently set at 1.0 to represent the 2012 CHTS data as calibrated to represent 2018 conditions in Butte County.

Trip Distribution (Gravity Model)

Once the trip generation step has estimated the number of trips that begin and end in each zone, the trip distribution process determines the specific destination of each originating trip. The destination may be within the zone itself, resulting in an intra-zonal trip. If the destination is outside of the zone of origin, it is an inter-zonal trip. Inter-zonal trips consist of II, IX, and XI trips.

The trip distribution model uses a gravity model equation to distribute trips to all TAZs. This equation estimates an accessibility index for each TAZ based on the number of attractions in each TAZ and the travel time between TAZ. Each attraction TAZ is given its share of productions based on its share of the accessibility index. This process applies to the I-I, I-X, and X-I trips. The X-X trips are added to the trip matrix prior to final assignment.

The model previously used a similar gravity model and the values were updated to include multimodal network. New features in trip distribution were added to match household income locations with job locations by salary, allow for internal-external and external-internal trips to vary by individual zone rather than by land use type and trip purpose, and to have the gateway used by each purpose more flexible. The trip distribution also added a new feature allowing the vehicles available to a household influence the distribution and the accessibility of a location to influence the attractiveness.

Friction Factors

Friction factors, also known as travel time factors, are used in calculating the relative attractiveness of each destination zone based on the travel time between TAZs and the number of potential origins and destinations in each TAZ. These factors are used in the trip distribution stage of the model. The BCAG model friction factors are based on data reported in national modeling reference documents such as *Travel Estimation Techniques for Urban Planning*, NCHRP 365 [7] and remain unchanged from the previous model update.

Vehicle Availability

The updated model forecasts include a new feature of vehicle availability as an input to both the trip distribution and mode choice. The vehicle availability model is a disaggregate multinomial logit model which predicts the probability of a household owning 0, 1, 2, or 3, or 4+ vehicles based on the variables in **Table 16**.

Table 16: Variables in Vehicle Availability Model

Category	Variable	Description
Cost Variable	Commute Cost Ratio	Average annual commute cost divided by household income
Accessibility Variables	Intersection Density	Intersections per square mile
	Transit Accessibility	Jobs within 30 minutes via transit
	Employment Density	Log of (jobs per developed acre)
Household Demographic Variables	Household Size	Household size 1, 2, 3, 4+
	Household Income	Less than \$35K, \$35K – \$50K, \$50K – \$75K, Greater than \$75K
	Household Residential Unit Type	Single Family, Multi-Family, Mobile Home

The commute cost ratio variable is an estimate of the proportion of a household's income required to own vehicles. It is derived from a county-level estimate of per-mile auto ownership costs, tract-level estimates of commuting VMT derived from the EPA's Smart Location Calculator[8], an annualization factor of 250 working days per year, and the household income. The variable is applied on a per-vehicle basis, so that owning no vehicles incurs no cost, owning two vehicles incurs twice the cost of owning one vehicle, and so on. **Table 17** below provides the coefficients of the auto ownership model.

[7] Martin, W. A., & McGuckin, N. A. (1998). *Travel Estimation Techniques for Urban Planning* (Report 365). Washington, DC: National Academy Press.

[8] https://ww2.arb.ca.gov/resources/documents/scs-evaluation-resources

Table 17: VMIP 2 Auto Ownership Model Coefficients

	0 Vehicles	1 Vehicle	2 Vehicles	3 Vehicles	4+ Vehicles
Alternative-Specific Constant					
CommuteCostRatio	7.51	3.95	0.00	0.00	0.00
PedOrIntDens	0.009	0	0	-0.004	-0.004
TransitAccessibility (x1000)	0.009	0.010	0	-0.051	-0.112
LogEmpDensity	0.39	0.24	0	0.00	-0.19
RUGroup=RU1	0	0	0	0	0
RUGroup=RU3	1.27	0.53	0	-1.53	-1.53
RUGroup=RU6	0.27	-.27	0	0	0
HH_size=1	-1.16	1.5	0	-3.15	-4.94
HH_size=2	-3.03	-0.42	0	-2.26	-4.19
HH_size=3	-3.37	-0.24	0	-1.34	-3.40
HH_size=4	-4.02	-0.66	0	-1.61	-3.13
HH_size=5+	-3.50	-0.89	0	-1.32	-2.44
HH_inc=IncG1	0	0	0	0	0
HH_inc=IncG2	-1.33	-0.28	0	0.86	0.98
HH_inc=IncG3	-3.87	-0.93	0	1.2	2.35
HH_inc=IncG4	-2.98	-1.55	0	1.55	2.35
HH_inc=IncG5	-4.23	-1.96	0	1.44	2.87

Note the model uses owning two vehicles as its base, and calculates the relative probability of owning fewer or greater vehicles; thus, the model coefficients describe relative probabilities as in the example below:

$$\ln\left(\frac{Prob(0\ vehicles)}{Prob(2\ vehicles)}\right) = 7.51(CommuteCostRatio) + 0.0093(PedOrIntDensity) + \ \ldots$$

The coefficients for this model are generally intuitive in direction and scale.

- Higher commuting cost increases the probability of owning 0 or 1 vehicles, and decreases the probability of owning 3 or 4 vehicles, as compared to the baseline of 2 vehicles.
- Higher scores for the three accessibility variables, indicating generally better accessibility by non-auto modes, increase the probability of owning 0 vehicles (and sometimes also 1 vehicle) relative to owning 2; and decrease the probability of owning 3 or 4.

- Household income is the demographic variable which has the largest influence in auto ownership. Generally, as incomes go up, probabilities of owning 0 or 1 vehicles go down, and probabilities of owning 3 or 4 vehicles go up.
- Household size behaves in the expected way, with probability of owning 0 or 1 vehicles going down as household size increases and probability of owning 3 or 4 vehicles going up.
- Multi-family unit types are more likely to own 0 or 1 vehicles, and less likely to own 3 or 4 vehicles, than single family. There weren't enough records in the RUG6 "other" category (RV, mobile home, etc.) to distinguish them from single family, and they were generally more similar to single family than multi-family uses, so they share the same coefficients as single family.

An important consideration for future model development is that car sharing and transportation network companies (i.e., UBER, LYFT, etc.) are changing auto availability dynamics and, potentially, long-term auto ownership. As more data becomes available it may be appropriate to modify the auto ownership model to recognize these changes and focus more on auto availability across multiple sub modes and costs per mile. **Table 18** summarizes the autos owned for both the model and the CHTS.

Table 18: Percent of Autos Owned

Autos Owned	Model	CHTS
0	7%	9%
1	37%	37%
2	39%	34%
3+	17%	20%

Source: Fehr & Peers, 2020.

Mode Choice

The previous model generated total auto trips. With the addition of vehicle availability, person trips, and a multimodal network with simplified transit, the model implemented a new feature as a full multinomial logit mode choice model that was developed for the San Joaquin Valley MPOs due to the similar rural character and transportation options. A nested logit form might have been preferred for theoretical reasons, given the strong relationships among drive, transit, and active modes. However, no satisfactory nested logit models were estimated, likely because of severe constraints on the amount of transit data available. Multinomial logit models produced generally more sensible results and were used instead. The mode choice model is segmented by trip purpose and vehicle availability, using three vehicle availability categories as described in **Table 19**.

Table 19: Vehicle Availability Segments in Mode Choice Model

Name	Description
0veh	Households which own no vehicles
1veh	Households which have one vehicle but more than one person
Others	Households with either one vehicle and one person, or more than one vehicle

Source: Fehr & Peers, 2020.

Table 20 below lists the modes available in the model.

Table 20: Modes Available in Mode Choice Models

Category	Name	Segments Available	Trip Purposes	Description
Auto	da	1Veh, Other	All	Drive-alone
	s2	All	All	Shared ride, 2 persons
	s3	All	All	Shared ride, 3+ persons
Transit	twb	All	All	Transit, walk-access, bus
	tdb	All	All	Transit, drive-access, bus
	twr	All	All but HBK, HBC	Transit, walk-access, rail
	tdr	All	All but HBK, HBC	Transit, drive-access, rail
	sb	All	HBK only	School bus
Active	walk	All	All	Walk
	bike	All	All	Bike

Source: Fehr & Peers, 2020.

The variables used in each of the modes in the choice model are listed in **Table 21** below. Not all variables are used in all trip purposes models. For the accessibility and built environment variables, the table notes whether the variable is measured at the trip production (P) or trip attraction (A). Note that value of time is a direct consequence of the relationship between in-vehicle time and cost. As such, it is not estimated directly but is instead a consequence of the in-vehicle time (IVT) and cost coefficients. For model implementation purposes, only value of time (VOT) is used in the mode choice utility equation; for clarity, both are reported in the tables below.

Table 21: Variables in Mode Choice Models

Variable	Purposes	Description
(Constants)	All	Alternative-specific constants
IVT	All	In-vehicle time
OVT	All	Out-of-vehicle time (access, transfer, egress, and waiting times)
Cost	All	Total cost, including auto operating cost, parking cost and tolls, and transit fares.
VOT	All	Value of time (conversion between cost variables and time variables)
TransitAccess	HBW, WBO, OBO	Jobs available within 30 minutes via transit, decay-weighted (P)
LogEmpDensity	HBW, HBS, HBO	Log (employment density of block group) (A)
IntDensity	HBK, HBC	Pedestrian-oriented intersection density (A)

Source: Fehr & Peers, 2020.

Home-Based Work

Table 22 lists model coefficients for HBW segments. Drive-alone was used as a reference mode for all trip purposes including the 0-vehicle segment where this mode is not permitted. In this segment, utility calculations were carried out without the drive-alone mode.

Table 22: HBW Mode Choice Model Coefficients

Variable	Mode	0-Vehicle	1-Vehicle, 2+ person HH	All Others
Constant	da	x	0	0
	s2	0.710	-1.839	-2.340
	s3	-0.229	-2.587	-2.936
	twb	-1.900	-1.602	-2.754
	tdb	-1.900	-1.602	0.000
	twr	-1.900	-4.173	-5.937
	tdr	-1.900	-0.444	-5.432
	bike	-2.438	-2.898	-3.763
	walk	1.477	0.030	-1.075
IVT	All	-0.035	-0.040	-0.040
OVT	All	-0.070	-0.080	-0.080
OVT/IVT	All	2	2	2
Cost	All	-0.003	-0.002	-0.001
VOT	All	6	10.055	18

Table 22: HBW Mode Choice Model Coefficients

Variable	Mode	0-Vehicle	1-Vehicle, 2+ person HH	All Others
LogEmpDensity	da	x	0	0
	s2	0.828	0.329	0.506
	s3	0.458	0.408	0.506
	twb	1.873	0.586	1.066
	tdb	1.873	0.586	1.066
	twr	1.202	0.850	1.202
	tdr	1.066	0.189	1.202
	bike	2.147	0.765	0.506
	walk	1.025	0.178	0.005
TransitAccess	da	0	0	0
	s2	0.013	0.013	0.005
	s3	0.013	0.013	0.005
	twb	0.158	0.027	0.032
	tdb	0.158	0.027	0.032
	twr	0.158	0.027	0.032
	tdr	0.158	0.027	0.032
	bike	0.136	0.031	0.062
	walk	0.136	0.031	0.062

Source: Fehr & Peers, 2020.

Home-Based Shop

Table 23 below lists model coefficients for HBS segments. Drive-alone was used as a reference mode for the 1-vehicle and 2-vehicle segments, while walk was used as a reference mode for the 0-vehicle segment.

Table 23: HBS Mode Choice Model Coefficients

Variable	Mode	0-Vehicle	1-Vehicle, 2+ person HH	All Others
Constant	da	x	0	0
	s2	-3.420	-0.495	-0.889
	s3	-4.269	-0.380	-1.009
	twb	-2.439	-3.542	-5.834
	tdb	-2.439	-3.542	-5.834
	twr	-2.439	-3.542	-5.834
	tdr	-2.439	-3.542	-6.961
	bike	-5.341	-3.756	-2.972
	walk	0	2.191	-0.684
IVT	All	-0.025	-0.025	-0.025
OVT	All	-0.050	-0.050	-0.050
OVT/IVT	All	2	2	2
Cost	All	-0.005	-0.003	-0.002
VOT	All	3	6	6.319
LogEmpDensity	da	x	0	0
	s2	-0.040	0.297	0.161
	s3	0.957	0.026	0.161
	twb	0.732	0.916	1.141
	tdb	0.732	0.916	1.141
	twr	0.866	0.866	0.750
	tdr	0.866	0.866	0.750
	bike	1.274	1.171	0.594
	walk	0	0.190	0.458

Source: Fehr & Peers, 2020.

Home-Based School (K-12)

Table 24 below lists model coefficients for SCHOOL segments. The reference mode for the 0- and 1-vehicle segments is walk; the reference mode for the 2-vehicle segment is shared ride 3.

Table 24: SCHOOL Mode Choice Model Coefficients

Variable	Mode	0-Vehicle	1-Vehicle, 2+ person HH	All Others
Constant	da	x	-4.874	-2.110
	s2	-3.560	-1.710	-0.703
	s3	-3.115	-1.540	0
	twb	-0.887	-7.657	0.316
	tdb	-0.887	-7.657	0.316
	bike	-4.456	-4.456	-2.876
	walk	0	0	0.273
	sb	-1.198	-1.346	0.449
IVT	All	-0.025	-0.025	-0.025
OVT	All	-0.050	-0.050	-0.050
OVT/IVT	All	2	2	2
Cost	All	-0.005	-0.003	-0.002
VOT	All	3	6	9
IntDensity	da	x	-0.004	0
	s2	0	-0.004	0.004
	s3	0	-0.004	-0.019
	twb	-0.019	0.003	0.004
	tdb	0	0	0
	bike	0.003	0.009	0.005
	walk	-0.008	0.000	0.005
	sb	-0.012	-0.004	-0.003

Source: Fehr & Peers, 2020.

Home-Based University

Table 25 below lists model coefficients for UNIV segments. Because of the very small number of trips in the household survey data, all vehicle ownership segments were pooled for model estimation purposes, with distinctions between segments left for adjustment during model calibration. Drive-alone was used as a reference mode. In the 0-vehicle segment, utility calculations were carried out without the drive-alone mode.

Table 25: UNIV Mode Choice Model Coefficients

Variable	Mode	0-Vehicle	1-Vehicle, 2+ person HH	All Others
Constant	da	x	0	0
	s2	-2.230	-2.230	-2.230
	s3	-2.396	-2.396	-2.396
	twb	-0.521	-0.521	-0.521
	tdb	-0.521	-0.521	-0.521
	bike	-3.848	-3.848	-3.848
	walk	-1.126	-1.126	-1.126
IVT	All	-0.025	-0.025	-0.025
OVT	All	-0.050	-0.050	-0.050
OVT/IVT	All	2	2	2
Cost	All	-0.005	-0.003	-0.002
VOT	All	3	6	9
IntDensity	da	x	0	0
	s2	-0.004	0.004	0.004
	s3	-0.004	-0.019	-0.019
	twb	0.003	0.004	0.004
	tdb	0	0	0
	bike	0.009	0.005	0.005
	walk	0	0.005	0.005

Source: Fehr & Peers, 2020.

Home-Based Other

Table 26 below lists model coefficients for HBO segments. Drive-alone was used as a reference mode for the 2-vehicle segment, while walk was used as a reference mode for the 0- and 1-vehicle segments.

Table 26: HBO Mode Choice Model Coefficients

Variable	Mode	0-Vehicle	1-Vehicle, 2+ person HH	All Others
Constant	da	x	-1.538	0
	s2	-3.032	-1.086	-0.151
	s3	-3.354	-1.250	0.014
	twb	-4.518	-3.406	-3.174
	tdb	-8.953	-5.947	-3.341
	twr	-6.684	-6.405	-7.221
	tdr	-6.684	-6.405	-7.221
	bike	-3.368	-3.596	-1.963
	walk	0	0	0.561
IVT	All	-0.025	-0.025	-0.025
OVT	All	-0.050	-0.050	-0.050
OVT/IVT	All	2	2	2
Cost	All	-0.005	-0.003	-0.002
VOT	All	3	6	9
LogEmpDensity	da	x	-0.455	0
	s2	-0.455	-0.455	0
	s3	-0.614	-0.614	0
	twb	0.387	0.277	0.315
	tdb	0.924	0.277	0.315
	twr	-0.407	0.277	0.363
	tdr	-0.407	0.277	0.363
	bike	-0.143	0.559	0.455
	walk	0	0	0.455

Source: Fehr & Peers, 2020.

Non-Home Based

Table 27 below lists model coefficients for NHB segments. Walk was used as a reference mode for the 0- and 1-vehicle segments; drive-alone was used as a reference mode for the 2-vehicle segment.

Table 27: NHB Mode Choice Model Coefficients

Variable	Mode	0-Vehicle	1-Vehicle, 2+ person HH	All Others
Constant	da	x	-0.732	0
	s2	-1.975	-0.223	-0.228
	s3	-2.353	-0.732	-0.388
	twb	-2.764	-3.899	-4.442
	tdb	-2.764	-3.899	-4.442
	twr	-4.017	-3.899	-5.409
	tdr	-4.017	-3.899	-5.409
	bike	-3.036	-4.219	-3.627
	walk	0	0	-0.444
IVT	All	-0.030	-0.030	-0.074
OVT	All	-0.061	-0.061	-0.147
OVT/IVT	All	2	2	2
Cost	All	-0.004	-0.003	-0.005
VOT	All	5.191	6	9
TransitAccess	da	x	-0.200	0
	s2	-0.200	-0.200	0
	s3	-0.369	-0.369	0
	twb	0.027	0.097	0.025
	tdb	0.027	0.097	0.025
	twr	0.027	0.097	0.025
	tdr	0.027	0.097	0.025
	bike	0.043	0.150	0.039
	walk	0	0	0.039

Source: Fehr & Peers, 2020.

Table 28 summarizes the aggregated mode choice for both the model and the CHTS. Note that while the model produces results for each individual mode by purpose, due to sample size in the CHTS the aggregated mode shares are used for validation. Prior to using the detailed mode choice by purpose and mode, a sub-area validation and potentially calibration should be undertaken.

Table 28: Mode Choice Results

Mode	Model	CHTS
Drive-alone	40%	43%
Shared Ride	42%	45%
Transit	4%	3%
Walk/Bike/Other	14%	9%

Note: Other includes school bus, taxi, and other specialized modes accounted for in the CHTS.
Source: Fehr & Peers, 2020.

Trip Assignment

The trip assignment process determines the route each vehicle trip takes from a particular origin to a particular destination. It uses an iterative, capacity-restrained assignment routine to determine a travel path that minimizes travel time, while considering congestion delays caused by the other simulated trips in the model. The model added new capabilities to account for the number of passengers in the car for passenger trips, the type of truck being used (small, medium, and large) for commercial trips, and the potential for roadway pricing on a roadway segment on a per mile basis or spot location for a single charge.

The general assignment process includes the following steps.

- Assign all trips to the links along their selected paths
- After all assignments, examine the volume on each link and adjust its impedance based on the volume-to-capacity ratio
- Repeat the assignment process for a set number of iterations or until specified criteria related to minimizing travel delays are satisfied

Calibration of the roadway network included modification of the centroid connectors to more accurately represent the location that traffic accesses local roads; adjustment of speeds from posted speed limits to reflect the attractiveness of the route and the prevailing speed of traffic; and adjustment of capacities to reflect the attractiveness of the route.

Time Periods

The model estimates travel for the average weekday (Monday through Friday). The daily roadway volumes are aggregated from the AM and PM peak period, and Mid-day and Evening off-peak period assignments. Additionally, although not included in the validation, the model performs AM and PM peak one hour assignments. Descriptions of each assignment time period are presented in **Table 29**. The specific time periods represented in the model were developed by reviewing the distribution of existing traffic counts across a 24-hour period as well as reviewing the time period distributions of travel models in neighboring jurisdictions (i.e., NCTC, SACOG, TRPA).

Table 29: Time Periods

Description	Duration	Time
AM Peak Period	3 Hours	6:00 – 8:59 AM
Mid-day Period	7 Hours	9:00 AM – 3:59 PM
PM Peak Period	3 Hours	4:00 – 6:59 PM
Off-Peak Period	11 Hours	7:00 PM – 5:59 AM
AM Peak Hour	1 Hour	7:00 – 7:59 AM
PM Peak Hour	1 Hour	5:00 – 5:59 PM

Source: Fehr & Peers, 2020.

Turn Penalties

Turn penalties are used to prohibit or add delay to certain turning movements. The BCAG model prohibits traffic from making turns across impassable medians. In addition, the model may prohibit U-turns at some locations to avoid counterintuitive traffic routing. Turn penalties may be in effect during the entire day, during one or all peak periods, or only at the peak hour level. Currently the turn penalties apply to all vehicles and there are no specific truck only turn penalties or prohibitions.

Vehicle Miles of Travel

A major focus of recent transportation related legislation in California focuses on VMT. In addition to Air Quality Conformity determinations, SB 375 and subsequent legislation such as SB 743 have highlighted the need to have a reliable method for forecasting VMT for regional planning. The traditional reasonableness check for VMT is to compare the regional model to HPMS for VMT on the roadways with the model area. **Table 30** below shows that the VMT for the model is within the 3% suggested error relative to HPMS. In addition to total VMT, it is often useful to understand the contribution of VMT from trip traveling through the model area and the ratio of VMT per capita.

Table 30: Model VMT Comparison to HPMS

HPMS	Model	% Deviation	% Through trip VMT	Model VMT per Capita
5,027,730	4,869,564	-3.15%	3.4%	21.39

Note:
HPMS estimates from 2018 for all roadways in Butte County
Model VMT per capita represents total VMT on the model network divided by the population. This is a ratio and not a VMT generation rate per resident.
Source: Fehr & Peers, 2020.

Transit Forecasting

Although the simplified representation of transit in terms of access and headway is validated at the regional mode share level, the mode choice and distribution processes allow for evaluation of mode share at the zone-to-zone and individual zone levels. Interregional transit must be done off-model. The regional mode share for transit from the travel model and CHTS are shown in **Table 28.**

4 Model Validation

Model validation is the term used to describe model performance in terms of how closely the model's output matches existing travel data in the base year. The extent to which model outputs match existing travel data validates the model algorithms and inputs.

Traditionally, most model validation guidelines have focused on the performance of the trip assignment function in accurately assigning trips to the roadway network. This method is called static validation, and it remains the most common means of measuring model's ability to replicate base year observed conditions.

Models, however, are seldom used for static applications. By far the most common use of models is to forecast how a change in inputs would result in a change in traffic conditions. Therefore, another test of a model's accuracy focuses on the model's ability to predict realistic differences in outputs as inputs are changed. This method is referred to as dynamic validation. This section describes the highest-level validation checks that have been performed for the model.

Static Validation

The 2017 *California Regional Transportation Plan Guidelines* [9], contains the following specific static validation criteria and thresholds.

- *At least 75 percent of the roadway links for which counts are available should be within the maximum desirable deviation*, which ranges from approximately 15 to 60 percent depending on total volume (the larger the volume, the less deviation is permitted).
- *A correlation coefficient of at least 0.88* – The correlation coefficient estimates the overall level of accuracy between observed traffic counts and the estimated traffic volumes from the model. These coefficient ranges from 0 to 1.0, where 1.0 indicates that the model perfectly fits the data.
- *The percent root mean squared error (%RMSE) below 40%* – The %RMSE is the square root of the model volume minus the actual count squared, divided by the number of counts. In other words, it is the average of all the link-by-link percent differences, and it is an indicator of how far the model volumes differ from the counts, on a link-by-link average, expressed as a percent. It is a measure similar to standard deviation in that it assesses the accuracy of the entire model.

In addition to these criteria, the model-wide volume-to-count ratio was checked against a desired maximum threshold of no more than a 10 percent deviation. The static validation results for the model are show in **Table 31** and reveal that the model passed all the tests

[9] *California Regional Transportation Plan Guidelines.* (2017). Sacramento, CA: California Transportation Commission.

Table 31: Results of Model Validation

Validation Item	Criterion of Acceptance	Daily
Model-wide Volume-to-Count Ratio	Within ± 10%	0.95
Percent of Links Within Deviation Allowance	At Least 75%	79%
Correlation Coefficient	At Least 88%	93%
RMSE	40% or Less	36%

Source: Fehr & Peers, 2020.

Dynamic Validation and CARB Model Sensitivity Tests

The tests below were conducted to evaluate the functionality of the model directly related to the scenarios being evaluated as part of the 2020 RTP/SCS, and to provide both BCAG and CARB information for determining the capabilities and sensitivity to the new features of the model.

Induced Vehicle Travel

The balance between traveler convenience and increased auto dependency is at the core of many legislative initiatives in California. MPOs expected to manage congestion while also reducing VMT. As such, induced vehicle travel effects are an essential consideration in forecasting VMT especially when future conditions included through expansion of roadway capacity. To evaluate the model sensitivity to induced vehicle travel, both short-term and long-term effects of increased roadway capacity listed below were evaluated by comparing different combinations of roadway network and socioeconomics.

Short-term responses

1. New vehicle trips that would otherwise would not be made
2. Longer vehicle trips to more distant destinations
3. Shifts from other modes to driving
4. Shifts from one driving route to another

Longer-term responses

5. Changes in land use development patterns (these are often more dispersed, low density patterns that are auto dependent)
6. Changes in overall growth

The scenarios are listed in **Table 32**: Induced Vehicle Travel Elasticity Scenarios with a detailed calculation sheet included in **Appendix C**.

Table 32: Induced Vehicle Travel Elasticity Scenarios

Model Scenario/ Components	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Model Framework	2018 RTP/SCS	2018 RTP/SCS	2018 RTP/SCS	2040 RTP/SCS
Network	2018 RTP	2040 RTP/SCS	2018 RTP	2040 RTP/SCS
Socioeconomic	2018 RTP	2018 RTP	2040 RTP/SCS	2040 RTP/SCS
Total VMT	4,869,563	4,873,926	5,503,619	5,527,618
Total Lane-Miles	7,020	7,069	7,020	7,069
VMT Per Lane-Mile	694	690	784	782

Source: Fehr & Peers, 2020.

Short-Term Induced Vehicle Travel

Short-term induced travel is caused by the immediate change in speeds and travel when a new roadway capacity expansion project is open to traffic (i.e. a Build compared to a No Build scenario). To reflect the short-term induced vehicle travel, the base year roadway network and the future year RTP/SCS roadway network were both implemented in the model with all other factors being the same (i.e. land use, demographics, and regional travel), and the resulting VMT and elasticity of VMT to lane miles were calculated. Since the change is short-term, mandatory travel from home such as work and school related trips were held constant with the presumption that changing home, work, or school location would not occur as an immediate response to new roadway capacity. Discretionary trips such as shopping were allowed to change.

The research shows a short-term elasticity of 0.1 to 0.60.[10] As shown in **Table 33**, the VMT change is in the correct direction and on the lower end of the magnitude relative to the elasticity in the literature. This is consistent with the expected response due to the low levels of congestion in Butte County. Hence, the model output demonstrates an appropriate sensitivity to short-term induced travel.

[10] https://ww2.arb.ca.gov/sites/default/files/2020-06/Impact_of_Highway_Capacity_and_Induced_Travel_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf

Table 33: Short-Term Induced Vehicle Travel Elasticity Check

	Unconstrained	Constrained	Change
Lane Miles	7,020	7,069	0.69%
Total VMT	5,356,425	5,332,327	0.09%
Model VMT Change	4,363		
Literature VMT Change [1]	3,356 to 20,135		

Note:
1. The change in VMT is based on CARB research for short-term elasticity ranging from 0.1 to 0.6.

Source: Fehr & Peers, 2020.

Long-Term Induced Vehicle Travel

Long-term induced vehicle travel effects consider the influence on land use and growth patterns over time.. Travel models are typically used to compare a Build and No Build condition and combine the influence of land use, demographics, socioeconomic conditions, and travel. To isolate the long-term VMT changes due to increased roadway capacity, two model runs were used in comparison to the Base Year as shown in **Table 34**.

Table 34: Long-Term Induced Vehicle Travel Elasticity Check

	Scenario 1	Scenario 2	Scenario 3
Model Framework	2018 RTP/SCS	2018 RTP/SCS	2040 RTP/SCS
Network	2018 RTP	2018 RTP	2040 RTP/SCS
Socioeconomic	2018 RTP	2040 RTP/SCS	2040 RTP/SCS
Lane Miles	7,020	7,020	7,069
Total VMT	4,869,563	5,503,619	5,527,618
Model VMT Change			658,055
Model VMT Change due to Population and Employment		634,056	
Model VMT Change due to Roadway Capacity			23,999
Literature VMT Change [1]	34,565		

Note:
1. https://ww2.arb.ca.gov/sites/default/files/2020-06/Impact_of_Highway_Capacity_and_Induced_Travel_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf. The specific elasticity value used from this research policy brief is 1.03 from Table 1 Duranton and Turner (2009)..

Source: Fehr & Peers, 2020.

Scenario 3 reflects the combination of land use and transportation network capacity increases anticipated by 2040 under the RTP/SCS. This resulted in an increase in VMT compared to the base year of 658,055. To isolate the change due to land use alone, Scenario 2 was run using the RTP/SCS land use and 2040 interregional travel with the 2018 base year roadway network. This resulted in an increase in VMT of 634,056 compared to the base year. Subtracting the isolated land use change in VMT from the total VMT change for the RTP/SCS model run, the change due to long-term induced travel from network changes alone is estimated to be 23,999. This is the correct direction of change, but the estimated VMT from the isolated test is lower than the value when applying the research elasticity.

If the VMT based on the elasticity from literature were applied rather than the model, the estimated VMT would be 668,621, a value 10,566 higher than what the model produced for the change in the RTP/SCS model run.

Given the rural nature of Butte County congestion is limited and is unlikely to influence vehicle travel such that trip making would be suppressed. Without suppression, induced vehicle travel effects will be substantially dampened. In other words, trip generation in the county is not constrained and trip rates tend to represent full demand levels. . For the model to produce the much higher VMT change estimated by the research elasticity would require unrealistic trip generation rates and/or longer trip lengths. This may be an example of ecological fallacy in the application of the elasticity where an inappropriate inference is being made for a single analysis unit (i.e. Butte County) based on a much larger population representing all of the Metropolitan Statistical Areas (MSAs) in the United States from which the elasticity value was derived.

Since the change due to induced travel in the long-term is much higher than the change in the short-term and the elasticity from the published literature seems to be much higher and not representative of travel conditions in Butte County, the model appears to be appropriately sensitive to long term induced travel.

Auto Operating Cost

The recommended CARB auto operating cost (AOC) methodology changed from including only petroleum-based vehicles to all energy sources. To test model sensitivity to the changes, the auto operating cost for the original method based on petroleum-based vehicles was compared to the updated method. The published literature presents the demand for fuel or the VMT and has only the impact of gas price not total auto operating cost as used in the model to determine auto ownership, distribution, travel mode, and route choice. The literature reports a short-term elasticity of VMT change relative to fuel price of -0.24 for low income groups to -0.40 for high income groups.

Table 35 below shows the results for both the base year and the future year with a similar VMT elasticity in both magnitude and direction. The negative on the elasticity indicates the VMT changes in the opposite direction than the auto operating cost. Although the magnitude of change is less than the expected range for fuel price, the recommended CARB parameter of auto operating cost accounts for more than fuel price and the past literature based on empirical data does not account for the non-petroleum vehicles currently included in the auto operating cost. As the fuel price decreases due to more efficient vehicles, the fixed costs become a larger percentage of the auto operating cost. Since the model is not overly sensitive to auto operating cost but does show reasonable sensitivity, the model is appropriate for RTP/SCS scenarios that do not include change of fleet or fuel sources. If the scenario being evaluated changes the auto operating cost or fuel cost as a scenario specific policy, it is recommended that additional calibration be considered. As noted in the CARB technical document, these results highlight the importance of considering equity impacts in analyzing the effects of changes in gas prices (and gas taxes).

Table 35: Auto Operating Cost Elasticity Check

	2018			2040		
	Updated	Original	Change	Updated	Original	Change
AOC	21.03	23.24	-9.5%	18.46	23.19	-20.4%
Total VMT	5,006,143	5,000,560	0.11%	6,593,556	6,575,916	0.27%
Model Elasticity	-0.0117			-0.0132		
Literature Elasticity [1]	-0.24 to -0.40					

Note:
1. The CARB research for short term elasticity only accounts for the fuel cost and excludes the fixed and maintenance costs.
Source: Fehr & Peers, 2020.

Active Transportation and Transit Enhancements

Active transportation such as sidewalks and bike lanes function as a system and often provide enhanced access to transit. For this test, the unconstrained active transportation network was implemented to provide access to transit, and the transit headways were reduced by half. As shown in **Table 36**, the direction of the elasticity is consistent with empirical data such that a reduction of headway and improved access to transit has a decrease in VMT. The magnitude of the elasticity is on the lower end of the range of elasticity, which is consistent with the rural character of Butte County. Although the model is sensitive to transit enhancements and is appropriate for use on the RTP/SCS, further investigation and sub-area validation with potential calibration should be considered prior to using the model on a transit-focused project.

Table 36: Active and Transit Enhancement Elasticity Check

	Enhanced	Base	Change
Headway	0.5	1	-50.0%
Total VMT	5,498,988	5,527,717	-0.52%
Model Elasticity	0.0104		
Literature Elasticity [1]	0 to 0.19		

Note:
1. The CARB research for elasticity does not reflect the interaction between enhanced access to transit through pedestrian or bike facilities and the reduction in headway.

Source: Fehr & Peers, 2020.

Land Use Tests

The BCAG Model has been developed to be used as a tool to evaluate land use scenarios in planning efforts such as EIRs, City General Plans, and the Regional Transportation Plan. The specific dynamic validation tests completed for this model update are listed below.

- Add 1, 10, and 100 dwelling units to a TAZ
- Add 1, 10, and 100 square feet of retail to a TAZ
- Remove 1, 10, and 100 dwelling units from a TAZ
- Remove 1, 10, and 100 square feet of retail from a TAZ

The key model output variable involved in the dynamic validation tests are daily vehicle trips (VT) generated. These tests are intended to reveal whether the model output changes in the correct direction and magnitude. The dynamic validation results for the land use changes summarized in **Table 37** show that the model responds reasonably to changes in both residential and non-residential land uses. For example, when changing residential uses, the change in overall model vehicle trip generation is stable across the entire range and produces results that are reasonable (i.e., 9.0 to 9.3 vehicle trips per household). In addition, the change in trip generation at the TAZ level is as expected with the increase/decrease corresponding to the change in households. The magnitude of vehicle trip generation at the TAZ level is reasonable given the socioeconomic characteristics of the test area located in Chico.

Table 37: Land Use Sensitivity Check

Land Use Change	Unit Change	VT Change	VT Change/Unit Change
Residential (DUs)	+1	9.30	9.30
	+10	90.80	9.08
	+100	909.30	9.09
	-1	-9.00	-9.00
	-10	-90.60	-9.06
	-100	-913.60	-9.14
Retail Space (KSF)	+1	12.11	12.11
	+10	121.00	12.10
	+100	1,208.67	12.09
	-1	-12.43	-12.43
	-10	-123.29	-12.33
	-100	-1,238.73	-12.39

Source: Fehr & Peers, 2020.

Parking Pricing

Parking pricing is a local policy that has proven beneficial in reducing auto travel and overall VMT. To evaluate the model sensitivity to changes in parking cost, the parking cost was increased by 20% at locations that currently have paid parking. As shown in **Table 38**, the direction of the elasticity is consistent with empirical data such that an increase in parking costs result in a reduction of VMT. The magnitude of change in regional VMT is much lower than the literature primarily due to the relatively small area covered by parking fees and the rural character of Butte County. Although the model is not overly sensitive to parking pricing and is appropriate for the RTP/SCS purposes, it is recommended that sub-area validation and investigation of specific zones and trips associated with parking areas be investigated before using the model for a parking specific study.

Table 38: Parking Pricing Elasticity Check

	TDM Parking Fee	Base	Change
Parking Price	1.2	1	20.0%
Total w\o XX	5,489,651	5,498,988	-0.17%
Model Elasticity	-0.0085		
Literature Elasticity	Average of -0.3		

Source: Fehr & Peers, 2020.

5 Future Year Model

This section describes the future year model data that were developed, with the following section combining the input data into scenarios for the 2020 RTP/SCS. The inputs that were developed for the future year model include the land use, transportation system, and interregional travel.

Future Land Use

Once the base year model calibration and validation was complete, Fehr & Peers received TAZ growth projections provided by BCAG staff and developed one future year (2040) and three interim (2020, 2030, and 2035) model scenarios. **Table 39** reports the land use totals for the base year, interim years, and future year, along with the growth projections. Note that due to the Camp Fire the land use development decreases from 2018 to 2020 and then increases into the future.

Table 39: Model Land Use Totals by Scenario Year

Land Use Type	Units	2018	2020	2030	2035	2040
Population	People	222,378	223,157	242,293	251,863	259,524
Single Family Residential	DU	55,279	48,635	60,278	64,200	65,980
Multi-Family Residential	DU	23,864	22,656	26,161	27,925	29,496
Mobile Home Residential	DU	11,819	9,552	12,058	11,420	11,694
Retail	KSF	11,949	11,772	11,272	13,012	13,729
Regional Retail	KSF	895	925	895	934	975
Industrial	KSF	12,367	14,297	13,430	13,631	14,014
Office	KSF	7,014	7,143	6,929	7,748	7,880
Medical Office	KSF	2,229	2,216	2,149	2,425	2,459
Public	KSF	2,311	2,246	2,439	2,598	2,710
Hospitals (HOSP_KSF)	KSF	1,159	966	1,049	1,272	1,320
Hotels (HOTEL_RMS)	Rooms	2,095	2,188	2,376	2,450	2,450
Park (PARK_AC)	Acres	476	491	533	554	556
Casino (CASINO_SLT)	Slots	2,000	2,000	2,172	2,257	2,326
University (UNIV_STU)	Students	16,500	16,578	18,000	18,710	19,279
Butte College (CC_STU)	Students	12,950	13,011	14,127	14,685	15,129
Schools (K12_STU)	Students	29,852	29,048	32,132	32,482	32,550

Source: BCAG, 2020 RTP/SCS Land Use Forecast.

Future Transportation System

The master network contains the planned and programmed transportation improvements for roadway and bike/pedestrian facilities with attributes related to the number of lanes, facility type, and type of travel allowed to use the facility along with the year the facility is open to traffic. The TAZ file contains the future transit accessibility and headway representing the simplified transit approach described previously. The list of planned and programmed projects can be found in **Appendix D**. It should be noted that this is not a complete listing of projects included in the 2020 RTP/SCS, rather, only projects which include changes to roadway capacity, effect the volume of the roadways, relate to bike/pedestrian facilities, or transit system characteristics.

Future Interregional Travel

For the future year, the production and attraction ratio for some purposes was not within the 10% guideline. After the Camp Fire, land use development was concentrated in existing jurisdictions while Paradise recovered. This caused a change to interregional travel that was not reflected in the base year data, so the interregional trip percentages were modified to reflect a better balance of trips staying within Butte County. This was especially true for work and shopping trips in 2020 and non-home based trips in the future scenarios. The adjusted interregional trip percentages used are the same for the future scenarios.

6 Alternatives Analysis

This section contains a quantification of strategies related to reducing Vehicle Miles Traveled (VMT) including transportation demand management (TDM) and pricing for the scenarios evaluated as part of the air quality conformity and RTP/SCS. This information can be used to evaluate related greenhouse gas (GHG) reductions, the air quality conformity determination, and the RTP/SCS EIR. A summary of the model results can be found in **Appendix E**.

Scenario Definition

The scenarios quantified and reported in this memo are described below.

- *2018 Base:* the base year land use and transportation system for the model used for validation against 2018 counts (pre-Camp Fire) and travel behavior based on 2012 California Household Travel Survey (CHTS)
- *2020 Base:* year 2020 forecast (post-Camp Fire) based on the 2020 RTP land use with 2020 RTP planned and programed transportation projects
- *2030 Base:* year 2030 forecast based on the 2020 RTP land use with2020 RTP planned and programed transportation projects
- *2035 Base:* year 2035 forecast based on the 2020 RTP land use with 2020 RTP planned and programed transportation projects
- *2040 Project:* year 2040 forecast based on the 2020 RTP land use with 2020 RTP planned and programed transportation projects
- *2040 No Project:* year 2040 forecast based on the adopted 2016 RTP land use with 2016 adopted transportation projects
- *2040 Unconstrained:* year 2040 forecast based on the 2020 RTP land use with the 2020 RTP planned and programed transportation projects including those that were unfunded.
- *2040 Environmentally Superior:* year 2040 forecast based on the 2020 RTP land use with all active planned and programed transportation projects and transit headways at half of Project headway (with a minimum of 15 minutes)
- *2040 Environmentally Superior with TDM:* year 2040 forecast based on the 2020 RTP land use with all active planned and programed transportation projects, transit headways at half of Project headway (with a minimum of 15 minutes), and parking costs 20% higher than existing (in areas with existing paid parking)

Land Use Summary

After the 2018 Base Year, the Camp Fire destroyed much of Paradise and displaced residents and employment. As a result, the 2020 land use has a much higher occupancy rate than 2018 and is more distributed within existing communities. After 2020, rebuilding in Paradise is forecast to proceed at a high rate, with a majority being single-family residential dwelling units (DUs). Due to the immediate housing need, the rebuilding is expected to be at a high rate until 2035 and then slow down slightly between 2035 and 2040. The summary of land use for each of the 2020 RTP scenarios is shown in **Table 39**.

VMT Summary

After implementing the model scenarios with the transportation and land use development, the VMT and VMT per capita ratio were calculated. **Table 40** summarizes the VMT traveling completely within Butte County (VMT w/o XX), VMT associated with trips traveling through Butte County (XX VMT), percentage of VMT traveling through Butte County (% of XX trips), total VMT on roadways within Butte County (Total with XX), total population for the scenario, and VMT related to trips completely within Butte County per capita. The VMT per Capita is a proxy for the SB 375 metric of GHG based on VMT within Butte County which was used in the target setting. The VMT per capita decreases from 2018 to 2020 due to the higher occupancy and density of development without having a substantial amount of development in Paradise. As Paradise recovers, the VMT per capita increases with the 2040 scenario being slightly lower than the 2018 base year. The 2040 No Project has a much higher population since the forecast was pre-Camp Fire and had more of the development in Paradise than the 2020 RTP, resulting in a higher total VMT but a slightly lower VMT per Capita. The No Project being higher in total VMT and lower in VMT per capita is reasonable given higher density of the No Project being forecast before the Camp Fire. Both Environmentally Superior scenarios result in similar VMT and VMT per capita due to the minimal locations that have parking pricing, the only difference between the scenarios. The highest VMT per capita of the 2040 scenarios is the Unconstrained scenario, which is expected due to its increased focus on auto travel and expanded roadway infrastructure projects.

The VMT by speed bin used for GHG and air quality conformity can be found in **Appendix E**.

Table 40: VMT Summary for 2020 RTP Scenarios

Scenario	VMT (w/o X-X VMT)	XX VMT	IX-XI VMT	Total VMT	% of X-X VMT	% IX-XI VMT	Population	VMT per Capita
2018 Base	4,705,417	164,146	700,748	4,869,563	3.4%	14.39%	222,378	21.2
2020 Base	4,343,919	164,153	697,312	4,508,072	3.6%	15.47%	223,157	19.5
2030 Base	4,883,463	169,430	445,363	5,052,893	3.4%	8.81%	242,293	20.2
2035 Base	5,181,813	181,958	485,998	5,363,771	3.4%	9.06%	251,863	20.6
2040 Project	5,332,327	195,390	504,900	5,527,717	3.5%	9.13%	259,524	20.5
2040 No Project	6,216,655	195,396	559,905	6,412,051	3.0%	8.73%	319,342	19.5
2040 Unconstrained	5,356,425	195,390	507,274	5,551,815	3.5%	9.14%	259,524	20.6
2040 Environmentally Superior	5,303,598	195,390	504,900	5,498,988	3.6%	9.18%	259,524	20.4
2040 Environmentally Superior (with TDM)	5,294,261	195,390	504,633	5,489,651	3.6%	9.19%	259,524	20.4

Source: Fehr & Peers, 2020.

Highway and Freeway Congestion

The revised State Transportation Improvement Program (STIP) guidelines for evaluating congestion are based on highways and freeways operating at or below 35 mph during the AM or PM peak periods. Congestion will be used for the RTP/SCS EIR for each of the scenarios. Based on the travel model for each of the scenarios, there are no scenarios that have highways or freeways at or below 35 mph during the AM or PM peak periods.

7 Model Use

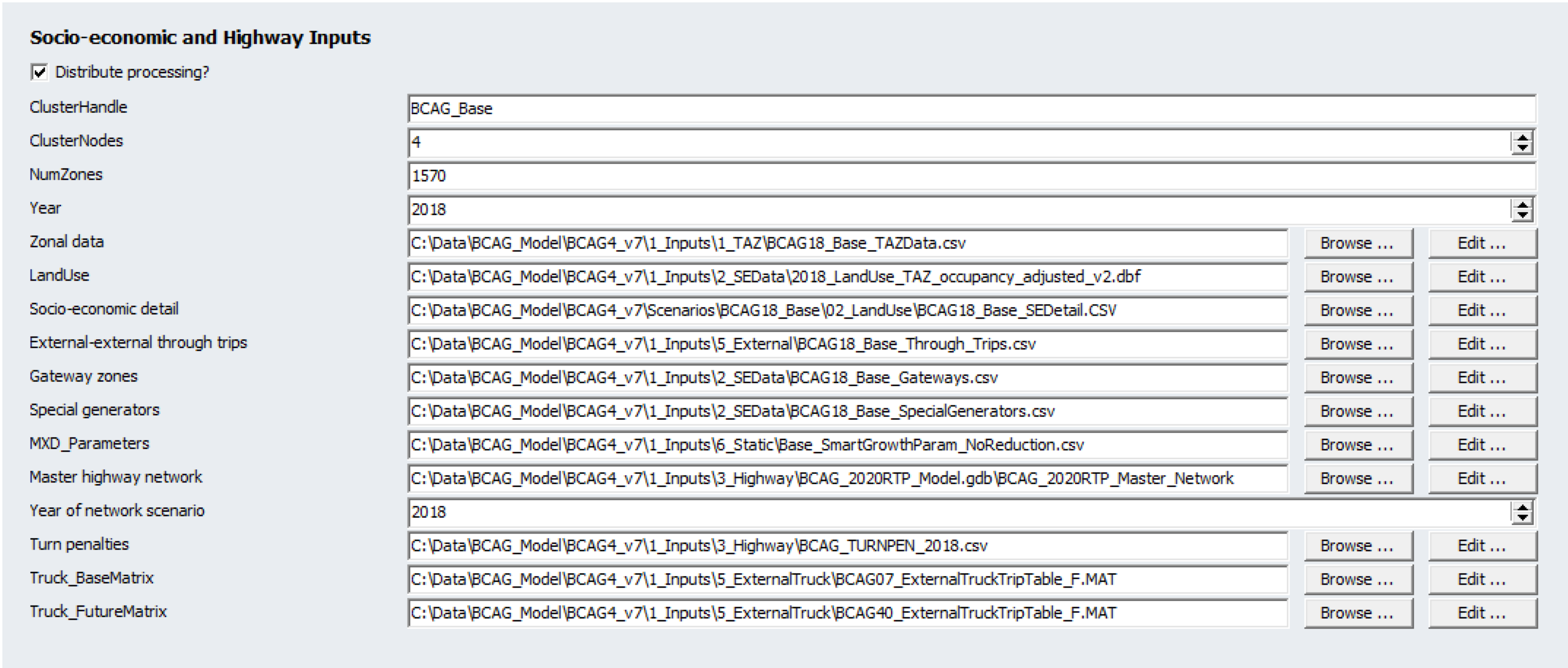
This section shows the user interface and describes the key inputs for applying the model for project application. **Appendix F** contains the metadata for the key inputs. The Model User Guide contains more detailed information on how to use the model.

Model Interface and Key Inputs

The screen capture on the following page shows the base 2018 scenario manager in the Cube Application Manager. The primary inputes are all located on this screen and should be evaluated prior to running a new scenario.

The inputs for the screen capture are shown below, with bold indicating the values that are most often updated with every scenario.

- Distributed processing, ClusterHandle, and ClusterNodes are used for running the model with Cube Voyager on multiple cores. It is recommended that this not be modified unless the machine running the model has fewer than four cores.
- Number of zones in general should not be modified unless the model is expanded in the future.
- **Year** refers to the time that the land use, interregional travel, and overall activity occur.
- **Land Use** data is the control total by zone in terms of occupied residential and occupied non-residential units.
- **Zonal data** contain the cross-classified residential factors, interregional travel percentages by purpose, simplified transit headways, parking fees, and other TAZ level information.
- **Socio-economic data** is an intermediate file that is output by combining the cross-classified demographics and the land use control totals.
- **External through trips** are personal vehicles traveling through the model area.
- Gateway zones are the productions and attractions by purpose used to balance with internal trips.
- **Special generators** are trips by purpose that cannot be accurately reflected by multiplying the trip generation and the land use. Note that special generators are additive to the land use generated trips.
- MXD parameters contain the built environment parameters to reflect the "Ds." In general, this should not be modified except for special land use types the model may not be able to capture, and for which a special generator is not possible.
- Master network refers to the geodatabase transportation network that contains base and future projects.
- **Year of network scenario** reflects the year that transportation projects are open to traffic. This can be different than the land use and interregional travel.
- Turn penalties are usually prohibitions for turning by time of day.
- Truck Base and Future are derived from the CSFFM and are interpolated based on Year.



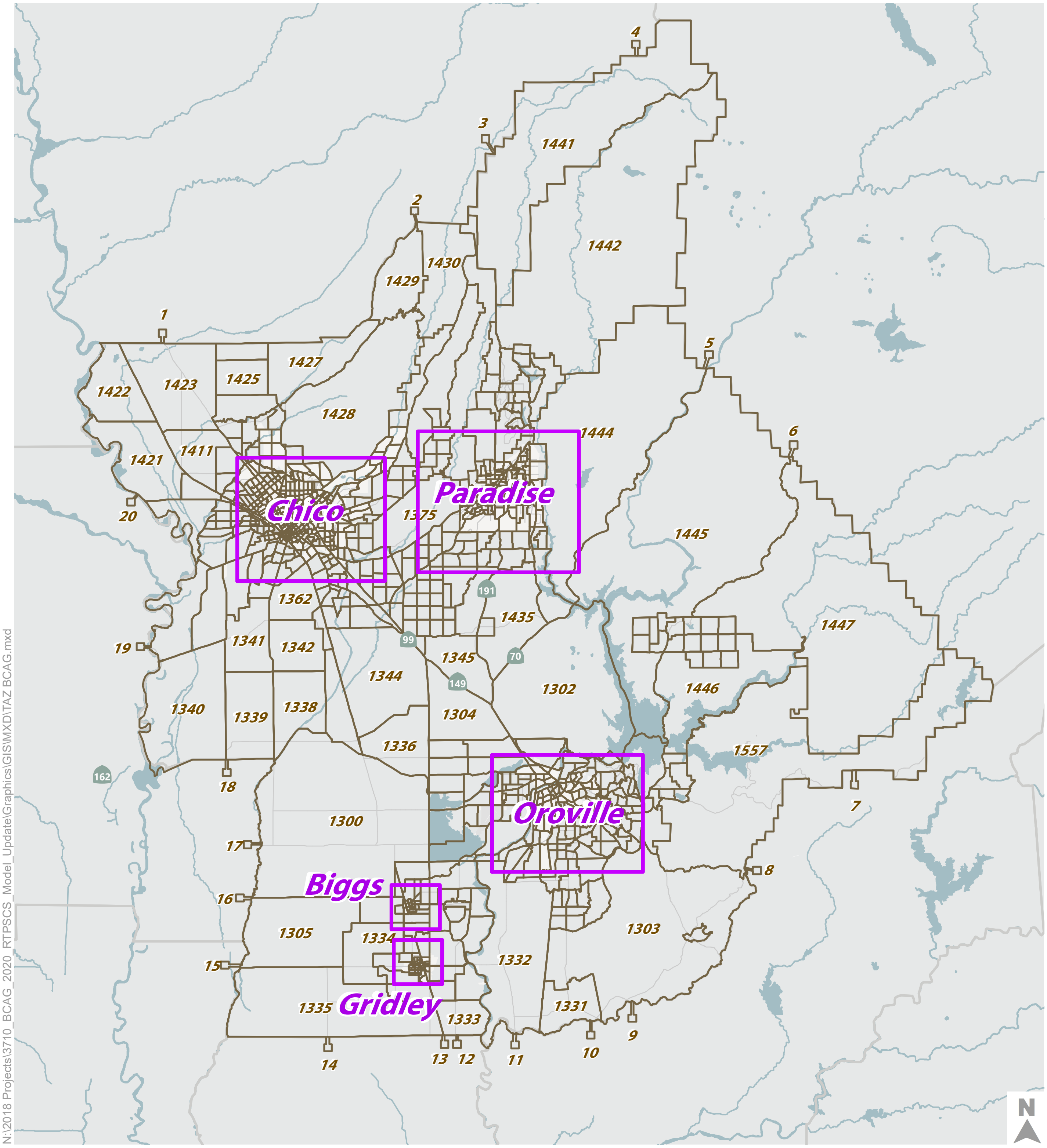
Socio-economic and Highway Inputs

☑ Distribute processing?

ClusterHandle	BCAG_Base		
ClusterNodes	4		
NumZones	1570		
Year	2018		
Zonal data	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\1_TAZ\BCAG18_Base_TAZData.csv	Browse ...	Edit ...
LandUse	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\2_SEData\2018_LandUse_TAZ_occupancy_adjusted_v2.dbf	Browse ...	Edit ...
Socio-economic detail	C:\Data\BCAG_Model\BCAG4_v7\Scenarios\BCAG18_Base\02_LandUse\BCAG18_Base_SEDetail.CSV	Browse ...	Edit ...
External-external through trips	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\5_External\BCAG18_Base_Through_Trips.csv	Browse ...	Edit ...
Gateway zones	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\2_SEData\BCAG18_Base_Gateways.csv	Browse ...	Edit ...
Special generators	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\2_SEData\BCAG18_Base_SpecialGenerators.csv	Browse ...	Edit ...
MXD_Parameters	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\6_Static\Base_SmartGrowthParam_NoReduction.csv	Browse ...	Edit ...
Master highway network	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\3_Highway\BCAG_2020RTP_Model.gdb\BCAG_2020RTP_Master_Network	Browse ...	Edit ...
Year of network scenario	2018		
Turn penalties	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\3_Highway\BCAG_TURNPEN_2018.csv	Browse ...	Edit ...
Truck_BaseMatrix	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\5_ExternalTruck\BCAG07_ExternalTruckTripTable_F.MAT	Browse ...	Edit ...
Truck_FutureMatrix	C:\Data\BCAG_Model\BCAG4_v7\1_Inputs\5_ExternalTruck\BCAG40_ExternalTruckTripTable_F.MAT	Browse ...	Edit ...

The Browse boxes are used to search for the input file and the Edit boxes are used to edit the file within Cube.

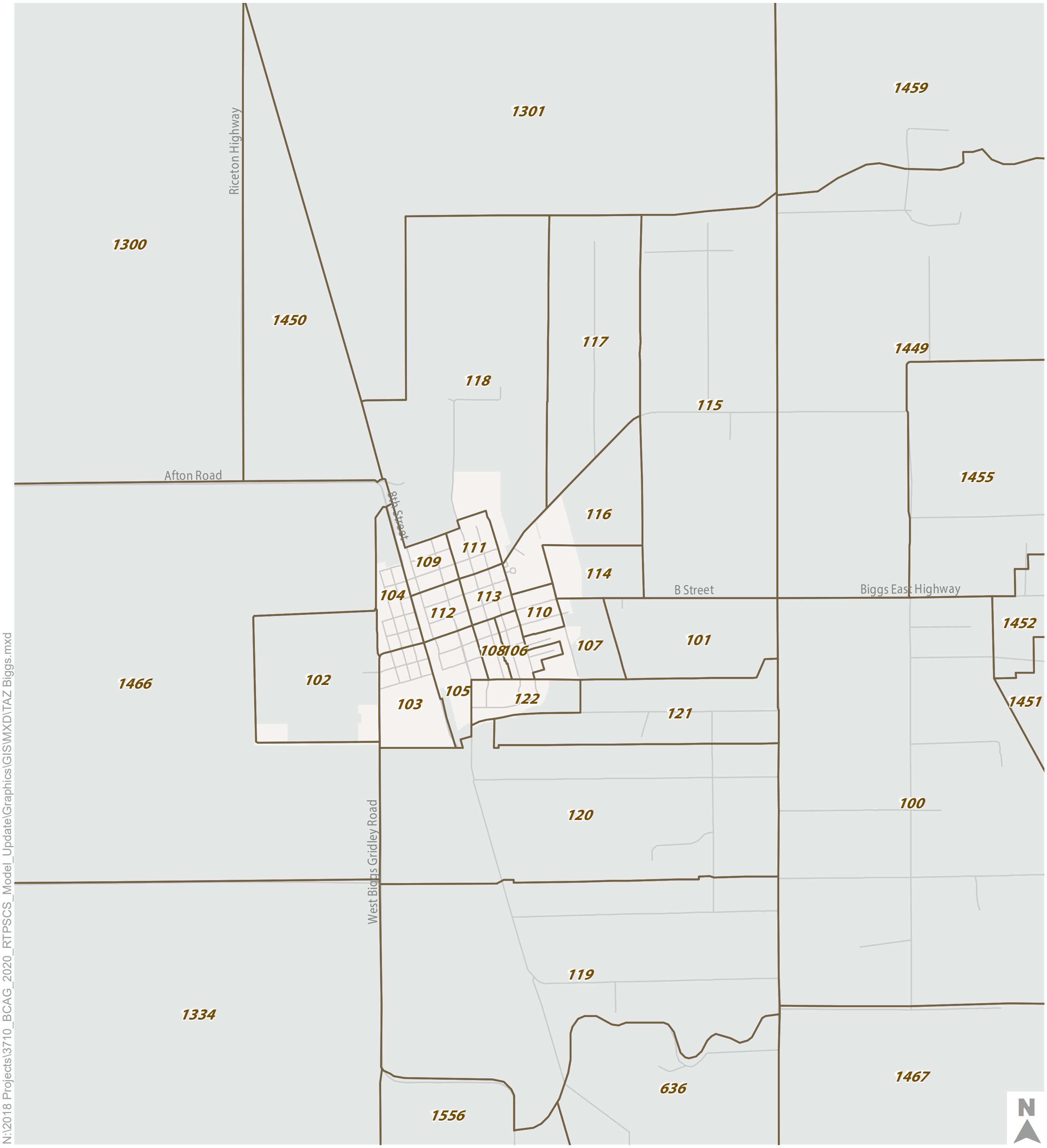
Appendix A:
TAZ Maps



Traffic Analysis Zone Boundaries

City Limits

BCAG Model Update - Traffic Analysis Zone Boundaries

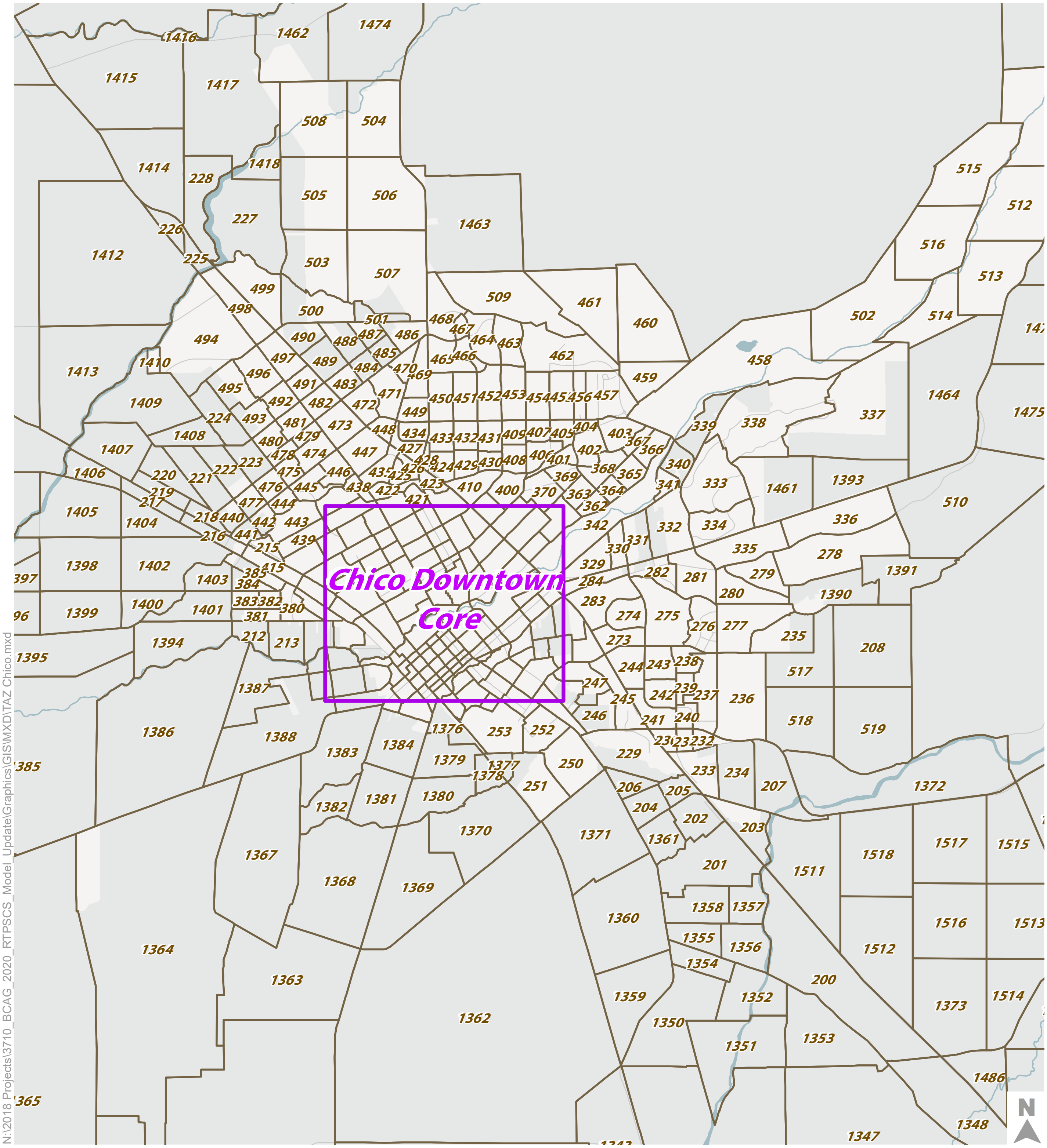


N:\2018 Projects\3710_BCAG_2020_RTPSCS_Model_Update\Graphics\GIS\MXD\TAZ Biggs.mxd

Traffic Analysis Zone Boundaries

City Limits

BCAG Model Update - Biggs TAZ Boundaries



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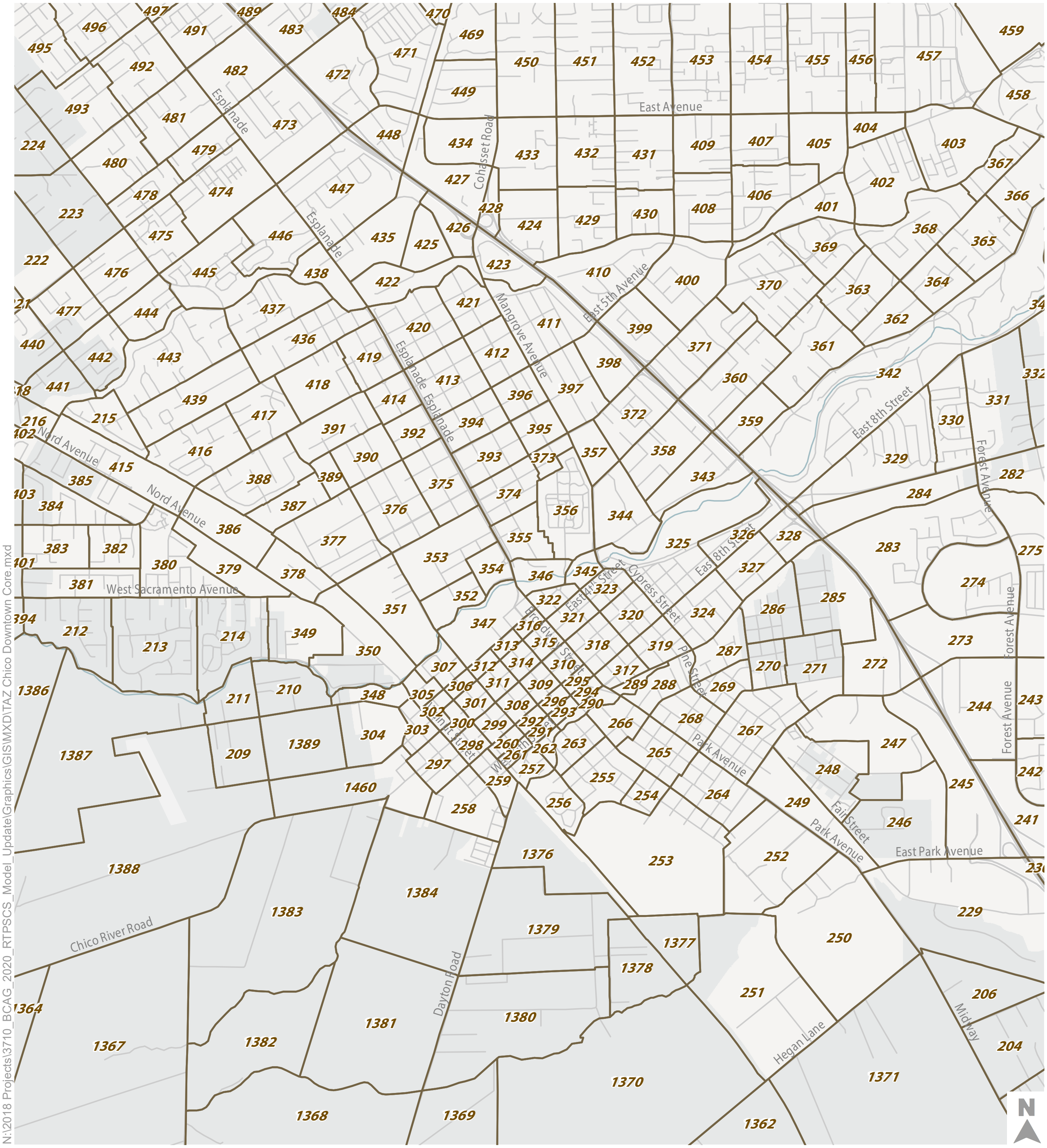
Traffic Analysis Zone Boundaries

City Limits

BCAG Model Update - Chico TAZ Boundaries



Traffic Analysis Zone Boundaries

City Limits

BCAG Model Update - Chico Downtown Core TAZ Boundaries

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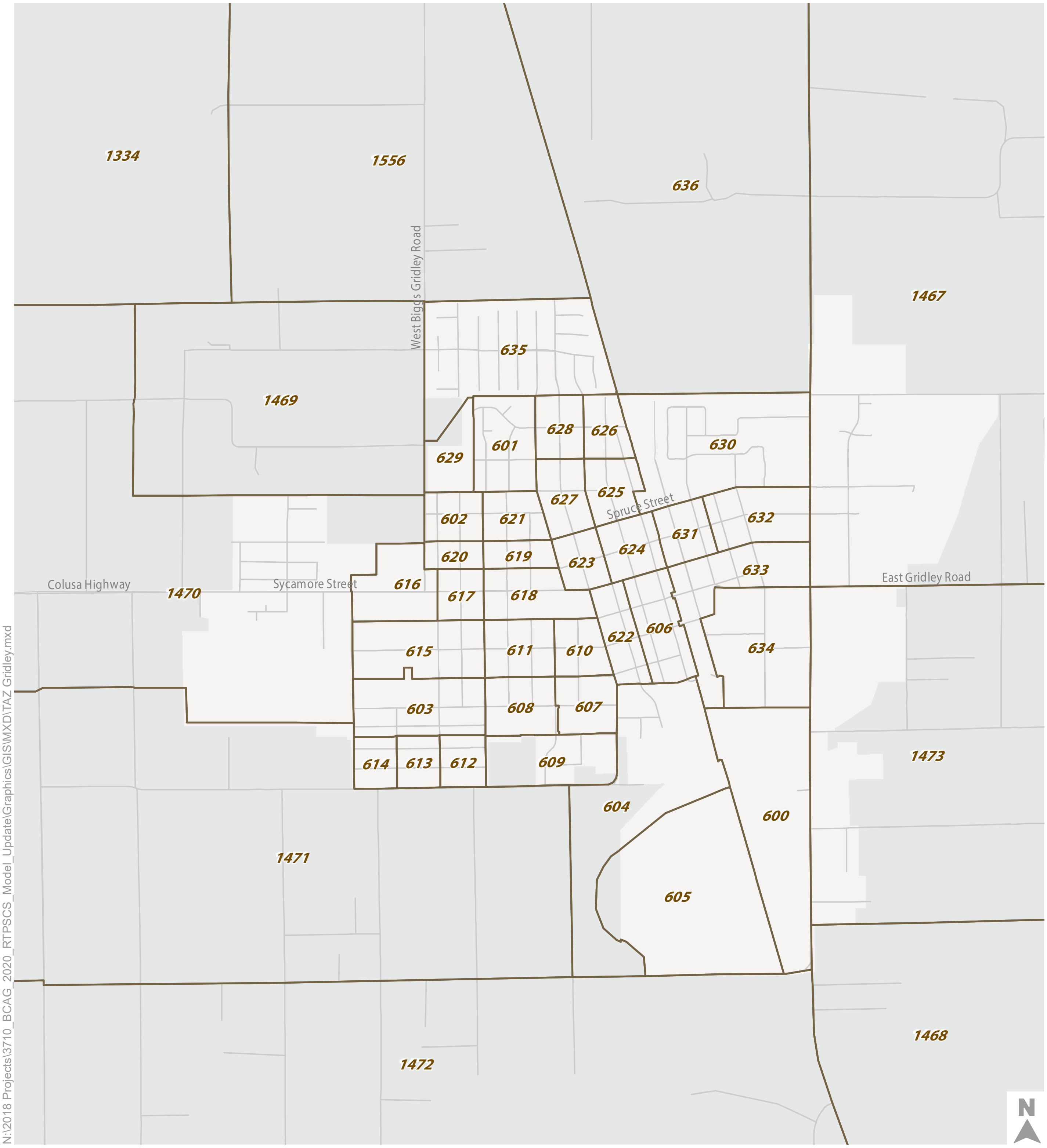
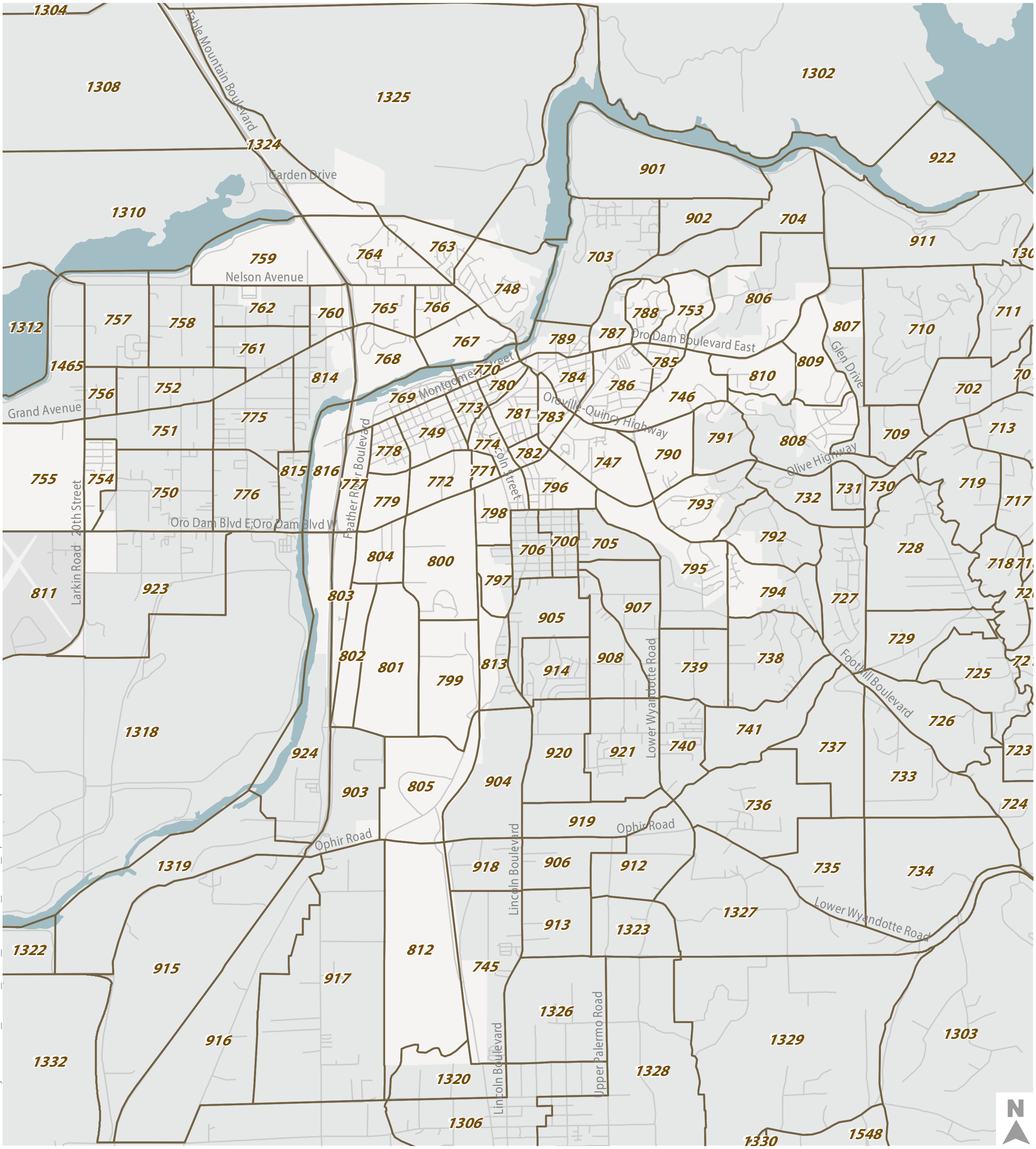


N:\2018 Projects\3710_BCAG_2020_RTPSCS_Model_Update\Graphics\GIS\MXD\TAZ Gridley.mxd

Traffic Analysis Zone Boundaries

City Limits

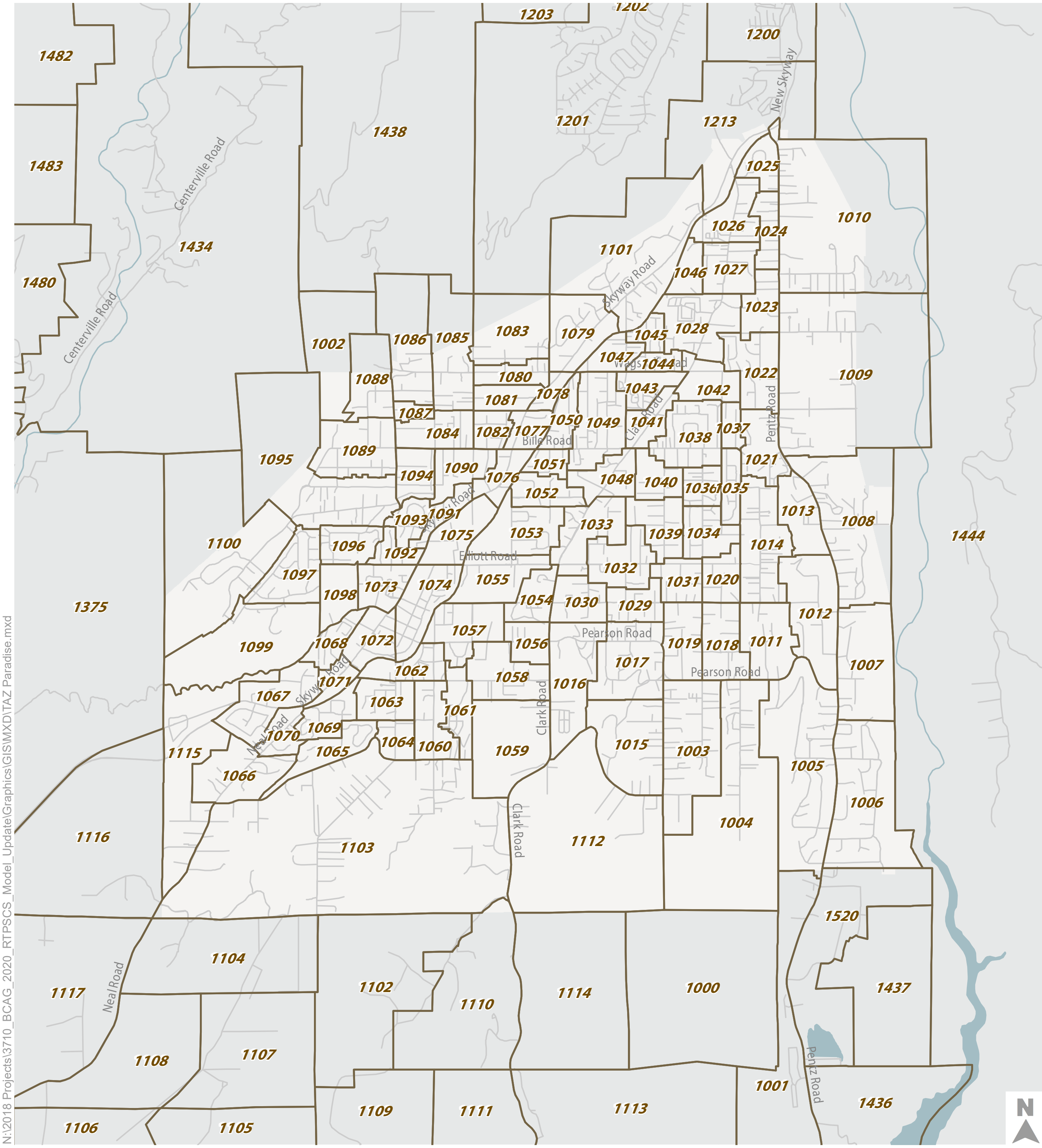
BCAG Model Update - Gridley TAZ Boundaries



Traffic Analysis Zone Boundaries

City Limits

BCAG Model Update - Oroville TAZ Boundaries



N:\2018 Projects\3710_BCAG_2020_RTPSCS_Model_Update\Graphics\GIS\MXD\TAZ Paradise.mxd

Traffic Analysis Zone Boundaries

City Limits

BCAG Model Update - Paradise TAZ Boundaries

Appendix B:
California Household Travel Survey Data

This appendix contains metadata and data from the CHTS that were used for overall comparisons and validation for the 2018 BCAG TDF Model.

CHTS Detailed Summaries

The tables below contain the metadata for the results of the CHTS processing. The raw summary files are included with the model files and the data used for validation are summarized in the 2018 BCAG Model Validation spreadsheet. Since the model was validated to the county level data, the warning levels are provided for the potential use at a more detailed level.

Table 1: Daily Trip Mode Shares – Metadata

Label	Field Type	Description	Notes
Geography Name	Text	Name of geographic unit whose residents are being summarized	
Geography Type	Text	Type of geography: state, region, county, or city	
Total Trips (all purposes)	Numeric	Total number of person-trips in this geography.	
Sample Trips (all purposes)	Numeric	Number of person-trips surveyed by CHTS in this geography	
Warning Level (all purposes)	Numeric (0, 1, 2)	Warning level 0: All-purpose mode shares can be used with confidence. Warning level 1: All-purpose mode shares should be used with caution and cross-referenced with other sources. Warning level 2: All-purpose mode shares should not be used alone, but can be aggregated with other geographies of the same type to achieve a larger sample size.	Warning level 0: Over 100 trips; warning level 1: 51-100 trips; warning level 2: 50 or fewer trips.
Drive-alone mode share (all trips)	Percentage	Percentage of drive-alone trips among all trips within the geography.	
Shared Ride 2 mode share (all trips)	Percentage	Percentage of 2-person carpool trips among all trips within the geography.	
Shared Ride 3+ mode share (all trips)	Percentage	Percentage of 3-or-more person carpool trips among all trips within the geography.	
Transit mode share (all trips)	Percentage	Percentage of transit trips among all trips within the geography.	
Bike mode share (all trips)	Percentage	Percentage of bike trips among all trips within the geography.	
Walk mode share (all trips)	Percentage	Percentage of walk trips among all trips within the geography.	
Other mode share (all trips)	Percentage	Percentage of other mode trips among all trips within the geography.	

Table 1: Daily Trip Mode Shares – Metadata			
Label	**Field Type**	**Description**	**Notes**
Total Trips (HBO trips)	Numeric	Total number of HBO person-trips in this geography.	
Sample Trips (HBO trips)	Numeric	Number of HBO person-trips surveyed by CHTS in this geography	
Warning Level (HBO trips)	Numeric (0, 1, 2)	Warning level 0: HBO mode shares can be used with confidence. Warning level 1: HBO mode shares should be used with caution and cross-referenced with other sources. Warning level 2: HBO mode shares should not be used alone, but can be aggregated with other geographies of the same type to achieve a larger sample size.	Warning level 0: Over 100 trips; warning level 1: 51-100 trips; warning level 2: 50 or fewer trips.
Drive-alone mode share (HBO)	Percentage	Percentage of drive-alone trips among HBO trips within the geography.	
Shared Ride 2 mode share (HBO)	Percentage	Percentage of 2-person carpool trips among HBO trips within the geography.	
Shared Ride 3+ mode share (HBO)	Percentage	Percentage of 3-or-more person carpool trips among HBO trips within the geography.	
Transit mode share (HBO)	Percentage	Percentage of transit trips among HBO trips within the geography.	
Bike mode share (HBO)	Percentage	Percentage of bike trips among HBO trips within the geography.	
Walk mode share (HBO)	Percentage	Percentage of walk trips among HBO trips within the geography.	
Other mode share (HBO)	Percentage	Percentage of other mode trips among HBO trips within the geography.	Other modes include school bus, taxi, private shuttles, etc.
Total Trips (HBW trips)	Numeric	Total number of HBW person-trips in this geography.	
Sample Trips (HBW trips)	Numeric	Number of HBW person-trips surveyed by CHTS in this geography	
Warning Level (HBW trips)	Numeric (0, 1, 2)	Warning level 0: HBW mode shares can be used with confidence. Warning level 1: HBW mode shares should be used with caution and cross-referenced with other sources. Warning level 2: HBW mode shares should not be used alone, but can be aggregated with other geographies of the same type to achieve a larger sample size.	Warning level 0: Over 100 trips; warning level 1: 51-100 trips; warning level 2: 50 or fewer trips.
Drive-alone mode share (HBW)	Percentage	Percentage of drive-alone trips among HBW trips within the geography.	
Shared Ride 2 mode share (HBW)	Percentage	Percentage of 2-person carpool trips among HBW trips within the geography.	

Table 1: Daily Trip Mode Shares – Metadata			
Label	**Field Type**	**Description**	**Notes**
Shared Ride 3+ mode share (HBW)	Percentage	Percentage of 3-or-more person carpool trips among HBW trips within the geography.	
Transit mode share (HBW)	Percentage	Percentage of transit trips among HBW trips within the geography.	
Bike mode share (HBW)	Percentage	Percentage of bike trips among HBW trips within the geography.	
Walk mode share (HBW)	Percentage	Percentage of walk trips among HBW trips within the geography.	
Other mode share (HBW)	Percentage	Percentage of other mode trips among HBW trips within the geography.	Other modes include school bus, taxi, private shuttles, etc.
Total Trips (NHB trips)	Numeric	Total number of NHB person-trips in this geography.	
Sample Trips (NHB trips)	Numeric	Number of NHB person-trips surveyed by CHTS in this geography	
Warning Level (NHB trips)	Numeric (0, 1, 2)	Warning level 0: HBO mode shares can be used with confidence. Warning level 1: HBO mode shares should be used with caution and cross-referenced with other sources. Warning level 2: HBO mode shares should not be used alone, but can be aggregated with other geographies of the same type to achieve a larger sample size.	Warning level 0: Over 100 trips; warning level 1: 51-100 trips; warning level 2: 50 or fewer trips.
Drive-alone mode share (NHB)	Percentage	Percentage of drive-alone trips among NHB trips within the geography.	
Shared Ride 2 mode share (NHB)	Percentage	Percentage of 2-person carpool trips among NHB trips within the geography.	
Shared Ride 3+ mode share (NHB)	Percentage	Percentage of 3-or-more person carpool trips among NHB trips within the geography.	
Transit mode share (NHB)	Percentage	Percentage of transit trips among NHB trips within the geography.	
Bike mode share (NHB)	Percentage	Percentage of bike trips among NHB trips within the geography.	
Walk mode share (NHB)	Percentage	Percentage of walk trips among NHB trips within the geography.	
Other mode share (NHB)	Percentage	Percentage of other mode trips among NHB trips within the geography.	Other modes include school bus, taxi, private shuttles, etc.

Table 2: Daily Vehicle Trip Metrics per Household – Metadata			
Label	**Field Type**	**Description**	**Notes**
Geography Name	Text	Name of geographic unit whose residents are being summarized	
Geography Type	Text	Type of geography: state, region, county, or city	
Total Households	Numeric	Total number of households in this geography	CHTS is weighted at county level to match household totals from 2012 5-year ACS. For city geography, this total reflects the CHTS city households, weighted and expanded.
Sample Households	Numeric	Number of households surveyed by CHTS in this geography	
Warning Level	Numeric (0, 1, 2)	Warning level 0: Household metrics can be used with confidence. Warning level 1: Household metrics should be used with caution and cross-referenced with other sources. Warning level 2: Household metrics should not be used alone, but can be aggregated with other geographies of the same type to achieve a larger sample size.	Warning level 0: Over 100 households; warning level 1: 51-100 households; warning level 2: 50 or fewer households.
VMT per Household, total	Numeric	Vehicle Miles Travelled generated per household, all trip purposes.	
VMT per Household, HBO	Numeric	Vehicle Miles Travelled generated per household, Home-Based Other trips only.	
VMT per Household, HBW	Numeric	Vehicle Miles Travelled generated per household, Home-Based Work trips only.	
VMT per Household, NHB	Numeric	Vehicle Miles Travelled generated per household, Non-Home-Based trips only.	
Vehicle Trips per Household, Total	Numeric	Vehicle Trips generated per household, all trip purposes.	
Vehicle Trips per Household, Total	Numeric	Vehicle Trips generated per household, Home-Based Other trips only.	
Vehicle Trips per Household, Total	Numeric	Vehicle Trips generated per household, Home-Based Work trips only.	
Vehicle Trips per Household, Total	Numeric	Vehicle Trips generated per household, Non-Home-Based trips only.	
Vehicle Trip Length, Total	Numeric	Average Vehicle Trip distance, all trip purposes.	Calculation: Total VMT per HH / Total VT per HH
Vehicle Trip Length, HBO	Numeric	Average Vehicle Trip distance, Home-Based Other trips only.	Calculation: HBO VMT per HH / HBO VT per HH
Vehicle Trip Length, HBW	Numeric	Average Vehicle Trip distance, Home-Based Work trips only.	Calculation: HBW VMT per HH / HBW VT per HH
Vehicle Trip Length, NHB	Numeric	Average Vehicle Trip distance, Non-Home-Based trips only.	Calculation: NHB VMT per HH / NHB VT per HH

Table 3: Daily Vehicle Trip Metrics per Capita – Metadata			
Label	**Field Type**	**Description**	**Notes**
Geography Name	Text	Name of geographic unit whose residents are being summarized	
Geography Type	Text	Type of geography: state, region, county, or city	
Total Persons	Numeric	Total number of persons living in capitas in this geography	Persons not living in capitas (e.g., persons living in group quarters such as university dorms) are not included in this total. CHTS is weighted by capitas at county level to match capita totals from 2012 5-year ACS. For city geography, this total reflects the CHTS city persons, weighted and expanded.
Sample Persons	Numeric	Number of persons in CHTS-surveyed capitas in this geography	
Warning Level	Numeric (0, 1, 2)	Warning level 0: Capita metrics can be used with confidence. Warning level 1: Capita metrics should be used with caution and cross-referenced with other sources. Warning level 2: Capita metrics should not be used alone, but can be aggregated with other geographies of the same type to achieve a larger sample size.	Warning level 0: Over 100 persons; warning level 1: 51-100 persons; warning level 2: 50 or fewer persons.
VMT per Capita, total	Numeric	Vehicle Miles Travelled generated per capita, all trip purposes.	
VMT per Capita, HBO	Numeric	Vehicle Miles Travelled generated per capita, Home-Based Other trips only.	
VMT per Capita, HBW	Numeric	Vehicle Miles Travelled generated per capita, Home-Based Work trips only.	
VMT per Capita, NHB	Numeric	Vehicle Miles Travelled generated per capita, Non-Home-Based trips only.	
Vehicle Trips per Capita, Total	Numeric	Vehicle Trips generated per capita, all trip purposes.	
Vehicle Trips per Capita, Total	Numeric	Vehicle Trips generated per capita, Home-Based Other trips only.	
Vehicle Trips per Capita, Total	Numeric	Vehicle Trips generated per capita, Home-Based Work trips only.	
Vehicle Trips per Capita, Total	Numeric	Vehicle Trips generated per capita, Non-Home-Based trips only.	
Vehicle Trip Length, Total	Numeric	Average Vehicle Trip distance, all trip purposes.	Calculation: Total VMT per capita / Total VT per capita
Vehicle Trip Length, HBO	Numeric	Average Vehicle Trip distance, Home-Based Other trips only.	Calculation: HBO VMT per capita / HBO VT per capita

Table 3: Daily Vehicle Trip Metrics per Capita – Metadata			
Label	**Field Type**	**Description**	**Notes**
Vehicle Trip Length, HBW	Numeric	Average Vehicle Trip distance, Home-Based Work trips only.	Calculation: HBW VMT per capita / HBW VT per capita
Vehicle Trip Length, NHB	Numeric	Average Vehicle Trip distance, Non-Home-Based trips only.	Calculation: NHB VMT per capita / NHB VT per capita

Table 4: Daily Person Trip Metrics per Household – Metadata			
Label	**Field Type**	**Description**	**Notes**
Geography Name	Text	Name of geographic unit whose residents are being summarized	
Geography Type	Text	Type of geography: state, region, county, or city	
Total Households	Numeric	Total number of households in this geography	CHTS is weighted at county level to match household totals from 2012 5-year ACS. For city geography, this total reflects the CHTS city households, weighted and expanded.
Sample Households	Numeric	Number of households surveyed by CHTS in this geography	
Warning Level	Numeric (0, 1, 2)	Warning level 0: Household metrics can be used with confidence. Warning level 1: Household metrics should be used with caution and cross-referenced with other sources. Warning level 2: Household metrics should not be used alone, but can be aggregated with other geographies of the same type to achieve a larger sample size.	Warning level 0: Over 100 households; warning level 1: 51-100 households; warning level 2: 50 or fewer households.
PMT per Household, total	Numeric	Person Miles Travelled generated per household, all trip purposes.	
PMT per Household, HBO	Numeric	Person Miles Travelled generated per household, Home-Based Other trips only.	
PMT per Household, HBW	Numeric	Person Miles Travelled generated per household, Home-Based Work trips only.	
PMT per Household, NHB	Numeric	Person Miles Travelled generated per household, Non-Home-Based trips only.	
Person Trips per Household, Total	Numeric	Person Trips generated per household, all trip purposes.	
Person Trips per Household, Total	Numeric	Person Trips generated per household, Home-Based Other trips only.	
Person Trips per Household, Total	Numeric	Person Trips generated per household, Home-Based Work trips only.	
Person Trips per Household, Total	Numeric	Person Trips generated per household, Non-Home-Based trips only.	
Person Trip Length, Total	Numeric	Average Person Trip distance, all trip purposes.	Calculation: Total PMT per HH / Total PT per HH
Person Trip Length, HBO	Numeric	Average Person Trip distance, Home-Based Other trips only.	Calculation: HBO PMT per HH / HBO PT per HH
Person Trip Length, HBW	Numeric	Average Person Trip distance, Home-Based Work trips only.	Calculation: HBW PMT per HH / HBW PT per HH
Person Trip Length, NHB	Numeric	Average Person Trip distance, Non-Home-Based trips only.	Calculation: NHB PMT per HH / NHB PT per HH

Geography Name			California	SACOG	Butte
Geography Type			state	region	county
All Trips	Trip Data	Total Trips	121,791,338	7,591,534	704,387
		Sample Trips	248,398	12,657	2,055
		Warning Level	0	0	0
	Mode Share, all trips	Drive Alone	40.1%	42.9%	42.9%
		Shared Ride 2	22.6%	23.3%	27.8%
		Shared Ride 3+	20.1%	20.9%	18.1%
		Transit	3.6%	2.0%	3.1%
		Bike	1.6%	2.8%	2.1%
		Walk	10.9%	7.1%	5.6%
		Other	1.0%	1.0%	0.3%
HBO Trips	Trip Data	Total Trips	17,630,532	1,055,514	92,052
		Sample Trips	39,865	1,974	311
		Warning Level	0	0	0
	Mode Share, HBO trips	Drive Alone	30.2%	33.1%	31.5%
		Shared Ride 2	25.4%	25.8%	29.9%
		Shared Ride 3+	24.6%	26.7%	23.8%
		Transit	3.3%	1.2%	4.7%
		Bike	1.8%	3.6%	3.0%
		Walk	13.3%	8.2%	6.7%
		Other	1.4%	1.5%	0.3%
HBW Trips	HBW Trips	Total Trips	68,518,400	4,393,210	392,226
		Sample Trips	135,701	6,892	1,066
		Warning Level	0	0	0
	Mode Share, HBW trips	Drive Alone	76.1%	76.8%	79.7%
		Shared Ride 2	7.9%	6.0%	15.5%
		Shared Ride 3+	2.4%	3.9%	0.8%
		Transit	8.1%	7.6%	2.2%
		Bike	1.9%	3.0%	1.7%
		Walk	3.4%	2.1%	0.0%
		Other	0.2%	0.6%	0.0%
NHB Trips	NHB Trips	Total Trips	35,642,406	2,142,810	220,108
		Sample Trips	72,832	3,791	678
		Warning Level	0	0	0
	Mode Share, NHB trips	Drive Alone	41.5%	46.3%	47.6%
		Shared Ride 2	24.5%	26.6%	29.2%
		Shared Ride 3+	20.4%	17.6%	15.3%
		Transit	0.8%	1.1%	0.7%
		Bike	2.1%	1.1%	0.7%
		Walk	10.1%	7.1%	6.1%
		Other	0.6%	0.2%	0.3%

Geography Name			California	SACOG	Butte
Geography Type			state	region	county
Household Metrics		Total Households	12,465,947	816,939	85,074
		Sample Households	30,215	1,438	222
		Warning Level	0	0	0
Daily Vehicle Trip Metrics	MT per Househc	Total	41.6	42.9	39.3
		HBO	15.4	18.1	15.8
		HBW	14.1	12.4	8.7
		NHB	11.2	11.6	14.3
	e Trips per Hou	Total	5.3	5.3	4.8
		HBO	2.5	2.6	2.2
		HBW	1.2	1.1	0.9
		NHB	1.6	1.6	1.7
	ge Vehicle Trip I	Total	7.9	8.1	8.3
		HBO	6.1	6.9	7.1
		HBW	12.2	11.6	9.4
		NHB	6.9	7.2	8.6

Geography Name			California	SACOG	Butte
Geography Type			state	region	county
Capita Metrics		Total Persons	34,153,524	2,120,050	195,774
		Sample Persons	77,587	3,648	534
		Warning Level	0	0	0
Daily Vehicle Trip Metrics	VMT per Capita	Total	15.1	16.6	17.2
		HBO	5.8	7.2	7.0
		HBW	5.1	4.7	3.8
		NHB	4.2	4.6	6.4
	Vehicle Trips per Capita	Total	2.0	2.1	2.1
		HBO	1.0	1.1	1.0
		HBW	0.4	0.4	0.4
		NHB	0.6	0.6	0.7
	Average Vehicle Trip Length	Total	7.6	7.9	8.1
		HBO	6.0	6.8	7.1
		HBW	12.1	11.5	9.3
		NHB	6.8	7.2	8.6

Geography Name			California	SACOG	Butte
Geography Type			state	region	county
Household Metrics		Total Households	12,465,947	816,939	85,074
		Sample Households	30,215	1,438	222
		Warning Level	0	0	0
Daily Person Trip Metrics	PMT per Household	Total	63.0	69.3	58.7
		HBO	28.0	36.6	26.8
		HBW	17.0	14.9	10.0
		NHB	16.7	16.4	21.3
	Person Trips per Household	Total	8.9	8.5	7.5
		HBO	4.9	4.9	4.2
		HBW	1.4	1.3	1.0
		NHB	2.6	2.4	2.4
	Average Person Trip Length	Total	7.1	8.1	7.8
		HBO	5.7	7.5	6.4
		HBW	11.8	11.4	9.7
		NHB	6.4	6.9	8.8

Geography Name			California	SACOG	Butte
Geography Type			state	region	county
Capita Metrics		Total Persons	34,153,524	2,120,050	195,774
		Sample Persons	77,587	3,648	534
		Warning Level	0	0	0
Daily Person Trip Metrics	PMT per Capita	Total	22.4	26.2	25.1
		HBO	10.2	14.1	11.7
		HBW	6.1	5.7	4.4
		NHB	6.2	6.4	9.2
	Person Trips per Capita	Total	3.3	3.3	3.3
		HBO	1.8	1.9	1.8
		HBW	0.5	0.5	0.5
		NHB	1.0	0.9	1.1
	Average Person Trip Length	Total	6.8	7.9	7.7
		HBO	5.6	7.4	6.4
		HBW	11.8	11.4	9.7
		NHB	6.4	6.8	8.7

Appendix C:
Induced Vehicle Demand Calculations

SB 743 TRANSPORTATION PROJECT - INDUCED TRAVEL AND VMT TESTING

Fehr & Peers Version 1.1 - 7.22.16

Model Scenarios/ Components	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Model Framework	2018 RTP/SCS	2018 RTP/SCS	2018 RTP/SCS	2040 RTP/SCS
Network	2018 RTP	2040 RTP/SCS	2018 RTP	2040 RTP/SCS
Socioeconomic	2018 RTP	2018 RTP	2040 RTP/SCS	2040 RTP/SCS
Total VMT	4,869,563	4,873,926	5,503,619	5,527,618
Total Lane-Miles	7,020	7,069	7,020	7,069
VMT Per Lane-Mile	694	690	784	782

Model vs Elasticity Comparisons		C-B		E-B
Model	VMT Change	4,363		658,055
	Lane Miles Change	48		48
Elasticity Results	Lane Miles Change	0.69%		0.69%
	VMT Change (Low)	3,356		NA
	VMT Change (High)	20,135		34,565
VMT Growth Comparisons (2036-2012)				
Method 1				
Total VMT (E-B)				658,055
VMT from Population and Employment (D-B)			634,056	
VMT from Increased Lane Miles (1)				23,999
Method 2				
VMT from Population and Employment (D-B)				634,056
VMT from Induced Travel (2)				34,565
Total VMT = VMT from Population and Employment (D-B) Plus Induced Travel VMT (2)				668,621

Notes:

Short-range elasticity	Low = 0.10, High = 0.60
Long-range elasticity	1.03. This is a 'minimum' benchmark for a travel model forecast since population and employment growth was controlled for in the statistical estimate of the elasticity.

(1)'Total VMT - VMT from Population and Employment.

All results were generated with the BCAG version of the 2020 RTP/SCS models.

This work was performed as part of Fehr & Peers internal R&D and hasn’t gone through normal QA procedures related to project work so the spreadsheet may contain errors or omissions.

Appendix D:
Planned and Programmed Project List

ROAD CAPACITY PROJECTS v2

#	Project ID	Implementing Agency	Project Type	Title	Segment Start	Segment End	Project Descriptioin	New Lane Miles	Fund Total Estimate (1,000s)	Primary Fund Source	Roadway Classification	Status*	IMP1 PRJID	Difference from V1	Implementation Year	Updated Model - Project ID and Project Year?	2020 RTP Analysis Year: 2018 - Model Base Year	2020 RTP Base Year	2030 Mile-stone	2035 GHG Year	2040 RTP Horizon	In 2016 RTP/SCS	ORIGINATING SOURCE: General Plan, Nexus, Specific Plan, Traffic or Corridor Study, Etc.
1	20200000107	Butte County	Capacity	Central House Rd Over Wymann Ravine Bridge	0.2 miles east of SR 70	-	Located at 0.2 miles east of SR 70. Scope is to replace the existing 1 lane structurally deficient bridge with a new 2 lane bridge. Bridge No: 12C011	0.04	4000	HBP	Collector	Programmed	n/a in model	same	2,030	n/a			X	X	X	Yes	Butte County Capital Improvement Program
2	10200000176	Caltrans	Capacity	SR 70 Passing Lanes (Segment 1)	0.1 mile south of Palermo Rd	Ophir Rd	SR 70, from 0.1 mile south of Palermo Road, to just north of Ophir Road/Pacific Heights intersection. Widen from 2 lanes to 4 lanes. (EA 3H71U). Capacity increasing portion only.	4.25	12480	STIP & Demo	Arterial/Expressway	Programmed	2	same	2,020			X	X	X	X	Yes	BCAG RTP/SCS & STIP
3	10200000177	Caltrans	Capacity	SR 70 Passing Lanes (Segment 2)	Cox Ln	0.1 mile south of Palermo Rd	On State Route 70, from Cox Lane to 0.1 mile south of Palermo Road. Widen from 2 lanes to 4 lanes. (EA 3F281 & 3H720)	5.33	16540	STIP	Arterial/Expressway	Programmed	3	same	2,030				X	X	X	Yes	BCAG RTP/SCS & STIP
4	10200000205	Caltrans	Capacity	SR 70 Passing Lanes (Segment 3)	0.4 mile south of E. Gridley Rd	0.3 mile south of Butte/Yuba Co. line	On Route 70 from 0.4 mile South or East of Gridley Road to 0.3 mile South of Butte/Yuba County line. Widen from 2 lanes to 4 lanes. (EA 3H930 & 3F282)	8.21	21800	STIP	Arterial/Expressway	Programmed	4	same	2,030				X	X	X	Yes	BCAG RTP/SCS & STIP
5	20200000204	Chico	Capacity	Bruce Rd Bridge Replacement Project	Bruce Rd	at Little Chico Creek	In Chico 0.5 miles south of Humboldt Rd on Bruce Road over Little Chico Creek.Project includes replacement of an existing 2-lane functionally obsolete bridge with a new 4-lane bridge including reconstruction of bridge approaches. New bridge incorporates a class I bicycle facility.	0.00	7900	LOCAL	Arterial	Planned	5	new	2,030				X	X	X	Yes	Chico General Plan
6	20200000108	Chico	Capacity	Guynn Rd over Lindo Channel Bridge Project	north of W Lindo Ave	-	Project is located just north of W Lindo Ave. Replace the existing 1 lane structurally deficient bridge with a new 2 lane bridge. Bridge No 12C0066	0.03	5300	HBP	Local	Programmed	n/a in model	same	2,030				X	X	X	Yes	Chico Capital Improvement Program
7	Nexus 601	Chico	Capacity	Bruce Rd. Widening	Skyway	SR 32	From Skyway to SR 32, widen Roadway (Bridge included as separate project)	4.09	13400	LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico Nexus
8	Nexus 602	Chico	Capacity	Commerce Court Connection	Ivy St	Park Ave	From Ivy Street to Park Ave. connect existing Commerce Ct. to Park Avenue via Westfield Lane.	0.06	1300	LOCAL	Local	Planned		same	2,030				X	X	X	No	Chico Nexus
9	Nexus 603	Chico	Capacity	E. 20th Street Widening	Forest Ave	Bruce Rd	From Forest Avenue to Bruce Road. Widen from 1 lane per direction to 2 lanes per direction with median	0.98	3100	LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico Nexus
10	Nexus 604	Chico	Capacity	W. Eaton Rd Extension	SR 32	Catherine Ct	From SR 32 to Catherin Ct. Construct new alignment. 2 lane expressway and bridge - RR crossing	3.18	53700	Unfunded	Arterial	Unconstrained		same	2,045							Yes	Chico Nexus
11	Nexus 605	Chico	Capacity	W. Eaton Rd Connection	Catherine Ct	Esplanade	Catherine Ct to Esplanade. New road connection	0.74	6200	Unfunded	Arterial	Unconstrained		same	2,045							No	Chico Nexus
12	Nexus 606	Chico	Capacity	Eaton Rd Widening	Hicks Ln	Cohasset Rd	From Hicks Lane to Cohasset. Widen and extend to 4 lanes with median and new bridge at Sycamore Creek Tributary	2.71	22000	LOCAL	Arterial	Planned		same	2,040						X	No	Chico Nexus
13	Nexus 607	Chico	Capacity	Eaton Rd Widening	Cohasset Rd	Manzanita Ave	From Cohasset to Manzanita. Widen to 4 lanes with median	5.17	14000	LOCAL	Arterial	Planned		same	2,040						X	Yes	Chico Nexus
14	Nexus 608	Chico	Capacity	Esplanade Widening	Eaton Rd	Nord Hwy	Eaton Rd to Nord Highway. Widen to 4 lanes with median. Extend median south to Shasta Ave	1.34	6500	LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico Nexus
15	Nexus 609	Chico	Capacity	Mariposa Ave Connection	Glenshire Ln	Eaton Rd	From Glenshire Lane to Eaton Road, add new arterial connection. 1 lane per direction.	1.10	1800	LOCAL	Arterial	Planned		same	2,030				X	X	X	No	Chico Nexus
16	Nexus 611	Chico	Capacity	Fair Street / Park Avenue Connection	Fair St	Park Ave	From Fair St to Park Ave. Extend E. 23rd St. /Silver Dollar Pkwy thru "wedge" to connect to Commerce Ct. Connection.	0.25	970	Unfunded	Collector	Unconstrained		same	2,045							No	Chico Nexus
17	Nexus 612	Chico	Capacity	Holly Avenue / Warner Avenue Connection	Capshaw Ct	Fuchsia Way	From Capshaw Ct. to Fuchsia Way. Construct new 2 lane connector.	0.54	2580	Unfunded	Collector	Unconstrained		same	2,045							No	Chico Nexus
18	Nexus 613	Chico	Capacity	Ivy Street Extension	Hazel St	Meyers St	From Hazel St to Meyers St. Construct new 2 lane connector.	0.84	71300	Unfunded	Collector	Unconstrained		same	2,045							No	Chico Nexus
19	Nexus 614	Chico	Capacity	Yosemite Drive Extension	SR 32	Humboldt Rd	From SR 32 to Humboldt Rd. Construct new 2 lane connection.	0.31	5820	Unfunded	Collector	Unconstrained		same	2,045							No	Chico Nexus
20	Nexus 615	Chico	Capacity	Notre Dame Boulevard Connection	Little Chico Creek	E. 20th St	From Little Chico Creek to E. 20th Street. Construct new 2 lane street and bridge at Little Chico Creek.	1.76	7850	LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico Nexus
21	Nexus 616	Chico	Capacity	Silver Dollar Way Extension	MLK Blvd	Fair St	From MLK Parkway to Fair St. Connect exist road stubs.	0.48	2760	Unfunded	Local	Unconstrained		same	2,045							Yes	Chico Nexus
22	Nexus 617	Chico	Capacity	Midway Widening	Hegan Ln	Park Ave	From Hegan Lane to Park Ave. Widen road from 2 lanes to 4 lanes with a median.	0.86	5660	LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico Nexus
23	Nexus 635	Chico	Capacity	West Park Extension	Midway	Otterson Dr	Extension from Midway to Otterson Dr (Bridge at creek)	0.91	9390	Unfunded	Collector	Unconstrained		new	2,045							No	Chico Nexus
24	Nexus 701	Chico	Capacity	SR 99 Auxilary Lanes (Segment 1)	Skyway I/C	E. 20th St I/C	From Skyway to E. 20th Street. Construct auxiliary lanes to the outside.	1.12	11500	STIP	Freeway	Planned		same	2,035					X	X	Yes	Chico Nexus
25	Nexus 702	Chico	Capacity	SR 99 Auxiliary Lanes (Segment 2)	E. 20th St I/C	SR 32 I/C	E. 20th to SR 32. Construct auxiliary lanes to the outside. CP 18057.	1.56	11000	STIP	Freeway	Planned		same	2,035					X	X	Yes	Chico Nexus
26	Nexus 703	Chico	Capacity	SR 99 Auxiliary Lanes (Segment 3)	E. 1st Ave I/C	Cohasset Rd I/C	E. 1st to Cohasset Rd. Construct auxiliary lanes to the outside.	2.17	20000	Unfunded	Freeway	Unconstrained		same	2,045							No	Chico Nexus
27	Nexus 706	Chico	Capacity	SR 32 Widening (Segment 3)	El Monte Ave	Bruce Rd	From El Monte to Bruce Rd. Widen from 2 to 4 lanes.	0.89	2000	LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico Nexus

ROAD CAPACITY PROJECTS v2

#	Project ID	Implementing Agency	Project Type	Title	Segment Start	Segment End	Project Descriptioin	New Lane Miles	Fund Total Estimate (1,000s)	Primary Fund Source	Roadway Classification	Status*	IMP1 PRJID	Difference from V1	Implementation Year	Updated Model - Project ID and Project Year?	2020 RTP Analysis Year: 2018 - Model Base Year	2020 RTP Base Year	2030 Mile-stone	2035 GHG Year	2040 RTP Horizon	In 2016 RTP/SCS	ORIGINATING SOURCE: General Plan, Nexus, Specific Plan, Traffic or Corridor Study, Etc.
28	Nexus 707	Chico	Capacity	SR 32 Widening (Segment 4)	Bruce Rd	Yosemite Dr	From Bruce Rd to Yosemite. Widen from 2 to 4 lanes with signal at Yosemite.	1.32	4000	LOCAL	Arterial	Planned		same	2,035					X	X	Yes	Chico Nexus
29	Nexus 710	Chico	Capacity	SR 99 / Eaton Rd Interchange	Esplanade	Hicks Ln	Widen overpass structure (2 to 4 lanes) and ramps, construct dual lane roundabouts.	0.97	22000	LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico Nexus
30	Nexus 711	Chico	Capacity	SR 99 / Cohasset Road Interchange	SR 99 @ Cohasset Rd	-	Construct Southbound direct on-ramp.	0.12	11000	LOCAL	Freeway	Planned		same	2,035					X	X	No	Chico Nexus
31	Nexus 717	Chico	Capacity	SR 99 at Southgate complex (I/C and connector roads)	SR 99 @ Southgate	-	I/C and connector roads (Player, Fair Street, Midway Connection, Notre Dame, Speedway, West Southgate, East Southgate, Midway)	8.00	4000	LOCAL	Arterial	Project Development Only		same	2,045							Yes	Chico Nexus
32	CH-CAPACITY-LOCAL-2020-1	Chico	Capacity	Cohasset Road Widening (Airport Blvd to Eaton Rd)	Eaton Rd	Airport Blvd	Widen Cohasset Road (2 to 4 lanes) from Eaton Rd to Airport Blvd.	3.61		LOCAL	Arterial	Planned		same	2,030				X	X	X	Yes	Chico
33	CH-CAPACITY-LOCAL-2020-2	Chico	Capacity	MLK Blvd Widening (E. Park Ave to E. 20th St)	E. Park Ave	E. 20th St	Widen MLK Blvd (2 to 4 lanes) from Park Ave to E. 20th St.	1.62		LOCAL	Collector	Planned		same	2,030				X	X	X	Yes	Chico
34	ORO-CAPACITY-LOCAL-2020-1	Oroville	Capacity	Olive Highway Widening (Oro-Dam Blvd to Foothill Blvd)	Oro-Dam Blvd	Foothill Blvd	Widen Olive Hwy from 2 to 3 lanes from Oro-Dam Blvd to Foothill Blvd. Additional lane will be added to eastbound travel.	0.90	3000	LOCAL	Arterial	Planned	Need to fix in Cub	same	2,040						X	Yes	SR 162 Corridor Plan
35	PAR-CAPACITY-LOCAL-2020-1	Paradise	Capacity	Neal Road Widening - Emergency Evacuation Route	Skyway	SR 99	Widen Neal Road (2 to 4 lanes) to facilitate emergency evacuation. Provides a critical alternative to SR 191 and Skyway.	16.80	20000	Unfunded	Arterial	Unconstrained		same	2,045							No	Paradise Vision Plan
36	PAR-CAPACITY-LOCAL-2020-2	Paradise	Capacity	Upper Skyway Widening	Bille Rd	Pentz Rd	Widen Skyway to facilitate emergency evacuation.	5.46	30000	Unfunded	Arterial	Unconstrained		same	2,045							No	Paradise Vision Plan
37	PAR-CAPACITY-LOCAL-2020-3	Paradise	Capacity	Roe Road Extension to SR 191	Roe Rd end	Clark Rd (SR 191)	Extend Roe Road to SR 191 to faciliate emergency evacuations.	1.02	5000	Unfunded	Collector	Unconstrained		same	2,045							No	Paradise Vision Plan
	Chico		Capacity	SR 32 (Nord Avenue) Improvements	W. Lindo Ave	W. 1st St	From W. Lindo Ave to W. 1st Street. Corridor improvements (roundabouts, bike lanes, ped crossings) per specific plan.	0.00			Arterial	Planned		removed					X	X	X	No	Chico Nexus
	Chico		Capacity	SR 32 (W. 8th St) at UPRR	W. 8th Ave	W. 9th Ave	Overpass, highway over railroad with reinforced earth retaining walls.	0.36			Arterial	Project Development Only		removed								No	Chico Nexus

STATUS FIELD:
Programmed (constrained) – all FTIP projects
Planned (constrained) – all projects which could reasonably be assumed funded, via BCAG or locally, by the year 2040
Project Development Only (constrained) – projects that are anticipated to begin early stages of development including project planning, design, preliminary engineering, environmental clearance, and ROW acquisition by 2040. These projects remain eligible to seek federal and state funding, but under the financial constraint requirements for forecasting revenues, the construction phase is not included in the 2020 RTP/SCS.
Unconstrained – all other projects outside of the constrained list

TRANSIT AND PASSENGER RAIL PROJECTS v3

#	Project ID	Implementing Agency	Project Type	Title	Segment		Project Descriptioin	Fund Total Estimate (1,000s)	Primary Fund Source	Status*	2020 RTP Analysis Year					In 2016 RTP/SCS	ORIGINATING SOURCE: General Plan, Nexus, Specific Plan, Traffic or Corridor Study, Etc.
					Start	End					2018 - Model Base Year	2020 RTP Base Year	2030 Mile-stone	2035 GHG Year	2040 RTP Horizon		
1	BCAG-TRANSIT-FTA-2020-1	BCAG	Transit	Eaton/Bruce Rd Corridor Route	Skyway	Esplanade	Add service along Eaton and Bruce Road. Frequency = 30 minute Peak and 60 minute Base		Federal Transit Administration	Planned				X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
2	BCAG-TRANSIT-FTA-2020-2	BCAG	Transit	Route 1 Transit Emphasis Corridor (Phase 1)	Chico Mall	Lassen & Ceres Transfer Point	Increase freqeuncy for Route 14/15. Frequency = 15 minute Peak and 30 minute Base		Federal Transit Administration	Planned			X	X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
3	BCAG-TRANSIT-FTA-2020-3	BCAG	Transit	Route 1 Transit Emphasis Corridor (Phase 2)	Chico Mall	North Valley Plaza Transit Village	Operations improvements along corridor = transit signal priority, improved stop spacing, mobile fare payment, improved routing		Federal Transit Administration	Planned			X	X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
4	BCAG-TRANSIT-FTA-2020-4	BCAG	Transit	Warner Street Transit Priority Corridor	W 2nd Street	W 8th Avenue	Add new service along Warner St. Frequency = 15 minute Peak and 30 minute Base		Federal Transit Administration	Planned				X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
5	BCAG-TRANSIT-FTA-2020-5	BCAG	Transit	East Avenue Transit Priority Corridor	Pillsbury Road	Manzanita Avenue	Add new service or increase existing service along East Ave. Frequency = 15 minute Peak and 30 minute Base		Federal Transit Administration	Planned				X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
6	BCAG-TRANSIT-FTA-2020-6	BCAG	Transit	North Valley Plaza Transit Center Improvements	North Valley Plaza Transit Center	-	Improve and realign stops at North Valley Plaza to include new shelters, bike parking, and pedestrian improvements	250	Federal Transit Administration	Planned			X	X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
7	BCAG-TRANSIT-FTA-2020-7	BCAG	Transit	Oroville Park & Ride Improvements	3rd St	-	Increase parking capacity at existing facility	1000	Federal Transit Administration	Planned			X	X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
8	BCAG-TRANSIT-FTA-2020-8	BCAG	Transit	Paradise Transit Center	Black Olive Dr	-	New transit center with park & ride	2000	Federal Transit Administration	Planned			X	X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
9	BCAG-TRANSIT-FTA-2020-9	BCAG	Transit	Gridley Park & Ride	Butte County Fairgrounds	-	New park & ride with pedestrian and bike facilities	1000	Federal Transit Administration	Planned			X	X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
10	BCAG-TRANSIT-FTA-2020-10	BCAG	Transit	Chico (Fir St) Park & Ride Improvements	Fir St Park & Ride	-	Add bus stops along 8th St (east bound) and 9th St (west bound)	250	Federal Transit Administration	Planned				X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
11	BCAG-TRANSIT-FTA-2020-11	BCAG	Transit	Implement Van Pool Service	Regional	-	Implement van pool services for commuter routes (Route 31 and 32)		Federal Transit Administration	Planned			X	X	X	Yes	BCAG Transit and Non-Motorized Plan (2015)
12	BCAG-TRANSIT-LCTOP-2020-1	BCAG	Transit	LCTOP - Electric Bus and Charger	Chico Area	-	New zero emission electric bus and charger to operate on Route 14/15 in the Chico area	1500	LCTOP	Programmed			X	X	X	No	B Line Budget
13	BCAG-TRANSIT-LCTOP-2020-2	BCAG	Transit	LCTOP - Mobile Ticketing	Regional	-	New mobile ticketing application for B-Line	250	LCTOP	Programmed		X	X	X	X	No	B Line Budget
14	BCAG-TRANSIT-FTALOWNO-2020-1	BCAG	Transit	FTA Low or No Emissions Program - Electric Bus and Charger	Chico Area	-	New zero emission electric bus and charger to operate in Chico area	1500	FTA LowNo	Planned			X	X	X	No	B Line Budget
15	BCAG-TRANSIT-FTA5339-2020-1	BCAG	Transit	FTA 5339 - Electric Bus and Charger (2)	Chico Area	-	2 New zero emission electric bus and charger to operate in Chico area	2000	FTA 5339	Planned			X	X	X	No	B Line Budget
16	BCAG-TRANSIT-TBD-2020-1	BCAG	Transit	Chico to Sacramento Inter-City Commuter Bus Service	Chico	Sacramento	New inter-city commuter bus serving Chico, Oroville, Marysville, and Sacramento.	5000	CMAQ/TDA/TIRCP/LCTOP/LOCAL	Planned			X	X	X	No	Butte County Inter-City Commuter Bus Feasibility Study
17	20200000200	BCAG	Transit	Butte Regional Transt - Capital and Operating Assistance	Countywide		Federal Transit Admininstration Program Sections 5307 & 5311 programs to support transit services provided by Butte Regional Transit.	27300	FTA 5307	Programmed	X	X	X	X	X	Yes	B Line Budget
18	20200000182	BCAG & Work Training Center	Transit	Paratransit Assistance Program	Countywide		Non Infrastructure Projects in Butte County for the Help Central Mobility Management Program for Butte 211 call center and for Butte Regional Transit for supplemental ADA paratransit operations.	600	FTA 5310	Programmed	X	X	X	X	X	Yes	B Line Budget
19	BCAG-TRANSIT-TBD-2020-2	BCAG	Passenger Rail	Oroville to Sacramento Commuter Rail Service	Oroville	Sacramento	New inter-city commuter rail serving Oroville, Marysville, and Sacramento. 3 daily round-trips (AM, Mid-Day, and PM)	5000	CMAQ/TDA/TIRCP/LCTOP/LOCAL	Planned			X	X	X	No	2018 California State Rail Plan; San Joaquin Joint Powers Authority - 2018 Business Plan Update

STATUS FIELD:
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Project Development Only (constrained) – projects that are anticipated to begin early stages of development including project planning, design, preliminary engineering, environmental clearance, and ROW acquisition by 2040. These projects remain eligible to seek federal and state funding, but under the financial constraint requirements for forecasting revenues, the construction phase is not included in the 2020 RTP/SCS.
Unconstrained – all other projects outside of the constrained list

BIKE AND PEDESTRIAN PROJECTS v4

#	IMP1 PRJID	Project ID	Implementation Year	Implementing Agency	Project Type	Title	Segment Start	Segment End	Project Description	New Class I or II (miles)	Fund Total Estimate (1,000s)	Primary Fund Source	Status	2020 RTP Analysis Year: 2018 - Model Base Year	2020 RTP Base Year	2030 Mile-stone	2035 GHG Year	2040 RTP Horizon	In 2016 RTP/SCS (for reference)	ORIGINATING SOURCE: General Plan, Nexus, Specific Plan, Traffic or Corridor Study, Etc.
10	1,010	20200000117	2,030	City of Chico	Bike/Ped	SR 99 Bikeway Phase 5	Chico Mall	Business Ln	Class 1	0.49	15500	ATP/CMAQ/LOCAL	Programmed			X	X	X	No	2019 City of Chico Bike Plan (Group A)
9	1,009	20200000189	2,030	City of Chico	Bike/Ped	SR 99 Bikeway Phase 4	Business Ln	Notre Dame Blvd	Class 1	0.84	2400	ATP/CMAQ/LOCAL	Programmed			X	X	X	Yes	2019 City of Chico Bike Plan (Group A)
53	1053	20200000190	2030	Town of Paradise	Bike/Ped	Pentz Rd Class 2	Bille Rd	Wagstaff Rd	Class 2	0.60	1733	ATP	Programmed			X	X	X	Yes	2012, Town of Paradise Master Bicycle and Pedestrian Plan
7	1,007	20200000194	2,030	City of Chico	Bike/Ped	Explanade Class 1	Memorial Way	11th Ave	Class 1	1.20	7700	ATP	Programmed			X	X	X	Yes	2019 City of Chico Bike Plan (Group A)
5	1,005	20200000195	2,030	Butte County	Bike/Ped	Monte Vista & Lower Wyandotte Class II Bike Project	_	_	Construct Class II bike facilities	0.00	750	CMAQ	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
5	1,005	20200000195	2,030	Butte County	Bike/Ped	Monte Vista Ave Class 2	Lincoln Blvd	Lower Wyandotte Rd	Class 2	0.93	750	CMAQ	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
5	1,005	20200000195	2,030	Butte County	Bike/Ped	Lincoln Blvd Class 2	Monte Vista Ave	Las Plumas Ave	Class 2	0.27	750	CMAQ	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
5	1,005	20200000195	2,030	Butte County	Bike/Ped	Lower Wyandotte Class 2	Forestview Dr	Las Plumas Ave	Class 2	0.43	750	CMAQ	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
5	1,005	20200000195	2,030	Butte County	Bike/Ped	Las Plumas Ave Class 2	Lincoln Blvd	Lower Wyandotte Rd	Class 2	0.99	750	CMAQ	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
4	1,004	20200000196	2,030	Butte County	Bike/Ped	Autry Lane & Monte Vista Safe Routes to Schools Gap Closure	_	_	Curb, gutter, sidewalk,	0.00	3150	CMAQ/ATP	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
4	1,004	20200000196	2,030	Butte County	Bike/Ped	Autrey Ln Class 2	Monte Vista Ave	Las Plumas Ave	Class 2	0.26	3150	CMAQ/ATP	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
4	1,004	20200000196	2,030	Butte County	Bike/Ped	Via Pacana and Cresridge Dr connector Class 2	Monte Vista Ave	Las Plumas Ave	Class 2	0.25	3150	CMAQ/ATP	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
24	1,024	20200000199	2,030	City of Oroville	Bike/Ped	SR 162 Class 2	Feather River Bridge	Foothill Blvd	Class 2	2.76	3951	ATP	Programmed			X	X	X	Yes	SR 162 Corridor Plan
19	1,019	20200000216	2,030	City of Gridley	Bike/Ped	SR 99 Class 1	Township Rd	Archer Ave	Class 1	0.97	2160	ATP	Programmed			X	X	X	No	Gridley Bike and Ped Plan
1	1,001	20200000217	2030	City of Biggs	Bike/Ped	SR2S 2nd St Class 2	H St	Bannock St	Class 2	0.32	15	CMAQ	Programmed			X	X	X	No	BCAG - 2020 RTP Consultation
55	1055	20200000219	2030	Town of Paradise	Bike/Ped	Pentz Rd Trailway Phase 2 (Segment 1) Class 1	Pearson Rd	Bille Rd	Class 1	1.65	9970	CMAQ	Programmed			X	X	X	No	BCAG - 2020 RTP Consultation
56	1056	20200000219	2035	Town of Paradise	Bike/Ped	Pentz Rd Trailway Phase 2 (Segment 2) Class 1	Wagstaff Rd	Skyway	Class 1	1.51	9970	CMAQ	Programmed				X	X	No	BCAG - 2020 RTP Consultation
52	1052	20200000220	2030	Town of Paradise	Bike/Ped	Neal Rd Class 1	Red Sky Ln	Skyway	Class 1	1.63	8525	ATP/CMAQ	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
54	1054	20200000221	2030	Town of Paradise	Bike/Ped	Oliver Rd Class 1	Valley View Dr	Skyway	Class 1	0.40	4975	CMAQ	Programmed			X	X	X	No	BCAG - 2020 RTP Consultation
1	1,001	BC-BIKE-LOCAL-2020-2	2,020	Butte County	Bike/Ped	Neal Rd Class 2	Oroville Chico Hwy	Wayland Rd	Class 2	5.06	_	LOCAL	Completed		X	X	X	X	Yes	2011, Butte County Bicycle Plan
2	1,002	BC-BIKE-LOCAL-2020-3	2,035	Butte County	Bike/Ped	Oroville Chico Hwy Class 2	Durham-Pentz	Midway	Class 2	4.90	2000	LOCAL	Planned				X	X	Yes	2011, Butte County Bicycle Plan (High Priority)
3	1,003	BC-BIKE-LOCAL-2020-4	2,035	Butte County	Bike/Ped	Durham-Pentz	Oroville Chico Hwy	Butte College	Class 2	4.19	100	LOCAL	Planned				X	X	Yes	2011, Butte County Bicycle Plan (High Priority)
4	1,004	BC-BIKE-LOCAL-2020-5	2,030	Butte County	Bike/Ped	Neal Rd Class 2	Wayland Rd	Red Sky Ln	Class 2	2.28	750	LOCAL	Planned			X	X	X	Yes	2011, Butte County Bicycle Plan (High Priority)
8	1,008	CH-BIKE-ATP-2020-1	2,030	City of Chico	Bike/Ped	Little Chico Creek Bike Bridge Class 1	Humboldt Ave	20th St Park	Class 1	0.05	2142	ATP/LOCAL	Programmed			X	X	X	No	2019 City of Chico Bike Plan (Group A)
11	1,011	CH-BIKE-LOCAL-2020-1	2,030	City of Chico	Bike/Ped	Whittmeier Dr Class 1 (Bikeway 99 connector)	SR99 Class 1	Forest Ave	Class 1	0.18	115	LOCAL	Planned			X	X	X	Yes	2019 City of Chico Bike Plan (Group A)
12	1,012	CH-BIKE-LOCAL-2020-2	2,020	City of Chico	Bike/Ped	Cohasset Rd Class 2	East Ave	Eaton Rd	Class 2	1.04	_	LOCAL	Completed		X	X	X	X	No	City of Chico

BIKE AND PEDESTRIAN PROJECTS v4

#	IMP1 PRJID	Project ID	Implementation Year	Implementing Agency	Project Type	Title	Segment		Project Description	New Class I or II (miles)	Fund Total Estimate (1,000s)	Primary Fund Source	Status	2020 RTP Analysis Year					In 2016 RTP/SCS (for reference)	ORIGINATING SOURCE: General Plan, Nexus, Specific Plan, Traffic or Corridor Study, Etc.
							Start	End						2018 - Model Base Year	2020 RTP Base Year	2030 Mile-stone	2035 GHG Year	2040 RTP Horizon		
13	1,013	CH-BIKE-LOCAL-2020-3	2,020	City of Chico	Bike/Ped	Sycamore Creek Class 1	Gibson Landing	Floral Ave	Class 1	0.46	_	LOCAL	Completed		X	X	X	X	No	City of Chico
14	1,014	CH-BIKE-LOCAL-2020-4	2,030	City of Chico	Bike/Ped	Oleander Ave Class 2	E 10th Ave	E 1st Ave	Class 2	0.76	76	LOCAL	Planned			X	X	X	No	2019 City of Chico Bike Plan (Group A)
15	1,015	CH-BIKE-LOCAL-2020-5	2,020	City of Chico	Bike/Ped	Humboldt Rd Class 1	Morning Rose Way	Bruce Rd	Class 1	0.51	305	LOCAL	Planned		X	X	X	X	No	2019 City of Chico Bike Plan (Group A)
16	1,016	CH-BIKE-LOCAL-2020-6	2,030	City of Chico	Bike/Ped	Esplanade Class 2	W 11th Ave	East Ave	Class 2	1.09	31	LOCAL	Planned			X	X	X	No	2019 City of Chico Bike Plan (Group A)
17	1,017	CH-BIKE-LOCAL-2020-7	2,030	City of Chico	Bike/Ped	Bruce Rd Class 1	Hwy 32	Remington Dr	Class 1	0.65	72	LOCAL	Planned			X	X	X	No	2019 City of Chico Bike Plan (Group A)
18	1,018	CH-BIKE-LOCAL-2020-8	2,030	City of Chico	Bike/Ped	Comanche Creek Class 1 (Phase 2)	Midway	Meyers Ind Park	Class 1	0.55	1662	LOCAL	Planned			X	X	X	No	2019 City of Chico Bike Plan (Group A)
21	1,021	GR-BIKE-LOCAL-2020-1	2,035	City of Gridley	Bike/Ped	Magnolia St Class 2	Idaho St	Vermont St	Class 2	0.42	5	LOCAL	Planned				X	X	Yes	2011 Gridley Bicycle Plan (High Priority)
22	1,022	GR-BIKE-LOCAL-2020-2	2,035	City of Gridley	Bike/Ped	Gridley Rd Class 2 (component of Magnolia Class 2)	Jackson St	SR 99	Class 2	0.25	3	LOCAL	Planned				X	X	Yes	2011 Gridley Bicycle Plan (High Priority)
23	1,023	OR-BIKE-LOCAL-2020-1	2,020	City of Oroville	Bike/Ped	Lincoln Blvd Class 2	Las Plumas Ave	Wyandotte Ave	Class 2	1.42	_		Completed		X	X	X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
33	1,033	OR-BIKE-LOCAL-2020-10	2,035	City of Oroville	Bike/Ped	Feather River Trail (North) Class 1	Table Mountain Bridge	SR 70 Bridge	Class 1	3.09	2009	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
34	1,034	OR-BIKE-LOCAL-2020-11	2,035	City of Oroville	Bike/Ped	5th Ave Class 2	SR 162	Safford St	Class 2	0.87	16	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
35	1,035	OR-BIKE-LOCAL-2020-12	2,035	City of Oroville	Bike/Ped	Veatch St Class 2	SR 162	Robinson St	Class 2	0.68	12	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
36	1,036	OR-BIKE-LOCAL-2020-13	2,035	City of Oroville	Bike/Ped	Power Lines ROW Class 1	Olive Hwy	Old Ferry Rd	Class 1	1.59	1034	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
37	1,037	OR-BIKE-LOCAL-2020-14	2,035	City of Oroville	Bike/Ped	Railroad Class 1	SR 162	Daryl Porter Way	Class 1	0.72	468	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
38	1,038	OR-BIKE-LOCAL-2020-15	2,035	City of Oroville	Bike/Ped	Feather River / Hwy 70 Class 1	SR 162	Montgomery St	Class 1	0.65	423	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
39	1,039	OR-BIKE-LOCAL-2020-16	2,035	City of Oroville	Bike/Ped	Robinson St Class 2	Oliver St	Feather River Blvd	Class 2	1.03	19	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
40	1,040	OR-BIKE-LOCAL-2020-17	2,035	City of Oroville	Bike/Ped	Montgomery St Class 2	Bridge St	Hwy 70	Class 2	1.88	34	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
41	1,041	OR-BIKE-LOCAL-2020-18	2,035	City of Oroville	Bike/Ped	Gilmore Ln Class 2	Oro-Dam Blvd	Executive Parkway	Class 2	0.22	4	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
42	1,042	OR-BIKE-LOCAL-2020-19	2,035	City of Oroville	Bike/Ped	Bird St Class 2	Washington Ave	Feather River Blvd	Class 2	1.23	22	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
25	1,025	OR-BIKE-LOCAL-2020-2	2,035	City of Oroville	Bike/Ped	Railroad Class 1	Villa Ave	SR 162	Class 1	5.09	3309	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
43	1,043	OR-BIKE-LOCAL-2020-20	2,035	City of Oroville	Bike/Ped	Bridge St Class 2	Oro-Dam Blvd E	Montgomery St	Class 2	0.58	10	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
44	1,044	OR-BIKE-LOCAL-2020-21	2,035	City of Oroville	Bike/Ped	Oroville Dam Blvd Class 2	Oro-Quincy Hwy	Acacia Ave	Class 2	0.71	13	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
45	1,045	OR-BIKE-LOCAL-2020-22	2,035	City of Oroville	Bike/Ped	Oliver St Class 2	Robinson St	Montgomery St	Class 2	0.20	4	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
46	1,046	OR-BIKE-LOCAL-2020-23	2,035	City of Oroville	Bike/Ped	Orange Ave Class 2	Washington Ave	Montgomery St	Class 2	0.31	6	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
47	1,047	OR-BIKE-LOCAL-2020-24	2,035	City of Oroville	Bike/Ped	Norton St Class 2	Bridge St	Montgomery St	Class 2	0.14	3	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
48	1,048	OR-BIKE-LOCAL-2020-25	2,030	City of Oroville	Bike/Ped	Oroville Dam Blvd Class 2	Olive Hwy	Oro-Quincy Hwy	Class 2	0.32	6	LOCAL	Planned			X	X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
49	1,049	OR-BIKE-LOCAL-2020-26	2,030	City of Oroville	Bike/Ped	Oro-Quincy Hwy Class 2	Oroville Dam Blvd	Foothill Blvd	Class 2	0.33	6	LOCAL	Planned			X	X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
50	1,050	OR-BIKE-LOCAL-2020-27	2,035	City of Oroville	Bike/Ped	Lincoln Blvd Class 2	Wyandotte Ave	SR 162	Class 2	0.25	5	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
26	1,026	OR-BIKE-LOCAL-2020-3	2,035	City of Oroville	Bike/Ped	Oroville Wildlife Area (A) Class 1	Pacific Heights Rd	Larkin Rd	Class 1	2.33	1515	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
27	1,027	OR-BIKE-LOCAL-2020-4	2,035	City of Oroville	Bike/Ped	Lincoln Blvd Class 2	Ophir Rd	Monte Vista Ave	Class 2	0.76	14	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
28	1,028	OR-BIKE-LOCAL-2020-5	2,035	City of Oroville	Bike/Ped	Oroville Wildlife Area (B) Class 1	Pacific Heights Rd	Larkin Rd	Class 1	1.57	1021	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
29	1,029	OR-BIKE-LOCAL-2020-6	2,035	City of Oroville	Bike/Ped	5th Ave Class 2	Ophir Rd	SR 162	Class 2	2.43	44	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
30	1,030	OR-BIKE-LOCAL-2020-7	2,035	City of Oroville	Bike/Ped	Pacific Heights Rd Class 2	Mathews Readymix	0.25 miles north of start	Class 2	0.27	5	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)

BIKE AND PEDESTRIAN PROJECTS v4

#	IMP1 PRJID	Project ID	Implementation Year	Implementing Agency	Project Type	Title	Segment		Project Description	New Class I or II (miles)	Fund Total Estimate (1,000s)	Primary Fund Source	Status	2020 RTP Analysis Year					In 2016 RTP/SCS (for reference)	ORIGINATING SOURCE: General Plan, Nexus, Specific Plan, Traffic or Corridor Study, Etc.
							Start	End						2018 - Model Base Year	2020 RTP Base Year	2030 Mile-stone	2035 GHG Year	2040 RTP Horizon		
31	1,031	OR-BIKE-LOCAL-2020-8	2,035	City of Oroville	Bike/Ped	SR 162 Class 2	20th St	10th St	Class 2	1.22	22	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
32	1,032	OR-BIKE-LOCAL-2020-9	2,035	City of Oroville	Bike/Ped	Wyandotte Ave Class 1 or 2	Lincoln Blvd	Olive Hwy	Class 2	0.78	14	LOCAL	Planned				X	X	Yes	2010, City of Oroville Bike Plan (1st Priority)
51	1,051	PAR-BIKE-LOCAL-2020-1	2,020	Town of Paradise	Bike/Ped	Maxwell Dr Class 2	Elliott Rd	Skyway	Class 2	0.58	_		Completed		X	X	X	X	Yes	2012, Town of Paradise Master Bicycle and Pedestrian Plan
5	1,005	20200000129	2,030	Caltrans	Bike/Ped	SR 32 ADA Curb Ramps	Walnut St	Poplar St	SR 32 - In Chico, from Walnut	0.00	5400	SHOPP	Programmed			X	X	X	No	SHOPP
2	1,002	20200000198	2,030	City of Biggs	Bike/Ped	Safe Routes to Schools Program	H St	Bannock St	Class 2	0.32	1500	CMAQ/ATP	Programmed			X	X	X	No	BCAG - 2020 RTP Consultation
20	1,020	20200000215	2,030	City of Gridley	Bike/Ped	Central Gridley Pedestrian Connectivity and Equal Access Project	Central Gridley - (Sycamore, Magnolia, Indiana, and Vermont St.)		Install ADA curb ramps and detectable	0.00	1500	CMAQ	Programmed			X	X	X	No	Gridley Bike and Ped Plan
6	1,006	20200000218	2,030	Butte County	Bike/Ped	Palermo/South Oroville SRTS Project (Phase 3)	Palermo Area		Curb, gutter, sidewalk,	0.00	2350	ATP/CMAQ/LOCAL	Programmed			X	X	X	Yes	BCAG - 2020 RTP Consultation
3	1,003	BC-BIKE-ATP-2020-1	2,030	Butte County	Bike/Ped	Butte County Safe Routes Resource Center	Countywide			0.00	1140	ATP	Programmed			X	X	X	No	BCAG - 2020 RTP Consultation
6	1,006	Nexus 708	2,030	City of Chico	Bike/Ped	SR 32 (Nord Avenue) Improvements	W. Lindo Ave	W. 1st St	From W. Lindo Ave to W. 1st	0.00	15000	LOCAL	Unconstrained			X	X	X	No	Chico Nexus

STATUS FIELD:

Programmed (constrained) – all FTIP projects

Planned (constrained) – all projects which could reasonably be assumed funded, via BCAG or locally, by the year 2040

Project Development Only (constrained) – projects that are anticipated to begin early stages of development including project planning, design, preliminary engineering, environmental clearance, and ROW acquisition by 2040. These projects remain eligible to seek federal and state funding, but under the financial constraint requirements for forecasting revenues, the construction phase is not included in the 2020 RTP/SCS.

Unconstrained – all other projects outside of the constrained list

Appendix E:
Model Scenario Reporting Tables

Modeling Parameters	2018	2020	2035	2040		Data Source(s)
	2020 RTP	2020 RTP	2020 RTP	2020 RTP	2016 RTP	
	2020 RTP Model	2020 RTP Model	2020 RTP Model	2020 RTP Model	2020 RTP Model	
TRIP DATA						
Number of Vehicle trips by trip purpose						BCAG Regional Travel Demand Model
- Home-based work	68,543	60,684	79,866	82,954	100,337	
- Home-based school	36,693	34,278	42,128	40,620	36,385	
- Home-based college	37,883	33,487	42,425	43,877	37,256	
- Home-based shopping	139,995	120,788	164,507	169,763	210,310	
- Home-based casino	9,531	2,553	3,357	3,486	4,326	
- Home-based others	98,275	82,549	108,546	112,713	139,883	
- Non home-based	127,255	130,912	145,008	149,141	167,745	
By trip purpose						
Average auto trip length (miles)	5.94	5.89	5.93	5.81	5.95	BCAG Regional Travel Demand Model
Average auto travel time (minutes)	13.26	13.51	13.53	13.52	13.83	
PERCENT PASSENGER TRAVEL MODE SHARE (whole day)						
Auto	81.72%	81.21%	82.06%	82.12%	82.99%	BCAG Regional Travel Demand Model
All Other (transit & non-motorized)	18.28%	18.79%	17.94%	17.88%	17.01%	
SOV	39.66%	39.10%	39.68%	39.77%	39.83%	
HOV	42.06%	42.11%	42.39%	42.34%	43.16%	
Public transit (Regular Bus)	4.18%	4.38%	4.23%	4.30%	4.01%	
Non-Motorized: Bike and Walk	12.37%	12.69%	12.03%	12.01%	11.74%	
Other (i.e. School bus)	1.73%	1.72%	1.68%	1.57%	1.26%	
TRANSPORTATION USER COSTS AND PRICING						
Vehicle operating costs ($ per mile)	0.210	0.2084	0.189	0.185	0.185	CARB

	2016 RTP		2020 RTP	
Measure	**Base Year (2014)**	**Year 2040**	**Base Year (2018)**	**Year 2040 Project**
Percentage of Trips by Pedestrian and Bicycle Mode Share	Bike 2.13%	Bike 2.93%	1.99%	2.03%
	Ped 5.63%	Ped 7.76%	10.37%	9.99%
Average Peak Period Vehicle Travel Time (minutes)	12.87	14.43	16.7	16.48
Average Peak Period Vehicle Trips	AM 94,038	AM 135,219	75,240	82,329
	PM 152,007	PM 217,882	100,768	113,598
Percentage of Congested Highway VMT	0%	19%	0%	0%

Butte County VMT Summary								
Scenario	VMT (w/o X-X Trips)	XX VMT	IX-XI VMT	Total (w/ X-X Trips)	% of X-X Trips	% of IX-XI Trips	Population	VMT per Capita
2018 Base	4,705,417	164,146	700,748	4,869,563	3.40%	14.39%	222,378	21.2
2020 Base	4,343,919	164,153	697,312	4,508,072	3.60%	15.47%	223,157	19.5
2030 Base	4,883,463	169,430	445,363	5,052,893	3.40%	8.81%	242,293	20.2
2035 Base	5,181,813	181,958	485,998	5,363,771	3.40%	9.06%	251,863	20.6
2040 Project	5,332,327	195,390	504,900	5,527,717	3.50%	9.13%	259,524	20.5
2040 No Project	6,216,655	195,396	559,905	6,412,051	3.00%	8.73%	319,342	19.5
2040 Unconstrained	5,356,425	195,390	507,274	5,551,815	3.50%	9.14%	259,524	20.6
2040 Environmentally Superior	5,303,598	195,390	504,900	5,498,988	3.60%	9.18%	259,524	20.4
2040 Environmentally Superior (with TDM)	5,294,261	195,390	504,633	5,489,651	3.60%	9.19%	259,524	20.4

Butte County Daily VMT Summary By Speed Bin

Speed Bin	2018	2020	2030	2035	2040 Project	2040 No Project	2040 Unconstrained	2040 Environmentally Superior	2040 Environmentally Superior (with TDM)
0 - 5	438	394	1,884	1,980	2,351	1,359	2,347	2,351	2,349
5 - 10	9,628	9,210	8,532	8,905	8,956	10,978	8,990	8,957	8,954
10 - 15	7,845	1,352	7,751	15,727	8,649	8,198	7,854	8,076	8,057
15 - 20	51,135	27,109	41,749	48,156	51,069	60,799	34,569	51,223	50,326
20 - 25	320,083	298,946	351,346	361,426	374,073	447,849	371,470	371,411	371,706
25 - 30	85,319	80,203	86,224	90,330	100,859	102,294	86,377	100,153	99,770
30 - 35	1,041,924	889,159	1,059,805	1,116,167	1,121,834	1,331,362	1,088,341	1,111,496	1,109,424
35 - 40	121,707	135,858	120,224	127,427	133,573	158,787	128,149	134,140	133,926
40 - 45	671,693	589,758	666,805	702,054	714,922	826,816	723,260	709,329	708,309
45 - 50	178,044	161,178	166,547	175,925	180,978	223,824	225,093	181,588	181,638
50 - 55	441,137	389,787	392,845	416,563	425,444	481,229	423,670	424,209	423,510
55 - 60	49,368	36,762	37,929	23,746	24,172	362,700	88,497	24,161	24,133
60 - 65	1,727,096	1,724,202	1,941,822	2,093,408	2,185,444	2,200,462	2,167,807	2,176,504	2,172,160
65 - 70	0	0	0	0	0	0	0	0	0
70 - 75	0	0	0	0	0	0	0	0	0
>75	0	0	0	0	0	0	0	0	0
VMT (w/o X-X Trips)	4,705,417	4,343,919	4,883,463	5,181,813	5,332,327	6,216,655	5,356,425	5,303,598	5,294,261
XX VMT	164,146	164,153	169,430	181,958	195,390	195,396	195,390	195,390	195,390
Total (w/ X-X Trips)	4,869,563	4,508,072	5,052,893	5,363,771	5,527,717	6,412,051	5,551,815	5,498,988	5,489,651
% of X-X Trips	3.4%	3.6%	3.4%	3.4%	3.5%	3.0%	3.5%	3.6%	3.6%
IX-XI VMT	700,748	697,312	445,363	485,998	504,900	559,905	507,274	504,900	504,633
Population	222,378	223,157	242,293	251,863	259,524	319,342	259,524	259,524	259,524
VMT per Capita	21.2	19.5	20.2	20.6	20.5	19.5	20.6	20.4	20.4

Appendix F:
Model Use Metadata for Key Inputs

Attribute	Description
TAZ	Traffic Analysis Zone ID Number
SF_DU	Number of Single Family Dwelling Units
MF_DU	Number of Multifamily Dwelling Units
MH_DU	Number of Multifamily High Units
RET_KSF	Total Retail Square Footage (KSF)
RRET_KSF	Total Regional Retail Square Footage (KSF)
IND_KSF	Total Industrial Square Footage (KSF)
OFF_KSF	Total Office Square Footage (KSF)
MED_KSF	Total Medical Office Square Footage (KSF)
HOSP_KSF	Total Hospital Square Footage (KSF)
PQP_KSF	Total Public/Quasi-Public Square Footage (KSF)
HOTEL_RMS	Number of Hotel Rooms
UNIV_STU	Number of University Students
CC_STU	Number of Community College Students
K12_STU	Number of K12 Students
PARK_AC	Acres of Park
CASINO_SLT	Number of Slot Machines at a Casino

Attribute	Description
TAZ	Traffic Analysis Zone ID Number
Jurisdiction	Jurisdiction TAZ centroid falls within
HH101	The percentage of households with 1 person, 0 worker, and income group 1
HH102	The percentage of households with 1 person, 0 worker, and income group 2
HH103	The percentage of households with 1 person, 0 worker, and income group 3
HH104	The percentage of households with 1 person, 0 worker, and income group 4
HH111	The percentage of households with 1 person, 1 worker, and income group 1
HH112	The percentage of households with 1 person, 1 worker, and income group 2
HH113	The percentage of households with 1 person, 1 worker, and income group 3
HH114	The percentage of households with 1 person, 1 worker, and income group 4
HH201	The percentage of households with 2 person, 0 worker, and income group 1
HH202	The percentage of households with 2 person, 0 worker, and income group 2
HH203	The percentage of households with 2 person, 0 worker, and income group 3
HH204	The percentage of households with 2 person, 0 worker, and income group 4
HH211	The percentage of households with 2 person, 1 worker, and income group 1
HH212	The percentage of households with 2 person, 1 worker, and income group 2
HH213	The percentage of households with 2 person, 1 worker, and income group 3
HH214	The percentage of households with 2 person, 1 worker, and income group 4
HH221	The percentage of households with 2 person, 2 worker, and income group 1
HH222	The percentage of households with 2 person, 2 worker, and income group 2
HH223	The percentage of households with 2 person, 2 worker, and income group 3
HH224	The percentage of households with 2 person, 2 worker, and income group 4
HH301	The percentage of households with 3 person, 0 worker, and income group 1
HH302	The percentage of households with 3 person, 0 worker, and income group 2
HH303	The percentage of households with 3 person, 0 worker, and income group 3
HH304	The percentage of households with 3 person, 0 worker, and income group 4
HH311	The percentage of households with 3 person, 1 worker, and income group 1
HH312	The percentage of households with 3 person, 1 worker, and income group 2
HH313	The percentage of households with 3 person, 1 worker, and income group 3
HH314	The percentage of households with 3 person, 1 worker, and income group 4
HH321	The percentage of households with 3 person, 2 worker, and income group 1
HH322	The percentage of households with 3 person, 2 worker, and income group 2
HH323	The percentage of households with 3 person, 2 worker, and income group 3
HH324	The percentage of households with 3 person, 2 worker, and income group 4
HH331	The percentage of households with 3 person, 3 worker, and income group 1
HH332	The percentage of households with 3 person, 3 worker, and income group 2
HH333	The percentage of households with 3 person, 3 worker, and income group 3

Attribute	Description
HH334	The percentage of households with 3 person, 3 worker, and income group 4
HH401	The percentage of households with 4 person, 0 worker, and income group 1
HH402	The percentage of households with 4 person, 0 worker, and income group 2
HH403	The percentage of households with 4 person, 0 worker, and income group 3
HH404	The percentage of households with 4 person, 0 worker, and income group 4
HH411	The percentage of households with 4 person, 1 worker, and income group 1
HH412	The percentage of households with 4 person, 1 worker, and income group 2
HH413	The percentage of households with 4 person, 1 worker, and income group 3
HH414	The percentage of households with 4 person, 1 worker, and income group 4
HH421	The percentage of households with 4 person, 2 worker, and income group 1
HH422	The percentage of households with 4 person, 2 worker, and income group 2
HH423	The percentage of households with 4 person, 2 worker, and income group 3
HH424	The percentage of households with 4 person, 2 worker, and income group 4
HH431	The percentage of households with 4 person, 3 worker, and income group 1
HH432	The percentage of households with 4 person, 3 worker, and income group 2
HH433	The percentage of households with 4 person, 3 worker, and income group 3
HH434	The percentage of households with 4 person, 3 worker, and income group 4
HH441	The percentage of households with 4 person, 4 worker, and income group 1
HH442	The percentage of households with 4 person, 4 worker, and income group 2
HH443	The percentage of households with 4 person, 4 worker, and income group 3
HH444	The percentage of households with 4 person, 4 worker, and income group 4
RET_L	The percentage of retail trips that are associated with low income employees
RET_M	The percentage of retail trips that are associated with medium income employees
RET_H	The percentage of retail trips that are associated with high income employees
RRET_L	The percentage of regional retail trips that are associated with low income employees
RRET_M	The percentage of retail trips that are associated with medium income employees
RRET_H	The percentage of retail trips that are associated with high income employees
IND_L	The percentage of industrial trips that are associated with low income employees
IND_M	The percentage of industrial trips that are associated with medium income employees
IND_H	The percentage of industrial trips that are associated with high income employees
OFF_L	The percentage of office trips that are associated with low income employees
OFF_M	The percentage of office trips that are associated with medium income employees
OFF_H	The percentage of office trips that are associated with high income employees
MED_L	The percentage of medical trips that are associated with low income employees
MED_M	The percentage of medical trips that are associated with medium income employees
MED_H	The percentage of medical trips that are associated with high income employees
HOSP_L	The percentage of hospital trips that are associated with low income employees

Attribute	Description
HOSP_M	The percentage of hospital trips that are associated with medium income employees
HOSP_H	The percentage of hospital trips that are associated with high income employees
PQP_L	The percentage of public/quasi-public trips that are associated with low income employees
PQP_M	The percentage of public/quasi-public trips that are associated with medium income employees
PQP_H	The percentage of public/quasi-public trips that are associated with high income employees
CAS_L	The percentage of Casinotrips that are associated with low income employees
CAS_M	The percentage of Casinotrips that are associated with medium income employees
CAS_H	The percentage of Casinotrips that are associated with high income employees
HBWL_IX	The percentage of home-based work trips that are from low income households and start inside the model boundary but end outside the model boundary
HBWM_IX	The percentage of home-based work trips that are medium income households and start inside the model boundary but end outside the model boundary
HBWH_IX	The percentage of home-based work trips that are high income households and start inside the model boundary but end outside the model boundary
HBO_IX	The percentage of home-based other trips that start inside the model boundary but end outside the model boundary
NHB_IX	The percentage of non-home-based trips that start inside the model boundary but end outside the model boundary
SCHOOL_IX	The percentage of school trips that start inside the model boundary and end outside of the model boundary
UNIV_IX	The percentage of university trips that start inside the model boundary and end outside of the model boundary
Casino_IX	The percentage of caisno trips that start inside the model boundary and end outside of the model boundary
MT_IX	The percentage of medium truck trips that start inside the model boundary and end outside of the model boundary
HT_IX	The percentage of heavy truck trips that start inside the model boundary and end outside of the model boundary
HBWL_XI	The percentage of home-based work trips that are from low income households that start outside of the model boundary and end inside of the model boundary
HBWM_XI	The percentage of home-based work trips that are from medium income households that start outside of the model boundary and end inside of the model boundary
HBWH_XI	The percentage of home-based work trips that are from high income households that start outside of the model boundary and end inside of the model boundary
HBO_XI	The percentage of home-based work trips that are medium income households and start outside the model boundary but end inside the model boundary
NHB_XI	The percentage of non-home-based trips that start outside the model boundary but end inside the model boundary
SCHOOL_XI	The percentage of school trips that start outside the model boundary and end inside of the model boundary
UNIV_XI	The percentage of university trips that start outside the model boundary and end inside of the model boundary
Casino_XI	The percentage of casino trips that start outside the model boundary and end inside of the model boundary
MT_XI	The percentage of medium truck trips that start outside the model boundary and end inside of the model boundary
HT_XI	The percentage of heavy truck trips that start outside the model boundary and end inside of the model boundary

GATEWAYS

Attribute	Description
TAZ	Traffic Analysis Zone ID Number
IX_A	Total IX attractions associated with the gateway zone
XI_P	Total XI productions associated with the gateway zone
HBWL_P	Total home-based work productions from low-income households associated with the gateway zone
HBWM_P	Total home-based work productions from medium-income households associated with the gateway zone
HBWH_P	Total home-based work productions from high-income households associated with the gateway zone
HBO_P	Total home-based other productions associated with the gateway zone
NHB_P	Total non home-based productions associated with the gateway zone
SCHOOL_P	Total school productions associated with the gateway zone
CASINO_P	Total casino productions associated with the gateway zone
UNIV_P	Total university productions associated with the gateway zone
MT_P	Total Medium Truck productions associated with the gateway zone
HT_P	Total Heavy Truck productions associated with the gateway zone
SP1_P	Total SP1 productions associated with the gateway zone
HBWL_A	Total home-based work attractions from low-income households associated with the gateway zone
HBWM_A	Total home-based work attractions from medium-income households associated with the gateway zone
HBWH_A	Total home-based work attractions from high-income households associated with the gateway zone
HBO_A	Total home-based other attractions associated with the gateway zone
NHB_A	Total non home-based attractions associated with the gateway zone
SCHOOL_A	Total school attractions associated with the gateway zone
CASINO_A	Total casino attractions associated with the gateway zone
UNIV_A	Total university attractions associated with the gateway zone
MT_A	Total Medium Truck attractions associated with the gateway zone
HT_A	Total Heavy Truck attractions associated with the gateway zone
SP1_A	Total SP1 attractions associated with the gateway zone

Attribute	Description
A	A node
B	B node
DISTANCE	Link distance in miles
CAPCLASS	Model Capacity Class
LANES	Number of directional through vehicle travel lanes
NAME	Roadway Name
ROUTE	Route Number for state routes or interstates
TERRAIN	Terrain
JURISDICTIO	Jurisdiction
SCREENLINE	Screenline number
SPEED	Freeflow speed
AREATYP	Area type
FACTYP	Faclity Type
AUX	Vehicle lane capacity adjustment for Auxiliary lane
USE	Use code for vehicle type
TOLL	Toll in dollars per mile
IMPROVED	Flag change from base year
TSM	Transportation System Management flag
EJ	Environmental Justice flag
A01_VOL	AM 1hr Directional Volume
TOT_A01_VOL	AM 1hr Total Volume
A03_VOL	AM 3hr Directional Volume
TOT_A03_VOL	AM 3hr Total Volume
M07_VOL	Mid-day 7hr Directional Volume
TOT_M07_VO	Mid-day 7hr Total Volume
P01_VOL	PM 1hr Directional Volume
TOT_P01_VOL	PM 1hr Total Volume
P03_VOL	PM 3hr Directional Volume
TOT_P03_VOL	PM 3hr Total Volume
E11_VOL	Evening 11hr Directional Volume
TOT_E11_VOL	Evening 11hr Total Volume
D24_VOL	Daily Directional Volume
TOT_D24_VOL	Daily Total Volume
A01_ASG_SP	AM 1hr congested speed
A03_ASG_SP	AM 3hr congested speed
M07_ASG_SP	Mid-day 7hr congested speed
P01_ASG_SP	PM 1hr congested speed
P03_ASG_SP	PM 3hr congested speed
E11_ASG_SP	Evening 11hr congested speed
AIRBASIN	Air Basin for Air Quality Analysis