TAHOE REGIONAL PLANNING AGENCY
TRANSPORTATION

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MEMORANDUM

DATE: December 19, 2016
TO: Amy Volz, Air Pollution Specialist
Terry Roberts, Manager, Sustainable Communities Policy & Planning
FROM: Nick Haven, Long Range and Transportation Planning Manager
RE: 2017 Regional Transportation Plan / Sustainable Communities Strategy Modeling, Background, and Greenhouse Gas Emission Reduction Target Update Information

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The purpose of this memorandum is to present TRPA/TMPO's 2017 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) greenhouse gas (GHG) target analysis, explain the main differences between 2012's and 2016's analysis, and provide background for updating future GHG reduction targets.

BACKGROUND:
Pursuant to the California Air Resources Board (CARB) recommended approach contained in the "Description of Methodology for ARB Staff Review of Greenhouse Gas Reductions from Sustainable Communities[1]" TRPA/TMPO fulfilled CARB's requirements of utilizing a technical methodology for evaluating the reductions in GHG emissions attributable to an SCS and to determine whether the SCS, if implemented, would meet the targets for passenger vehicles set by CARB. On May 16, 2016, TRPA/TMPO submitted for CARB review, the draft methodology for calculating GHG emissions per-capita for the Lake Tahoe Region (attached). On June 16, 2016 CARB responded to the methodology (attached) indicating that they would request supporting information from TRPA/TMPO as it becomes available. This memorandum serves as the supporting information requested consistent with the recommended CARB approach.

MODEL DOCUMENTATION:
As part of the TRPA 2012 Regional Plan Update and the 2012 TMPO RTP/SCS, staff started the process of compiling the appropriate documentation to update the TransCAD Tour Based Model. Since that time, additional updates to the model and associated documentation have been completed and is attached for reference herein titled; Methodology for estimating Vehicle Miles Traveled and Greenhouse Gas Reductions in the 2016 Regional Transportation Plan Update, TRPA-TMPO, Nov. 2016. Consistent with CARB's recommendation, TRPA/TMPO underwent an independent peer review of both the static and dynamic model validation performance (attached). As

[1] CARB, July 2011

indicated, the model was determined to meet all static and dynamic validation tests consistent with the Caltrans Regional Transportation Plan Guidelines.

DOCUMENTATION OF OFF-MODEL TOOLS OR METHODS USED:
The TRPA/TMPO maintains a Trip Reduction Impact Analysis (TRIA) spreadsheet tool to evaluate the trip and vehicle miles travelled (VMT) reduction impacts of various transportation policies and programs that are considered under the RTP/SCS effort. The purpose of the TRIA is to provide planning-level, order of magnitude comparative analysis of the impacts such as the construction of new bike trails and sidewalks, transit improvements, traveler information systems and other programs have on the reduction of auto trips, VMT and GHG emissions.

2016 RTP/SCS TARGET ANALYSIS RESULTS:
A key element of the Tahoe Region RTP/SCS is to demonstrate that the transportation and land-use changes proposed in the plan will allow the Region to reach its major environmental thresholds in conjunction with the goals of Senate Bill 375. Based on its authority under SB 375, the California Air Resources Board requires the Tahoe Region to create a plan to reduce GHG emissions from cars and light trucks by 7 percent per-capita by 2020, and 5 percent per-capita by 2035, as compared to 2005 levels. To determine if the Tahoe Region will meet these GHG reduction targets, TRPA/TMPO analyzed the impacts that planned land-use patterns identified in the TRPA Regional Plan and planned transportation strategies will have on Lake Tahoe's baseline vehicle trips and resulting GHG emissions.

The results of the analysis are shown in the following table which identifies that drivers within the California portions of the Lake Tahoe Basin generated approximately 445 tons of GHG emissions per day in 2005. The table also shows that investments in sustainable transportation systems and the land-use patterns are sufficient to reduce GHG emissions on the California side of the basin by the targeted amount. Despite a gradual increase in total vehicle miles traveled as a result of modest resident population growth and continued increased visitation, per-capita GHG emissions would be reduced from 2005 values by 8.8 percent by 2020 and by 5 percent by 2035[2]. It is important to note that the GHG reductions are greater in 2020 than in 2035 because the Tahoe Region is expected to reach build-out prior to the 2030 timeframe, at which time the resident population is projected to remain static while visitor VMT will continue to increase as the population in the surrounding regions continue to grow.

[2] The greenhouse gas reductions per capita are greater in 2020 than in 2035 because the Tahoe Region is expected to reach build-out around 2030. At that time, the population will remain the same but visitor vehicle miles traveled will continue to increase slightly as the population in the surrounding regions continues to grow.

Table 1: 2017 RTP/SCS Greenhouse Gas Emission Results

	2005	2020	2035
Population Forecasts	41,377	43,341	45,166
Air Resources Board Targets			
% Reduction in CO_2 per capita from 2005 values (ARB Targets)		7.0%	5.0%
Sustainable Communities Strategy Forecast			
Total Daily VMT	1,041,890	1,038,998	1,149,601
Total Daily CO_2 equivalents (tons) from Daily VMT	445	430	469
Total Daily CO_2 equivalents reduced by additional use of electric vehicles		428	461
CO_2 per capita (lbs.)	21.5	19.8	20.4
% Reduction in CO_2 per capita from 2005 values – Linking Tahoe forecast		8.8%	5.0%

Comparison of 2012 and 2016 GHG Analysis:
As part of the 2012 TRPA/TMPO RTP/SCS submittal, staff forecasted that per-capita GHG reduction values would be 12.1 percent in 2020 and 7.2 percent by 2035 below the 2005 base year. As shown above, our most recent forecast for 2020 indicates an 8.8 per-capita reduction and 5 percent per-captia reduction for 2035 below the 2005 base year. A significant factor between the two forecasts is due to the update to our TransCAD socio-economic database. Early in 2013, TRPA/TMPO started to compile updated Census and Employment data to better reflect our spatial and demographic changes. The resulting update coupled with better coordination of the forecasted growth from adjacent counties at our external stations increased our VMT forecast for 2020 by 113,848. This updated data and the use of the EMFAC2014 model resulted in a more up-to-date 2016 projected per-capita reductions. Though the anticipated percentage reductions are lower than predicted in 2012, this does not reflect a change in policy direction or project prioritization. TRPA/TMPO is committed to planning, funding, and encouraging implementation of a sustainable transportation system that improves the environment through coordinated land-use and transportation strategies that reduce reliance on the automobile, enhance multi-modal options, encourage the use of zero emission vehicles, and reduce congestion through dynamic traffic flow control.

Background on Updating GHG Targets:
TRPA estimates that prior to the 2035 time frame, the percent of VMT associated with visitors to the region will increase beyond 51 percent of all VMT in the Region. While these visitor miles must be included in the per-capita GHG emissions calculation, the accounting of the population associated with that VMT is not. Equally important to note, is the increasing number of vacation rentals that are occurring around the Region that

were previously occupied by year-round residents and the recent amount of approved growth located just outside the basin that increases visitor VMT but does not increase the overall resident population. Future target recommendations from TRPA will be based on the current 2017 RTP analysis described above. As CARB works with MPOs to develop the next round of GHG targets, we would welcome a discussion of possibility adjusting the role that visitor travel has on tourist areas like the Tahoe Region and the calculation of future GHG targets. TRPA anticipates providing updated target recommendations to CARB in the spring of 2017.

Next Steps:
TRPA/TMPO plans to release the draft 2017 Regional Transportation Plan and associated environmental document in February of 2017. The agency will use the release of this plan to begin the public and agency stakeholder outreach process of vetting the current GHG reduction target analysis to determine future reduction targets. This work should be conducted in tandem with CARB on working to identify strategies to better reflect the unique travel patterns and population considerations of the Lake Tahoe Region.

We look forward to continuing our work with CARB, the public, and agency stakeholders on establishing future GHG reduction targets. Please contact me or my staff with additional questions at 775-589-5256 or nhaven@trpa.org.

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DATE: May 16, 2016

TO: Nicole Dolney, Chief of the Transportation Planning Branch, California Air Resources Board (ARB)

FROM: Tahoe Regional Planning Agency (TRPA) and Tahoe Metropolitan Planning Organization (TMPO)

RE: Methodology for estimating greenhouse gas emissions reductions from the Sustainable Communities Strategy for the Lake Tahoe Region

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Overview

This memorandum describes the draft methodology for calculating greenhouse gas emissions per capita for the Lake Tahoe Region. This information is provided in accordance with California's Senate Bill 375 (SB 375), the Sustainable Communities and Climate Protection Act of 2008. The methodology utilizes three tools or components:

- Lake Tahoe's Activity-Based Transportation Model
- The Trip Reduction Impact Analysis (TRIA)Tool, a post-processor spreadsheet model
- Calculation of the share of vehicle miles traveled (VMT) attributable to the California portion of the Lake Tahoe Region; and modeling greenhouse gas estimates using ARB's EMFAC2014 model

Background

Since the development of the bi-state Tahoe Regional Planning Compact (Public Law 96-551) in 1969, planning efforts in the Lake Tahoe Basin have engaged citizens in creating a vision for the future of Tahoe that will balance preservation of its natural beauty with its economic viability. A significant part of this vision is a reduction in dependence on automobiles as the primary means of transportation, in order to reduce the impacts on the environment and on the built form.

Recently, mitigation of climate change impacts has emerged as a high priority for all communities in California. SB 375 requires regional metropolitan planning organizations (MPOs) to focus regional land use and transportation policies to reduce greenhouse gas emissions (GHG) in order to meet targets established by the California Air Resources Board. SB 375 calls for each MPO to develop a Sustainable Communities Strategy (SCS) with its Regional Transportation Plan, identifying how regional GHG will be reduced to meet the regional targets.

Tahoe Regional Planning Agency (TRPA) and TMPO Planning Responsibilities

TRPA operates under the authority of the bi-state Tahoe Regional Planning Compact (Public Law 96-551) between the states of California and Nevada and is required to regulate transportation and land use. TRPA also serves as the Tahoe Metropolitan Planning Organization (TMPO) for the Basin and in this role is responsible for development of the region's long-range transportation plan to meet state and federal requirements. Because of these requirements, TRPA is involved in several on-going planning processes related to transportation, land use, and the environment, including:

- Achieving the Environmental Thresholds of the bi-state Compact;
- Regularly updating the TRPA Regional Plan;
- Regularly updating the Regional Transportation Plan (RTP) (per California and federal law);
- Updating the region's Sustainable Communities Strategy (SCS) under California state law, as part of the update of the Regional Transportation Plan.

As the primary authority regulating land use in the Lake Tahoe Basin, TRPA is responsible for developing a land use plan that, when integrated with transportation and housing strategies, supports the goals of SB 375. The Sustainable Communities Strategy must rely on the transportation strategies of the RTP and the land use strategies of the Regional Plan to meet the Lake Tahoe GHG targets. In 2012 the Regional Plan underwent a major update, incorporating new land use strategies to help meet regional greenhouse gas targets.

Updates since the 2012 Regional Transportation Plan

In the 2016 RTP/SCS, called *Linking Tahoe*, the TMPO will use the same land use assumptions that it used in the 2012 RTP/SCS, and anticipates building upon the transportation strategies that were presented in that plan.

As part of the development of the 2012 Regional Plan Update and the 2012 RTP/SCS, the TRPA and the TMPO considered and evaluated five different land use strategies. In December of 2012, the TRPA Governing Board approved Alternative 3, the "Low Development, Highly

Incentivized Redevelopment" scenario. In developing the 2016 RTP/SCS, the TMPO determined that the land use regulations that were in place as of December 31, 2014, were the appropriate regulations to use as the land use component of the strategy. The Alternative 3 land use strategies approved in December of 2012 were still wholly in place with no modifications that would affect the SCS as of December 31, 2014. Although the land use strategies themselves have not changed since the 2012 analysis, the TRPA and TMPO have made some improvements to the modeling, and will be better able to model forecasted transfers of commercial floor area and tourist accommodation units in the 2016 RTP/SCS.

The TMPO anticipates making some updates to the estimated VMT and greenhouse gas reductions associated with the transportation strategies. The updates will include a review of recent research and incorporation of new findings into the reduction estimates, and incorporation of new strategies, pending public and board input. In particular the TMPO anticipates inclusion of new transit strategies, as new strategies are currently being developed through updates to short- and long-range transit plans.

The Transportation Vision for Lake Tahoe

Through an extensive public planning process to update the TRPA's Regional Plan in 2012, the TRPA developed a transportation vision statement, which is reflected in the 2012 Regional Transportation Plan, *Mobility 2035:*

> *An innovative multimodal transportation system is in place that gives priority to viable alternatives to the private automobile, appeals to users, and serves mobility needs, while improving the environmental and socioeconomic health of the Region.*

While on-going public feedback gathered since 2012 supports this vision, formal public outreach processes planned for the spring and summer of 2016 will continue to vet and test this vision. Needed modifications will be incorporated into the 2016 RTP.

A central goal of the Regional Transportation Plan update is to develop the necessary transportation projects, policies, and programs that complement the land use strategies called for in the Regional Plan, and that achieve the vision while meeting regional threshold and greenhouse gas emission targets. The sections below describe the TRPA's methodology for estimating the greenhouse gas impacts of the 2016 Sustainable Communities Strategy.

Component 1: The Lake Tahoe Transportation Model

The Lake Tahoe Transportation Model is the primary tool used to calculate the VMT and GHG impacts of the existing and planned land use pattern, the existing and proposed street network, and the basic transit network. Progressively sophisticated versions of the transportation model

have been in use in the Lake Tahoe Region since 1981, when the first model was used to develop an environmental threshold goal for VMT for the region. The TRPA now uses an activity-based model, which is described in more detail below. As part of the RTP update the TRPA used outside peer review to validate the model. The memo describing the results of this model validation is included as Attachment A.

The TRPA invests in updates to the travel-forecasting model on an on-going basis. In 2005, the TRPA updated its model from a 3-step trip-based model developed in the 1980's, to an activity-based model that uses the TransCAD platform. The TransCAD activity-based model introduced several improvements over the previous model, including the ability to associate non-home-based trips with their producing household and associated socio-demographic variables. Another strength of Tahoe's activity-based model is the ability of a "traveler" represented within the model to make trip substitution decisions along the trip chain, by eliminating a trip or changing the destination or time that a trip begins. Each "decision" is encapsulated within a separate sub-model and therefore a modeled household is able to dynamically adjust its trip choices. In a trip-based model (like the TRPA's old model), if a traveler is faced with congestion during mode choice, then the traveler's only choice is to change modes. In the activity-based model, that same traveler could choose to leave at a different time period for a work trip, or choose a different destination for a discretionary trip.

The 2005 resident and visitor sub-models were based on a resident and visitor survey conducted in 2005. The results of the survey provided the necessary information about resident, seasonal resident, and visitor travel characteristics in order to develop the submodels to create realistic trip patterns for these groups. The 2005 surveys, however, did not provide sufficient information about the number of external workers traveling into and out of the region, the entry/exit point into the region for day visitors, or the number of visitors in the region at any one time. In 2010, the TRPA received a grant from the Strategic Growth Council to conduct a license plate survey that was followed up by a web-based travel survey of vehicle drivers entering and exiting the Region. The goal of the survey was to obtain the total number of vehicles entering the Region and to determine the travel purpose of each vehicle. This data was used to validate and update the existing assumptions about proportions of residents, visitors, external workers, and through travelers. Based on the new license plate survey, adjustments were made to the trip and tour purposes at the seven external stations around the Basin.

The Tahoe model consists of an activity-based resident model and an activity-based visitor model. Because the number of resident households, employment locations, person activities, and the resident/visitor mix are potentially very different in the region during the summer versus the winter, socio-economic data has been developed for the two seasons. Thus, the user may choose to model an average summer weekday or an average winter weekday. Both the SB 375 targets for the Tahoe Region and the Region's Vehicle Miles Traveled Threshold are based on the average summer weekday model.

For the SCS analysis, the Tahoe model will utilize the land-use scenario approved in the Regional Plan in 2012. Once the model run is complete, the resulting trip table is used as an input to the remaining two components of the GHG analysis. Due to the model update described above, the 2005 base year inputs will be re-run using the most recent version of the model, so that the greenhouse gas targets, which are based on the 2005 base year, will be comparable with the new 2020 and 2035 greenhouse gas estimates.

Validation of the Updated Transportation Model and Forecast Year Assumptions

Whenever updates are made to the transportation model, TRPA conducts a model validation process to ensure that the model is accurately predicting travel patterns and that the model is sensitive to changes in land use. TRPA conducted a test of the model in 2015 in preparation for the development of the SCS forecasts and found that the model met the static and dynamic validation criteria recommended in the Caltrans 2010 RTP Guidelines (see Attachment A). In addition, TRPA verified model input assumptions for the 2020 and 2035 forecast years through a variety of means, including:

- Comparing model factors that influence growth in overnight and day visitors to California and Nevada demographer population forecasts from surrounding counties and counties that serve as a major source of tourists to the Region;
- Comparing model factors that influence growth in overnight and day visitors to the recent "Bay to Tahoe Basin Recreation and Tourism Rural Roadway Impact Study" completed by El Dorado County in October 2014;
- Vetting visitor growth assumptions with representatives from the tourism industry at Lake Tahoe;
- Comparing 2035 TRPA model forecast volumes on Basin entry roads with forecast volumes from Sacramento Area Council of Governments (SACOG), Carson Area Metropolitan Planning Organization (CAMPO), Washoe Regional Transportation Commission (Washoe RTC), and Placer County (Table 1).

Table 1

California Entries	2014 Count	2014 Model	2035 TRPA Model Volumes	2035 Outside Model Volumes-Reference	
SR 89 MP 0.00 Alpine-El Dorado	3600	4446	5309	5400	Caltrans PSR (April 2012)
US 50 MP 65.62 Echo Lake Road	15300	13171	16053	17500	SACOG Model - Caltrans PSR
SR 89 MP 13.72 Squaw Valley Rd	15000	21253	25520	22080	Truckee Model (Shaw) Caltrans PSR 2012
SR 267 MP 6.23 Martis Peak Rd	12900	16556	19243	16500	Martis Valley Model (Shaw) Caltrans PSR 2012
	46800	55426	66125	61480	
Nevada Entries					
SR 207 ATR 0531509- sta 0024	7301	8467	11503	8950	Douglas County (Jeff Foltz-Parsons)
US 50 ATR 252125	15202	19894	21939	15900	Carson City RTC (John Long DKS)
SR 431 sta 770	4949	11053	12317	9000	Washoe RTC (Xuan Wang)
	27452	39414	45759	33850	

3/10/2016

Component 2: Off-Model Reductions

The TRPA maintains a Trip Reduction Impact Analysis (TRIA) spreadsheet tool to evaluate the trip and VMT reduction impacts of various transportation policies and programs under consideration as part of the Sustainable Communities effort. While the TransCAD model is robust, it cannot capture more nuanced strategies that can have a significant effect on travel demand such as parking policies, traveler information systems, new transit operations, or construction of new bike trails and sidewalks. The purpose of the TRIA is to provide planning-level, order-of-magnitude, comparative estimates of the quantitative impacts on auto trips, vehicle miles traveled and greenhouse gas emissions of the continuation of existing policies and programs compared to the impacts of implementing new policies and programs in the areas of transit service expansion, bicycling and walking, and transportation demand management.

TRIA Methodology

As noted above, the TRIA provides a way to make comparisons between different policy alternatives and their ultimate effect on greenhouse gas emissions. Using the tool allows the TRPA to develop a package of policies tailored to the Tahoe area that will help the Region meet the greenhouse gas emissions reduction targets set by the California Air Resources Board under California's Senate Bill 375.

As far as possible, the TRIA will use estimates based on current conditions in the Tahoe Basin, or existing forecasts developed locally, particularly in the case of new transit services and new active transportation facilities such as bike trails and sidewalks. For policies or projects for which there are no local studies the impacts will be estimated based on a review of the available literature and studies of places where these policies have already been implemented. Where

research shows that a policy might vary in effectiveness the more conservative approach will be chosen, so as not to overstate the trip and VMT reduction potential.

The TRIA is built around the main modes of transportation and analysis of how the land use plan and transportation strategies and policies proposed in the Regional Transportation Plan will impact these modes. The main categories considered in the model are:

- Bicycling and walking
- Public transit, including new technologies
- Transportation Demand Management measures
- Parking policy changes

The model is structured in such a way as to estimate the potential growth for each mode, for example the potential for new transit riders who were previously vehicle riders, and to take this growth as reductions in vehicle trips.

Analysis by Mode

Bike and Pedestrian Facilities

The reductions for bicycle and pedestrian trips will be developed based on the TRPA/TMPO Bicycle Trail User Model (available at www.tahoempo.org) and trip and VMT reduction estimates documented in the memo "Environmental, Economic, and Public Health Impacts of Shared Use Paths in Lake Tahoe,"
available at http://www.tahoempo.org/documents/Impacts_Memorandum_110107.pdf. This model and report estimate trip and VMT reduction from a variety of planned bicycle and pedestrian facilities proposed in the Regional Transportation Plan.

Transit Services and Facilities

The transit portion of the trip and VMT reductions will be based on ridership projections from the most recent short- and long-range transit systems plans. Potential investments under consideration include additional frequency on both the North Shores and South Shores, free fares, and improved traveler experience through deployment of advanced technologies such universal fare payment systems, seamless transfers, and improved traveler information. To the extent feasible, ridership projections will be increased over time to correlate with increases in population or visitor growth. Other services may include new inter-regional transit to population centers outside of the Region, and cross-lake waterborne ferry service.

Where transit alternatives are obviously mutually exclusive, only the project with the highest projected ridership will be included. Otherwise, all proposed transit projects will be included and assumed not to affect the ridership of other services.

Transportation Demand Management (TDM) Measures

The TRIA will compare the effect of improving the compliance rate of existing TDM ordinances through improved enforcement or updating of policies. Compliance rates and trip reduction potential will be based on literature review and local mode share survey data.

Parking Management

Where available, the parking calculations used in the trip and VMT reduction estimates will be based on observed parking occupancy statistics and estimates of the total parking supply provided by existing studies, compared to the total parking supply estimated to be available after parking management strategies proposed in the RTP go into effect. Where occupancy and turnover data is not available, trip generation rates will be based on data from Trip Generation, 9th Edition[1].

Cumulative Effect

While the effect of each policy or project type will be analyzed individually, the cumulative effect of these policies will also be estimated. The cumulative effect of the policies cannot simply be the sum of individual effects. The impact of some policies depends on the origin and destination – for example whether they affect trips that start in Tahoe but end outside the region, or if the entire trip takes place within the Tahoe Basin. Other policies may be mutually exclusive – i.e. the measures could not reasonably be implemented at the same time.

Where there are several reduction measures that are not mutually exclusive, the total cumulative reduction does not equal Measure A + Measure B. Once Measure A has been applied, the Measure B will then apply to a base that has already been reduced by the measure A. For example, if two trip reduction measures would each give a 10% trip reduction, the total cumulative reduction is not 20%. Rather, it would be equal to 100% - (90%*90%) = 19%.

Other Off-Model Reductions

Additional strategies to reduce greenhouse gas emissions, such as changes to the amount of vehicle miles traveled by electric vehicles, may be applied prior to finalizing greenhouse gas emissions estimates.

Component 3: Calculating VMT and Greenhouse Gas emissions

Because the Tahoe Transportation Model spans both California and Nevada in its region-wide VMT calculations, it is necessary to develop a methodology for splitting out the VMT attributable to the California portion of the Region. In addition, in accordance with the RTAC protocol for accounting for half of the VMT of all trips with an origin or destination outside the region, and

[1] Trip Generation, 9th Edition, Institute of Transportation Engineers (2012)

none of the VMT for trips that cross through the region without stopping, additional post-processing of the transportation model results is necessary. This section explains how the TRIA is integrated into the model results, and how total VMT and GHG emissions for the California portion of the Region are calculated.

The TRPA developed an "accounting-based" approach to improve the accuracy of VMT estimates in the Tahoe Basin. As described below, this approach accounts for every vehicle trip in the TRPA model. By doing so, it does not have to rely on any interim assumptions, and produces accurate VMT estimates that can be readily reviewed/confirmed by others.

VMT Calculation for the TRPA Travel Demand Model

This section outlines the process the TRPA will undertake to calculate the California-side VMT for the 2005, 2020, and 2035 model years. As noted, VMT is estimated for a peak summer weekday.

Step 1: Obtain Daily Trip Table

The daily trip table is a large matrix displaying the total number of vehicle trips on a daily basis that travel from one particular traffic analysis zone (TAZ) to another. Trip tables also include the number of trips that remain internal to a particular TAZ and trips that have an origin or destination to an external gateway. Below is an illustration of TRPA's trip table.

	1	2	3	4	5	6	7	9	10	11	12	13	
1	69.00	23.00	11.00	30.00	24.00	21.00	30.00	1.00	2.00	0.00	0.00	0.00	0.(
2	36.00	60.00	15.00	17.00	36.00	28.00	28.00	16.00	41.00	16.00	14.00	24.00	4.(
3	0.00	8.00	44.00	1.00	4.00	3.00	0.00	13.00	49.00	20.00	9.00	18.00	2.(
4	26.00	23.00	10.00	7.00	28.00	23.00	28.00	1.00	1.00	2.00	0.00	1.00	0.(
5	25.00	19.00	9.00	34.00	10.00	29.00	29.00	0.00	6.00	3.00	1.00	1.00	0.(
6	30.00	29.00	16.00	26.00	14.00	33.00	29.00	0.00	0.00	0.00	0.00	0.00	0.(
7	44.00	27.00	11.00	28.00	24.00	22.00	81.00	0.00	1.00	0.00	0.00	0.00	0.(
9	1.00	9.00	12.00	0.00	1.00	0.00	0.00	4.00	9.00	4.00	2.00	9.00	2.(
10	1.00	8.00	9.00	0.00	1.00	0.00	2.00	6.00	8.00	1.00	7.00	8.00	2.(
11	0.00	5.00	8.00	1.00	0.00	0.00	0.00	5.00	2.00	2.00	2.00	3.00	1.(
12	3.00	19.00	13.00	0.00	0.00	1.00	0.00	12.00	18.00	3.00	20.00	15.00	5.(
13	1.00	12.00	13.00	2.00	2.00	1.00	0.00	7.00	14.00	3.00	9.00	7.00	3.(
14	0.00	8.00	5.00	0.00	2.00	1.00	1.00	3.00	4.00	1.00	6.00	6.00	0.(
15	1.00	3.00	6.00	2.00	1.00	0.00	0.00	1.00	3.00	0.00	3.00	2.00	0.(

Step 2: Apply TRIA Adjustments

The TRIA quantifies the trip reduction benefits of various transportation programs and policies that are part of the SCS. Since the traffic model is not capable of modeling changes in behavior due to these strategies (e.g., employer shuttles, parking management, subsidized transit, etc), it is necessary to model these behavior changes through 'post-processing' of the model results. TRPA will modify the daily trip table shown above by reducing trips in accordance with the percentages displayed in the TRIA in those TAZs where travel behavior would be affected by the SCS strategies.

Step 3: Estimate Distance of Trips

A distance-skim matrix is used to estimate the travel distance between all TAZs within a model. It is a matrix of identical size to a trip table, but whose contents are expressed as miles versus vehicle trips.

Step 4: Calculate Zone-to-Zone VMT

The TransCAD software program allows for matrix multiplication. The adjusted trip table from Step 2 is multiplied by the distance skim in Step 3 to yield a new matrix whose content is VMT (i.e., number of daily trips multiplied by distance) between all zones in the model.

Step 5: Aggregate Zones into California and Nevada Sides

To show achievement of the greenhouse gas targets associated with SB 375, VMT must be calculated for the California side only. The TRPA model contains 289 TAZs, of which 184 represent land uses on the California side of the Tahoe Basin and 105 represent land uses on the Nevada side of the Tahoe Basin and external gateways. The California and Nevada zones are identified so that Step 6 can be conducted.

Step 6: Apply RTAC's VMT Calculation Methodology

The Regional Targets Advisory Committee (RTAC) established under SB 375 recommends the following accounting of various trip types for VMT purposes[2]:

- Include 100% of internal-internal (I-I) trips
- Exclude external-external (X-X) trips
- Count 50% of internal-external (I-X) and external-internal (X-I) trips[3]

Since the SB 375 evaluation is for the California side of the Tahoe Basin, I-I trips are those that begin and end in this area. An example of an I-X trip is a trip from Meyers, CA to Incline Village, NV, or a trip from Sacramento to Tahoe City, CA. An example of an X-X trip is a trip from Echo Summit, CA to Incline Village, NV, or a trip from Placerville, CA to Carson City, NV.

The zone-to-zone VMT matrix from Step 4 was manipulated based on the aggregation of zones in Step 5 and the above VMT calculation methodology.

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[2] Recommendations of the Regional Targets Advisory Committee (RTAC) Pursuant to Senate Bill 375. September, 2009. http://www.arb.ca.gov/cc/sb375/rtac/report/092909/finalreport.pdf

[3] TMPO has decided to count 100% of the modeled VMT for I-X and X-I trips with one trip end in the California side of the Basin and the other trip end to a California point outside the Tahoe Basin, as the transportation model provides trip lengths only to the borders of the TMPO Region. For I-X and X-I trips occurring between the California portion of the Tahoe Basin and the Nevada portion of the Tahoe Basin, or external Nevada point, the TMPO will count 50% of the VMT, in recognition that not all of this VMT is attributable to the California side.

The results of this six-step process yield the VMT for the California side of the Tahoe Basin using the RTAC-recommended calculation method.

Greenhouse Gas Emission Estimation

The California Air Resources Board requires MPOs to use the Emissions Factors (EMFAC) model to calculate greenhouse gas emissions associated with the SCS. In 2015 ARB released a memo entitled "*Methodology to Calculate CO2 Adjustment to EMFAC Output for SB 375 Target Demonstrations.*" The methodology states:

> *"In 2010, ARB established regional SB 375 greenhouse gas (GHG) targets in the form of a percent reduction per capita from 2005 for passenger vehicles using the ARB Emission Factor model, EMFAC 2007. EMFAC is a California-specific computer model that calculates weekday emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses. ARB updates the EMFAC model periodically to reflect the latest planning assumptions (such as vehicle fleet mix) and emissions estimation data and methods. Since the time when targets were set using EMFAC2007, ARB has released two subsequent versions, EMFAC2011 and EMFAC2014."*

The memo continues:

> *"As MPOs estimate GHG emissions reductions from subsequent RTP/SCSs, they will use the latest approved version of EMFAC, but using a different model will influence their estimates and their ability to achieve SB 375 targets. The goal of this methodology is to hold each MPO to the same level of stringency in achieving their SB 375 targets regardless of the version of EMFAC used for its second RTP/SCS."*

The methodology describes a process for neutralizing the changes in fleet average emission rates between the version of EMFAC used for the first SCS and the version used for the second SCS. The methodology adjusts for the small benefit or disbenefit resulting from the use of a different version of EMFAC by applying an adjustment when quantifying the percent reduction in per capita CO2 emissions using the newest version of EMFAC.

After calculating the VMT attributable to the California side of the Tahoe Basin in accordance with RTAC procedures, the TRPA will use this VMT as an input to EMFAC2014 model to estimate GHG emissions. The resulting GHG emissions are then divided by the 2005, 2020, and 2035 residential populations to obtain GHG emissions per capita. Since the TRPA used EMFAC2011 to calculate GHG emissions in its first SCS, the TRPA will apply ARB's

methodology for neutralizing the difference between EMFAC models in order to ensure that resultant estimates are comparable to the targets set for the Region.

Attachments:

A. Validation of TRPA Base Year (2014) Travel Demand Model

Air Resources Board

Mary D. Nichols, Chair
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Matthew Rodriquez
Secretary for
Environmental Protection

Edmund G. Brown Jr.
Governor

June 16, 2016

Ms. Joanne Marchetta
Executive Director
Tahoe Metropolitan Planning Organization
PO Box 5310
Stateline, Nevada 89449

Dear Ms. Marchetta:

Thank you for your May 16, 2016 submittal to the Air Resources Board (ARB) of the Tahoe Metropolitan Planning Organization's (TMPO) Senate Bill 375 (SB 375) technical methodology document for your 2016 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). Your submittal fulfills the requirement under California Government Code section 65080 (b)(2)(J)(i) that each MPO submit to ARB a description of the technical methodology it will use to estimate greenhouse gas (GHG) emissions from its RTP/SCS.

TMPO's methodology will use three components to assess transportation-related GHG emissions: Lake Tahoe's Activity-Based Travel Demand Model; The Trip Reduction Impact Analysis (TRIA) Tool, a post-processor spreadsheet tool to adjust for variables to which the travel demand model is not reasonably sensitive; and ARB's Emission Factor Model (EMFAC2014).

For regional growth projections, the Tahoe Regional Plan was comprehensively updated in 2012, when the Tahoe Regional Planning Agency (TRPA) Governing Board approved the "Low Development, Highly Incentivized Redevelopment" land use scenario. The adopted land use plan for the Region is unchanged, and the 2016 RTP/SCS will use the same land use assumptions that were used in the 2012 RTP/SCS.

TRPA and TMPO plan to incorporate some model improvements that will allow better forecasting of land use and transportation strategies in the 2016 RTP/SCS, including better estimates of forecasted commercial floor area and tourist accommodation unit transfers under TRPA's transfer of development rights (TDR) program, incorporating more recent visitor travel data, and incorporating new research findings and data sources into the TRIA tool.

ARB staff will use the general review methodology identified in its July 2011 report entitled, "Methodology for ARB Staff Review of Greenhouse Gas Reductions in Sustainable Communities Strategies." This methodology is intended to provide the framework for a transparent evaluation of the GHG emissions from an SCS. It focuses on the technical aspects of transportation modeling that are central to quantifying passenger vehicle-related GHG emissions. ARB staff will be requesting supporting information from TMPO, as it becomes available through the draft and final RTP/SCS development process. This supporting information will be necessary to conduct ARB's technical evaluation pursuant to SB 375.

We look forward to continuing our technical collaboration as TMPO finalizes and adopts its 2016 RTP/SCS. If you have any questions, please contact me at (916) 322-7137 or Terry Roberts at (626) 450-6182.

Sincerely,

Karen Magliano, Chief
Air Quality Planning and Science Division

cc: Ms. Terry Roberts, Manager
Transportation Planning Branch
Air Quality Planning and Science Division

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TRANSPORTATION ENGINEERING / PLANNING
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MEMORANDUM

Date: July 24, 2015

Project #: 188850

To: Keith Norberg, Karen Fink
Tahoe Regional Planning Agency
PO Box 5310, Stateline, NV 89449
(775) 588-4547

From: Franklin Cai, TE, Jim Damkowitch

Subject: TRPA Model Review

FINDING SUMMARY

Kittelson & Associates performed a peer review of both static and dynamic model validation performance of the Tahoe Regional Planning Agency/Tahoe Metropolitan Planning Organization's (TRPA/TMPO) Tour Based Travel Demand Model. Based on this analysis, the TRPA/TMPO travel demand model was determined to meet all static and dynamic validation tests with the exception of one – which was more a function of an inadequate sample size for testing than a model accuracy issue.

INTRODUCTION

To evaluate the veracity of the TRPA/TMPO travel demand model to accurately predict travel behavior, TRPA/TMPO's 2014 baseline model results were evaluated relative to several key validation criteria pursuant to the following related travel demand model publications:

- Caltrans 2010 Regional Transportation Plan Guidelines;
- Travel Forecasting Guidelines, (California Department Transportation, 1992); and,
- Nevada Department of Transportation (NDOT) Traffic Forecasting Guidelines (May, 2012)

To facilitate the peer review, TRPA/TMPO provided the following 2014 baseline model files:

- Loaded base year model networks for four land-use alternatives.
- Geographic files of centroids
- Geographic files of the basin outline
- Geographic files of TAZ boundaries
- Excel summary file of static validation statistics

In addition, the following model background materials were also provided:

- Technical Memorandum (Fehr & Peers, June, 2010): Final TRPA PTOD Areas Mixed Use Trip Generation Estimate
- Technical Memorandum (Fehr & Peers, September 20, 2011): Validation of TRPA Base Year 2010 Travel Demand Model
- VMT Indicator Summary (TRPA)
- Draft Technical Memorandum (Fehr & Peers, August 9, 2011): TRPA Travel Demand Model Sensitivity Evaluation
- Technical Memorandum (TRPA, February 27, 2015): 2014 Model Calibration

Although not entirely relevant to this peer review, KAI also summarized all model validation criteria from the following state/federal documents as a potential future resource for TRPA/TMPO to consider during future baseline model updates. This summary is provided in Attachment A of this memorandum.

- Travel Forecasting Guidelines, California Department Transportation (1992)
- Travel Forecasting Guidelines, Nevada Department of Transportation (May 2012)
- Travel Model Validation and Reasonableness Checking Manual Second Edition
- Travel Model Improvement Program Travel Model Validation and Reasonableness Checking Manual Second Edition (September 24, 2010)
- 2010 California Regional Transportation Plan Guidelines (April 7, 2010)
- A Manual of Regional Transportation Modeling Practice for Air Quality Analysis
- Transportation-Air Quality Planning: Issues & Analysis Needs
- EPA Section 187 VMT Forecasting and Tracking Guidance (March 1992)
- Guidance for the Use of Latest Planning Assumptions in Transportation Conformity Determinations (March 2001)

VALIDATION CRITERIA:

Based on the review of the aforementioned documents and previous TRPA/TMPO modeling validation efforts, the following static criteria were selected for this evaluation.

Primary Static Criteria and Thresholds

Validation Item	Criteria for Acceptance
Percent of Links with volume-to-count ratios within Caltrans deviation allowance	At Least 75%
Correlation Coefficient	At Least 0.88
Percent Root Mean Squared Error (RMSE)	Below 40%

In order to determine if the TRPA/TMPO model "behaves" appropriately to changes in model parameters or inputs, the following dynamic land use sensitivity tests were also examined:

- Add 100 households to a TAZ
- Add 100 employees to a TAZ
- Subtract 100 households from a TAZ
- Subtracts 100 employees from a TAZ

Based on the static nature of the transportation system, model sensitivity to network changes was not considered necessary.

ASSESSMENT OF VALIDATION RESULTS

Static Validation

Based on the existing sample of roadway locations historically tracked by TRPA/TMPO for model validation purposes, the link level static validation results for state highways in the Tahoe Region are provided in **Table 1** and also shown graphically in **Figure 1**. As shown, the model generally over-estimates daily volumes on SR-28, SR-431 and SR-267 and both under- and over-estimates, depending on location, daily traffic on US-50. Of the 24 locations reported, 15 (or 63%) are within the "Maximum Deviation". To increase the representativeness of the validation sample, nine local roadways with available count data were added to the analysis (**Table 2**). The resulting percentage of validation links meeting criteria increased to 70%. For future validation assessments, it is recommended that TRPA/TMPO expand its' model validation sample. This would likely yield an overall percentage of locations that meet the target criteria of 75% (see Recommendation Section of this technical memorandum).

As shown in **Figure 2**, the correlation coefficient between the TRPA/TMPO baseline model volumes and traffic counts is .8949 - which meets established criteria. Another statistic for identifying the consistency between the model outputs and the base year counts is the Percent Root Mean Square Error (RMSE). The percent RMSE for the TRPA/TMPO baseline model is 25.79% which is well below the maximum acceptable range of 40%. Given that acceptable RMSE limits vary by AADT range, **Table 3** shows the TRPA/TMPO model RMSE by ADT volume range relative to NDOT's RMSE error tolerance criteria. All ADT volume range groups meet established criteria.

Table 4 summarizes the static validation results for the TRPA/TMPO 2014 baseline model. As shown, two of the three tests meet criteria for validation of travel demand models.

Although not listed as Primary Static Criteria, given the importance of accurately estimating VMT in the Tahoe Region particularly in the context of TRPA/TMPO's VMT Threshold, a VMT validation metric is desired. Given that Tahoe Region specific HPMS VMT estimates are not developed or reported jointly by Caltrans and NDOT, compliance with Section 187 of the Clean Air Act – VMT tracking and baseline VMT percent deviation criteria is not possible. However, the 1990 Clean Air Act (November 15, 1990) Section 187 VMT model validation criteria was applied based on the traffic count information in **Table 2**. The sum of daily traffic counts at the 24 count locations was multiplied by the TRPA/TMPO VMT adjustment factor 3.42 to yield daily VMT specific to the Principal Arterial functional classification. This estimate was then compared to the TRPA/TMPO travel demand model 2014 VMT estimate for principal arterials. This comparison was within the proscribed 3% tolerance established by Section 187 of the CAAA (**Table 5**).

Table 2. Tahoe Region Traffic Count Station Calibration (State Highways Only)

2014 Base Count Station Location	Cross Street	Status	2014 Traffic Count	2014 Model	Model-Count Difference	Model-Count % Difference	Deviation	Maximum Deviation	Within Deviation
US 50 mp 70.62	SR 89	Trend	17,600	14,794	2,806	84.06%	0.1594	0.30	Yes
US 50 mp 71.48	Pioneer	Trend	17,200	20,151	(2,951)	117.2%	(0.1716)	0.30	Yes
US 50 mp 75.45	Wye	Trend	39,500	29,525	9,975	74.7%	0.2525	0.23	No
US 50 mp 76.41	Keys	Trend	37,500	35,916	1,584	95.8%	0.0422	0.24	Yes
US 50 mp 77.33	Al Tahoe	Trend	39,000	39,128	(128)	100.3%	(0.0033)	0.23	Yes
US 50 mp 80.14	Park	Continuous	36,500	29,166	7,334	79.9%	0.2009	0.24	Yes
US 50 ATR 0521109	Parkway	Continuous	33,738	39,960	(6,222)	118.4%	(0.1844)	0.24	Yes
US 50 sta 0041	Kingsbury	Trend	25,980	25,013	967	96.3%	0.0372	0.26	Yes
SR 28 sta 0035	Spooner	Trend	6,805	9,842	(3,037)	144.6%	(0.4463)	0.42	No
SR 28 ATR 3122409	W.Lakeshore	Continuous	16,494	23,741	(7,247)	143.9%	(0.4394)	0.30	No
SR 28 mp 11.00	Stateline	Continuous	17,900	24,198	(6,298)	135.2%	(0.3518)	0.30	No
SR 28 mp 9.34	SR 267	Continuous	21,500	21,256	244	98.9%	0.0113	0.27	Yes
SR 28 mp 1.85	Lake Forest	Trend	13,700	20,718	(7,018)	151.2%	(0.5123)	0.32	No
SR 89 mp 19.54	Bliss Park	Trend	6,000	4,314	1,686	71.9%	0.2810	0.44	Yes
SR 89 mp 11.69	Fallen Leaf	Trend	6,400	5,938	462	92.8%	0.0722	0.44	Yes
SR 89 mp 8.67	TC Wye	Trend	18,200	13,514	4,686	74.3%	0.2575	0.31	Yes
SR 267 mp 9.28	North Avenue	Trend	13,100	15,957	(2,857)	121.8%	(0.2181)	0.32	Yes
SR 89 MP 0.00 Alpine-El Dorado	Luther	Trend	3,400	4,240	(840)	124.7%	(0.2471)	0.60	Yes
US 50 MP 65.62 Echo Lake Road	Echo	Trend	15,100	12,276	2,824	81.3%	0.1870	0.31	Yes
SR 207 ATR 0531509- sta 0024	Kingsbury	Continuous	13,153	17,431	(4,278)	132.5%	(0.3252)	0.31	No
US 50 ATR 252125	Spooner	Continuous	14,349	18,785	(4,436)	130.9%	(0.3092)	0.31	Yes
SR 431 sta 770	Mt. Rose	Trend	6,700	11,053	(4,353)	165.0%	(0.6497)	0.43	No
SR 267 MP 6.23 Martis Peak Rd	SR 267	Trend	10,600	16,435	(5,835)	155.0%	(0.5505)	0.36	No
SR 89 MP 13.72 Squaw Valley Rd	SR 89	Continuous	16,600	19,830	(3,230)	119.5%	(0.1946)	0.32	No
		Total	447,019	473,181	(26,162)	**0.9447**			

Table 3. Tahoe Region Traffic Count Station Calibration (Includes Local Roadways)

2014 Base Count Station Location	Cross Street	Status	2014 Traffic Count	2014 Model	Model-Count Difference	Model-Count % Difference	Deviation	Maximum Deviation	Within Deviation
US 50 mp 70.62	SR 89	Trend	17,600	14,794	2,806	84.06%	0.1594	0.30	Yes
US 50 mp 71.48	Pioneer	Trend	17,200	20,151	(2,951)	117.2%	(0.1716)	0.30	Yes
US 50 mp 75.45	Wye	Trend	39,500	29,525	9,975	74.7%	0.2525	0.23	No
US 50 mp 76.41	Keys	Trend	37,500	35,916	1,584	95.8%	0.0422	0.24	Yes
US 50 mp 77.33	Al Tahoe	Trend	39,000	39,128	(128)	100.3%	(0.0033)	0.23	Yes
US 50 mp 80.14	Park	Continuous	36,500	29,166	7,334	79.9%	0.2009	0.24	Yes
US 50 ATR 0521109	Parkway	Continuous	33,738	39,960	(6,222)	118.4%	(0.1844)	0.24	Yes
US 50 sta 0041	Kingsbury	Trend	25,980	25,013	967	96.3%	0.0372	0.26	Yes
SR 28 sta 0035	Spooner	Trend	6,805	9,842	(3,037)	144.6%	(0.4463)	0.42	No
SR 28 ATR 3122409	W.Lakeshore	Continuous	16,494	23,741	(7,247)	143.9%	(0.4394)	0.30	No
SR 28 mp 11.00	Stateline	Continuous	17,900	24,198	(6,298)	135.2%	(0.3518)	0.30	No
SR 28 mp 9.34	SR 267	Continuous	21,500	21,256	244	98.9%	0.0113	0.27	Yes
SR 28 mp 1.85	Lake Forest	Trend	13,700	20,718	(7,018)	151.2%	(0.5123)	0.32	No
SR 89 mp 19.54	Bliss Park	Trend	6,000	4,314	1,686	71.9%	0.2810	0.44	Yes
SR 89 mp 11.69	Fallen Leaf	Trend	6,400	5,938	462	92.8%	0.0722	0.44	Yes
SR 89 mp 8.67	TC Wye	Trend	18,200	13,514	4,686	74.3%	0.2575	0.31	Yes
SR 267 mp 9.28	North Avenue	Trend	13,100	15,957	(2,857)	121.8%	(0.2181)	0.32	Yes
SR 89 MP 0.00 Alpine-El Dorado	Luther	Trend	3,400	4,240	(840)	124.7%	(0.2471)	0.60	Yes
US 50 MP 65.62 Echo Lake Road	Echo	Trend	15,100	12,276	2,824	81.3%	0.1870	0.31	Yes
SR 207 ATR 0531509- sta 0024	Kingsbury	Continuous	13,153	17,431	(4,278)	132.5%	(0.3252)	0.31	No
US 50 ATR 252125	Spooner	Continuous	14,349	18,785	(4,436)	130.9%	(0.3092)	0.31	Yes
SR 431 sta 770	Mt. Rose	Trend	6,700	11,053	(4,353)	165.0%	(0.6497)	0.43	No
SR 267 MP 6.23 Martis Peak Rd	SR 267	Trend	10,600	16,435	(5,835)	155.0%	(0.5505)	0.36	No
SR 89 MP 13.72 Squaw Valley Rd	SR 89	Continuous	16,600	19,830	(3,230)	119.5%	(0.1946)	0.32	No
Barbara Avenue	Martin	Local Cnt	3,370	2,834	536	84.1%	0.1591	0.49	Yes
Black Bart	Pioneer	Local Cnt	4,360	5,113	(753)	117.3%	(0.1727)	0.47	Yes
Lake Tahoe Blvd.	N Upper Truckee	Local Cnt	2,104	3,221	(1,117)	153.1%	(0.5309)	0.53	No
Lake Tahoe Blvd.	Sawmill	Local Cnt	4,512	4,034	478	89.4%	0.1059	0.46	Yes
North Upper Truckee Road	Mt. Rainer Drive	Local Cnt	7,749	5,443	2,306	70.2%	0.2976	0.41	Yes
North Upper Truckee Road	US 50	Local Cnt	5,750	6,239	(489)	108.5%	(0.0850)	0.43	Yes
Pioneer Trail	US 50	Local Cnt	6,450	6,777	(327)	105.1%	(0.0507)	0.44	Yes
Pioneer Trail	Golden Bear	Local Cnt	7,988	9,125	(1,137)	114.2%	(0.1423)	0.40	Yes
Pioneer Trail	City Limits	Local Cnt	11,757	10,448	1,309	88.9%	0.1113	0.33	Yes
		Total	501,059	526,415	(25,356)	**0.9518**			

Figure 1. Tahoe Region Traffic Count Station Calibration

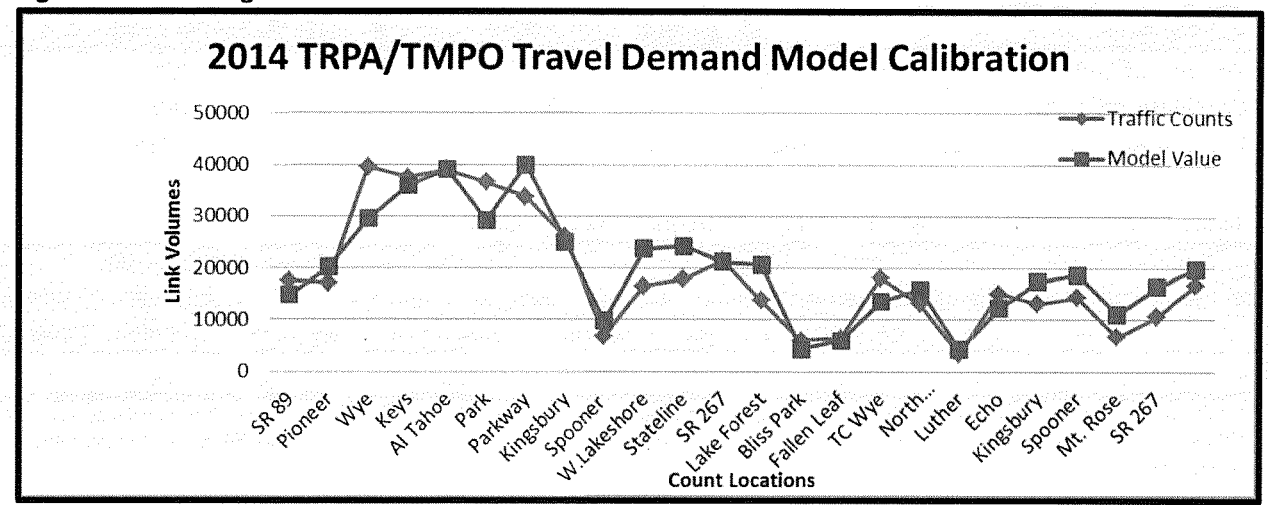


Figure 2. 2014 Model Coefficient of Determination (State Highways Only)

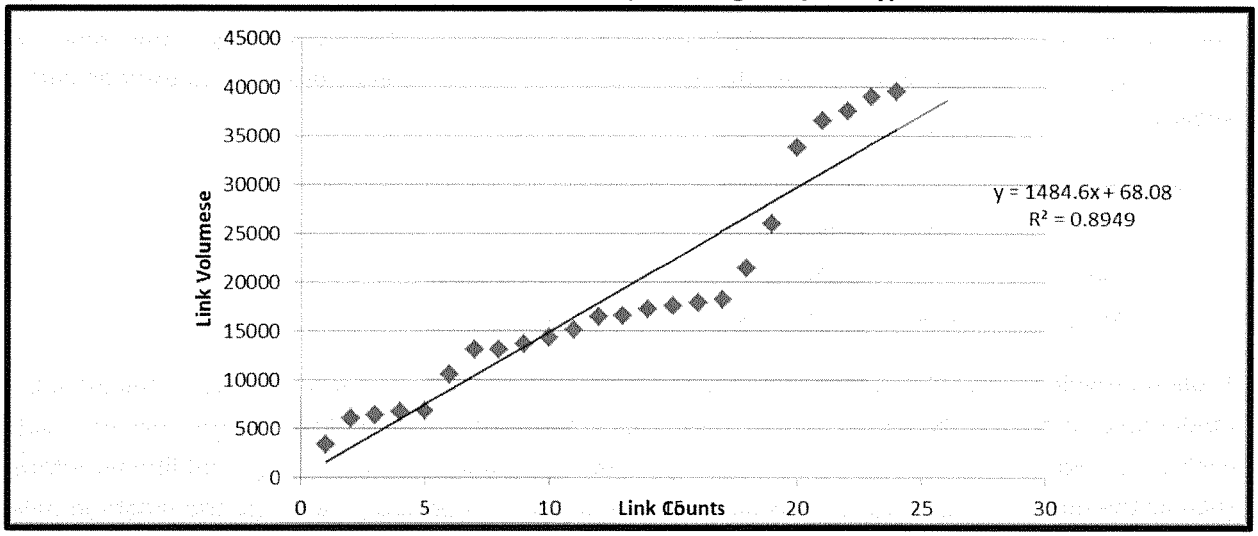


Table 3. Percent Root Mean Square Error by ADT Range

AADT Range	Max RMSE	Model RMSE	Within Max	Observations
< 5,000	100%	21.96%	Yes	5
5,000 – 9,999	45%	32.46%	Yes	8
10,000 – 14,999	35%	30.49%	Yes	6
15,000 – 19,999	30%	27.13%	Yes	7
20,000 – 49,999	25%	15.83%	Yes	7
> 50,000	20%	n/a	n/a	0

Table 4 Static Validation Results

Validation Item	Criteria for Acceptance	TRPA/TMPO Model Result
Percent of Links within allowable deviation	At Least 75%	70%
Correlation Coefficient	At Least 0.88	.89
Percent Root Mean Squared Error (RMSE)	Below 40%	25.79%

Table 5 CAA Section 187 VMT Tracking – Principal Arterials Only

2014 Base TRPA/TMPO Model	2014 Count Based PA VMT[1]	2014 Model PA VMT	Model-Count Difference	Model-Count % Difference	Deviation	Section 187 Max VMT Deviation	Within Deviation
Principal Arterial VMT Check	1,528,805	1,539,037	-10,232	1.006692809	-1.3585364	3%	Yes

1. Daily VMT from a peak travel day (2nd weekend in August) multiplied times a constant of 3.42 that accounts for other VMT model inputs (e.g., average distance traveled, average vehicle occupancy). The constant was derived by dividing the 1981 VMT estimate (1,649,000) by the 1981 peak August traffic volume (482,106).

Dynamic Validation

The following dynamic land use sensitivity tests were examined to test the sensitivity of the TRPA/TMPO to parameter changes. **Figure 3** provides the approximate locations of each of the TAZs used as part of this analysis.

- Scenario 1 Add 100 households to TAZ 90
- Scenario 2 Add 100 employees to TAZ 297
- Scenario 3 Subtract 100 households from TAZ 137
- Scenario 4 Subtracts 100 employees from TAZ 212

Table 6 provides the VMT changes that resulted from each of these scenarios relative to the 2014 baseline model run. As shown, the model behaved correctly in terms of direction of change (positive or negative) in each case. For evaluating the reasonableness of the magnitude of VMT change, additional information such as the number of trips reduced is needed. In lieu of this information, average trip length in miles was estimated taking the weighted average (using % of VMT as the weight) of model based average trip lengths by type of trip (**Table 7**). Applying the average trip length to the total VMT change in Scenario 1 and Scenario 3 results in an average number of vehicle trips per household (added or reduced) of 15.82 and 9.7 daily vehicle trips per household respectively. Based on the ITE Trip Generation Manual 9th Edition, the trip generation for a single-family detached housing unit (ITE Land Use Code 210) is 9.52 trips per weekday (9.81 per weekend day). Based on this comparison – the magnitude of VMT change for Scenario 3 is reasonable. The higher 15.82 vehicle trip per household for Scenario 1 also appears reasonable when considering that the location of TAZ 90 is nearly outside the Basin and would necessitate considerably longer trip lengths to meet basic OD pairs.

The magnitude of change in VMT resulting from the addition and subtraction of employment is also reasonable when considering the locations of TAZ 212 relative to TAZ 297. The relative change in attractiveness in TAZ 212 would result in expectedly less VMT change given the greater intensity of

development and population in TAZ 212 resulting in shorter trip lengths and therefore VMT change relative to TAZ 297.

Based on these findings, the dynamic validation results of the TRPA/TMPO travel demand model appear reasonable.

Table 6 Dynamic Validation Results

Scenario	Description	Daily VMT	Delta of Baseline	VMT/HH Baseline	VMT/Emp Baseline
Scenario 0	Baseline	1,891,180	n/a		
Scenario 1	Add 100 HH TAZ 90	1,917,910	26,730	267.3	
Scenario 2	Add 100 Emp TAZ 297	1,924,577	33,397		333.97
Scenario 3	Sub 100 HH TAZ 137	1,874,734	-16,446	-164.46	
Scenario 4	Sub 100 Emp TAZ 212	1,885,239	-5,941		-59.41

Table 7 Tahoe Region Average Trip Length (Weighted Average)

Trip Type	2014 Trip Length	% of Total VMT	VMT % Weighted Trip Length
Day Visitor	32.2	33.50%	10.8
External Worker	21.76	7.60%	1.7
Overnight Worker	7.2	10.10%	0.7
Resident	4.53	38.30%	1.7
Seasonal	13.64	7.60%	1.0
Through	32.79	2.90%	1.0
Weighted Average Trip Length			**16.9**

Figure 3. Dynamic Validation Test Locations

RECOMMENDATIONS FOR FUTURE VALIDATION REPORTING

According to California Department of Transportation's Forecasting Guidelines, "the regional agency should strive to obtain traffic counts on ten percent or more of the region wide highway segments (i.e., model links) being analyzed... this ten percent goal applies also to the distribution of counts in each functional classification (freeways and principal arterials, at a minimum)." The TRPA/TMPO model validation uses counts from just 24 (expanded to 33 locations herein) for validation purposes. Expansion of the number of count locations is recommended for future validation assessments. Systematic data collection of traffic counts on roadways that are not on the state system should be considered. Count locations should be strategically considered during the establishment of screenline locations (see following recommendation).

As part of the calibration/validation process, a screen line analysis was not performed - but due to the "circular" nature of the model's network, screen lines may not be necessary given that the count locations are on the state highways which already serve as the only means of getting in and out of the Tahoe Region. Nonetheless, given that screenline assessments help validate model trip distribution results, TRPA/TMPO should consider establishing model screenlines for future model validation exercises.

Multiple guidelines (including California DOT's) ask for the calibration and validation of the transit model. Documenting the calibration/validation of the mode split module to actual transit ridership is recommended. This can be performed as a region-wide holistic check by summing up total model ridership and comparing to total actual transit ridership. More detailed line specific transit ridership validation tests is problematic given the historical variability in transit ridership by line in the Tahoe Region.

Given that Tahoe Region specific HPMS VMT estimates are not developed or reported jointly by Caltrans and NDOT, compliance with Section 187 of the Clean Air Act – VMT tracking and baseline VMT percent deviation criteria is not possible. For this analysis, the TRPA/TMPO VMT adjustment factor 3.42 was used to yield a "ground truth" daily VMT of the principal arterial system which was then compared to model VMT by functional classification output. It is recommended that a secondary alternative principal arterial VMT estimate be developed via: Segment Length (in miles) x AADT. This can be annually calculated using Excel using published information by Caltrans and NDOT.

4-D Utility Discussion – Dynamic Validation

To ensure that the travel and vehicle emission benefits of Smart Growth land use strategies are reasonably quantified by TRPA/TMPO's travel demand model, it is recommended that future dynamic validation exercises include a with and with-out 4D post processing comparison. The comparison should specifically focus on the number of vehicle trip reductions and the average trip length of these eliminated trips as well changes in mode split resulting from 4-D processor. Logically, the average trip length of reduced trips resulting from the 4D process should be less than the model average trip length for most if not all trip purposes. This expected outcome is premised on the understanding that Smart Growth strategies do not eliminate person trips – but facilitates shorter trip lengths and/or promotes choices to use alternatives to the single occupant vehicle.

If such testing reveals that the 4D process as currently applied by TRPA/TMPO (i.e., factoring the vehicle trip OD matrix) does not yield logical results, TRPA/TMPO should consider modifications within a model's trip distribution and mode split estimates.

Original statistical research used as the basis for the Ds methods as well as newer research and techniques to improve on the Ds process so that travel models do not just reduce vehicle trips but actually estimate shifts to shorter trips and alternative modes has been applied as "Urban Form Adjustment" techniques. These techniques were tested in Fresno County during the San Joaquin Valley Blueprint process and are currently being implemented in other models. The Urban Form Adjustment process mostly uses lists of TAZs with easy-to-use rating scales (0 to 3) to identify locations with urban forms which help to promote lower vehicle trips. The process uses simple identification of the following inputs:

- TAZs with supportive urban design features (such as high density right next to an arterial with bus service), and rate the TAZ by how much of the TAZ land use includes the newer development types
- Districts of TAZs with supportive urban design features (such as a dense retail development across the street from a dense residential development in a different TAZ)
- Corridors of TAZs with improved transit service or improved bicycle/pedestrian paths

However, even more sophisticated models can have difficulty in evaluating smart growth issues if the land uses are aggregated into medium or large TAZs. With the aggregation to TAZs, the specific accessibility of individual land uses within each TAZ cannot be distinguished and separately evaluated. In addition, a 3-Step or 4-Step model does not automatically account for changes in the travel environments such as pedestrian and bicycle amenities, or development architecture that encourages the use of alternative modes.

It should also be noted that the D process is most appropriate for models that have little sensitivity to smart growth factors. These would include models with large TAZs, vehicle trip generation as opposed to person trip generation, poor representation of short trips, and few land use categories for trip generation estimates. It may be that the TRPA/TMPO model exhibits some of these characteristics.

ATTACHMENT A.

SUMMARY OF STATE AND FEDERAL CRITERIA FOR THE VALIDATION OF TRAVEL DEMAND MODELS:

Forecasting Guidelines, California Department of Transportation

- The regional agency should strive to obtain traffic counts on ten percent or more of the region wide highway segments being analyzed, if resources allow. This ten percent goal applies also to the distribution of counts in each functional classification (freeways and principal arterials, at a minimum). Validation for groups of links in a screenline should include all highway segments crossing the screenline.

- Calibration and validation of the transit assignment model follows the same procedures as the highway assignment model, except that transit ridership counts would replace traffic counts. Inaccurate estimates can imply incorrect assumptions used in path-building or mode choice.

- A test of the percent error by functional classification will provide insight into whether the assignment model is loading trips onto the functionally classified systems in a reasonable manner. The percent error by functional classification is the total assigned traffic volumes divided by the total counted traffic volumes (ground counts) for all links that have counted volumes, disaggregated by functional classification. Suggested error limits are:

  Suggested and Region-wide Validation Criteria Functional Classification Percent Error:

Freeways	Less than 7 percent
Principal Arterials	Less than 10 percent
Minor Arterials	Less than 15 percent
Collectors	Less than 25 percent
Frontage Roads	Less than 25 percent

  Source: FHWA Calibration & Adjustment of System Planning Models; December 1990

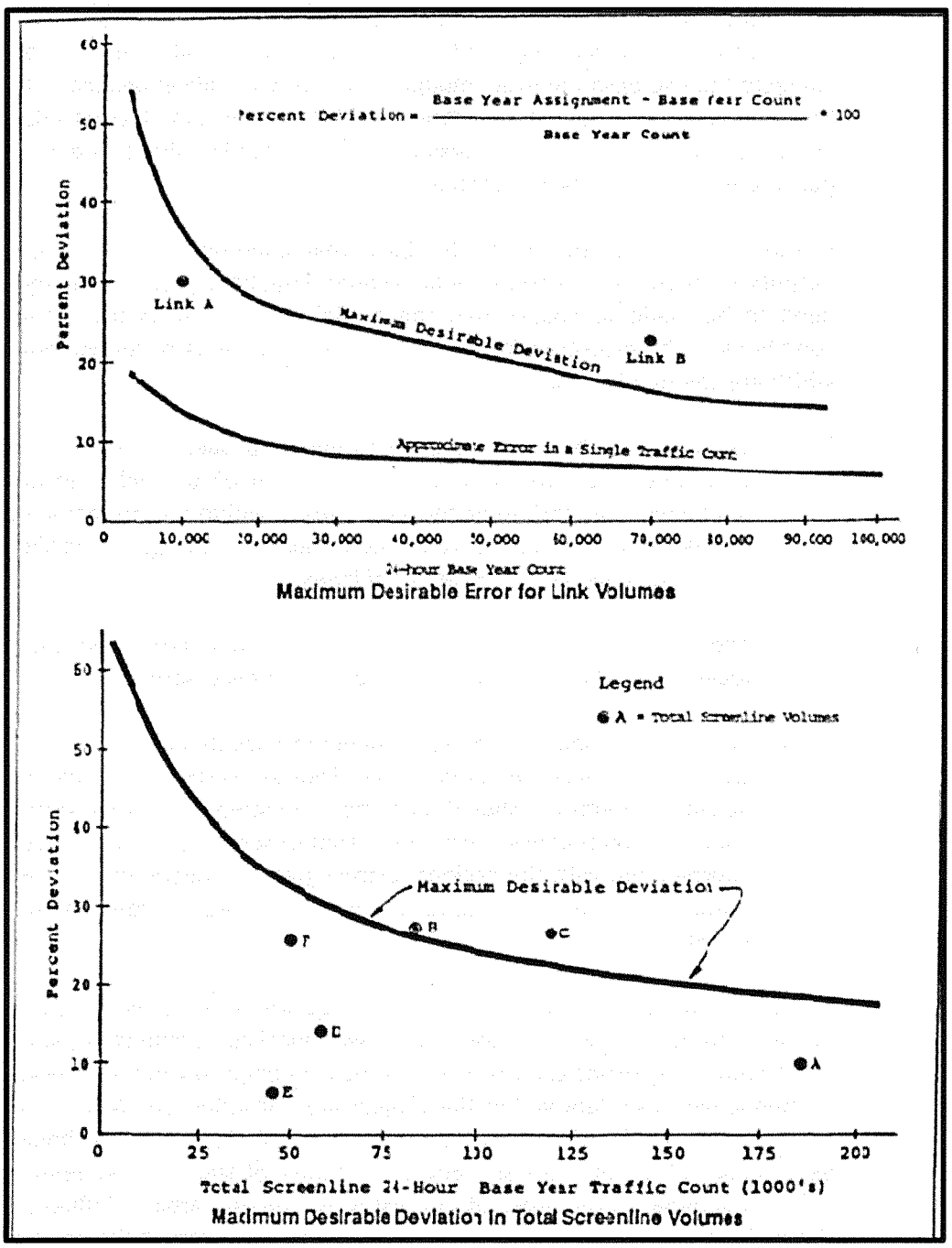
- The correlation coefficient estimates the correlation between the actual ground counts and the estimated traffic volumes and is produced by most software packages.

- Suggested Region wide Correlation Coefficient > 0.88.

- The vehicle-miles-traveled is a significant factor for emission inventories and should be compared to available data sources, such as the Highway Performance Management System (HPNIS). HPMS and other estimates of regional estimates of VMT are also subject to estimation error and are reasonable only as verification of consistency and do not provide a useful measure of the accuracy of the model system.

- The validation process should also include the comparison of ground counts to estimated volumes on individual freeway and principal arterial links, as well as screenlines defined to capture the travel demand from one area to another.

- The suggested link-specific validation criteria are that 75% of freeway and principal arterials and all screenlines meet the maximum desirable deviation in the figure below.



Travel Forecasting Guidelines, Nevada Department of Transportation

- The review of the base year model is performed to ensure the ability of the model to replicate base year conditions and as an extension, the design year conditions in the project vicinity. The validation of the base year model is performed by comparing base year counts to the modeled volumes. It is important to establish the output of the model in comparison with the field data available. The output from most models is the Average Weekday Traffic (AWDT); some models may also output other quantities (AADT, etc.). Since models can vary significantly, the agency responsible for developing and maintaining the model should be contacted to establish the exact model output. Any modifications made to the model output and the calculation of the modification factors (also known as Model Output Conversion Factors (MOCF)) should be well documented in the traffic forecasting report.

- In the evaluation of the model for base year conditions, if the model outputs are found to vary from the field count data, base year refinements need to be made to ensure that the model better reflects the actual conditions in the project vicinity. The following is a series of refinements which are commonly used:

  - The network should be updated to ensure proper representation of roadway facilities through the inclusion of parallel roadway links, collector, and other secondary roads within the project area of influence. Acceptable refinements include changes in facility type, area type, and the number of lanes.

  - The Traffic Analysis Zone (TAZ) centroid connectors and their location should be examined and adjusted if necessary.

  - The socio-economic base year data in the TAZs should be reviewed within the project area of influence. Trips generated by prominent activity generators should also be compared to actual traffic counts. If discrepancies are found from observed conditions, then coordination with the regional planning agency needs to occur to obtain consent and approval to make TAZ socio-economic modifications.

- The base year land use data should be analyzed within the project area of influence for its accuracy and consistency with local comprehensive plans. Local planning agencies and MPOs should be contacted to verify the socio-economic land use data within the project area of influence. Within the project area of influence, all existing Traffic Analysis Zones (TAZs) should be analyzed based on their size and the number of trips they generate. Trip end summaries for zones of interest in the project area of influence should be evaluated for reasonableness. It may be necessary in the project area of influence to refine the existing TAZ structure to obtain a better

assignment. Special care must be taken to correctly code the new centroid connectors. It is noted that population, employment and other totals for the entire model cannot be changed. These totals must continue to reflect the adopted RTP totals.

- The model base year network within the project area of influence should also be evaluated to see if all of the major roadways are coded appropriately. Additional roadways might need to be added to the network to provide better loading points for newly created TAZs/centroid connectors, and to allow for an improved path building process. The coding of all roadways within the area of influence should be checked with regards to their facility type and number of lanes.

- An analysis should be conducted to identify whether a sufficient amount of count data is available within the project area of influence. If critical links are missing counts then additional counts should be obtained. If any roadways have been added to the network, the availability of counts should be checked for these added roadways. An analysis should be conducted to add cutlines, which might require additional counts, within the project area of influence to create the ability to quickly analyze the accuracy of the distribution patterns. These additional counts would have to be adjusted to the base year of the study as well as to the units the model uses (axle adjustments, AADT, ADT, AWDT, etc.). Note that this may be a costly endeavor, and not always feasible or desirable, based on the production schedule of certain projects.

- After refining the model to improve its ability to reflect base year conditions, the model outputs should be tested against consistency thresholds. If it meets the consistency thresholds, then the model can be applied for the future year conditions.

- Base year (model) runs should be compared with the base year ground counts along cutlines and the project corridor on a link by link basis. This comparison will indicate where specific network coding changes may be required. Traffic volumes assigned to a link in the project area of influence that significantly vary from the ground counts.

- Maximum Allowable Percent Deviation Comparison Scale for Planning Projects Environmental Analysis of Volume-Count Difference for All links at Cutlines:

  - ± 20% (< 50,000 AADT)
  - ± 15% (≥ 50,000 AADT & < 250,000 AADT)
  - ± 10% (≥ 250,000 AADT)
  - ± 10% (< 50,000 AADT)
  - ± 7.5% (≥ 50,000 AADT & < 250,000 AADT)
  - ± 5% (≥ 250,000 AADT)

Travel Model Validation and Reasonableness Checking Manual Second Edition

- Comparisons of base year model results to observations might be considered "traditional" validation. The comparisons might be of model results to disaggregate data such as data from a supplementary survey not used for model estimation or to aggregate data such as traffic counts or transit boardings. Comparing base year model results to different aggregations of the data used to estimate or calibrate a model is not as sound of a validation practice as comparing to independent data. However, for some validation tests, the data used for model estimation or calibration are the only data available.

- Temporal validation is an important aspect of model validation since, by definition, it implies comparing model results to data not used in model estimation. Both backcasts and forecasts may be used for model validation. For example, if a model is estimated using 2007 survey data, the model could be used to backcast to 2000 conditions, and compared to year 2000 traffic counts, transit boardings, Census Transportation Planning Package (CTPP) data, or other historical data. Likewise, if a model was estimated or calibrated using 2005 survey data, a "forecast" validation could be performed against 2008 data.

- Model sensitivity testing includes several important types of checks including both disaggregate and aggregate checks. Disaggregate checks, such as the determination of model elasticity, are performed during model estimation. Aggregate sensitivity testing results from temporal validation. Sensitivity testing can also include model application using alternative demographic, socioeconomic, transportation supply, or policy assumptions to determine the reasonableness of the resulting travel forecasts.

- Reasonableness and logic checks include the types of checks that might be made under model sensitivity testing. These checks also include the comparison of estimated (or calibrated) model parameters against those estimated in other regions with similar models. Reasonableness and logic checks may also include "components of change" analyses and an evaluation of whether or not the models "tell a coherent story" as recommended by the FTA for New Starts analysis.

2010 California Regional Transportation Plan Guidelines

Validation testing for a travel demand forecasting (TDF) model should include both static and dynamic tests. Static validation tests compare the model's base year traffic volume estimates to traffic counts using the statistical measures listed below and the threshold criteria contained in the table below as specified in the Travel Forecasting Guidelines, Caltrans, 1992. Below is a list of possible validation measures and thresholds.

- Volume-to-count ratio – is computed by dividing the volume assigned by the model and the actual traffic count for individual roadways model-wide. This value provides a general context for the relationship (i.e., high or low) between model volumes and counts.

- Percent of Links Within Caltrans Deviation Allowance – the deviation is the difference between the model volume and the actual count divided by the actual count. The Caltrans deviation thresholds recognize that allowances shrink as the count increases (i.e., lower tolerance for differences between the model volume estimates and counts).

- Correlation Coefficient – estimates the correlation (strength and direction of the linear relationship) between the actual traffic counts and the estimated traffic volumes from the model.

- Percent Root Mean Square Error (RMSE) – is the square root of the model volume minus the actual count squared divided by the number of counts. It is a measure similar to standard deviation in that it assesses the accuracy of the entire model.

  Static Validation Criteria and Thresholds:

  - Percent of links with volume-to-count ratios within Caltrans deviation allowance: At Least 75%
  - Correlation Coefficient: At Least 0.88
  - Percent Root Mean Squared Error (RMSE): Below 40%

Dynamic validation determines the model's sensitivity to changes in land uses and/or the transportation system. These types of tests are recommended in the Model Validation and Reasonableness Checking Manual (Travel Model Improvement Program, FHWA, 1997). The results of dynamic validation tests are inspected for reasonableness in the direction and magnitude of the changes. Dynamic validation can include the following model sensitivity tests, as appropriate given the type of regional model and alternatives under evaluation.

- Add lanes to a link
- Add a link

- Delete a link
- Change link speeds
- Change link capacities
- Add 100 households to a TAZ
- Add 1,000 households to a TAZ
- Add 5,000 households to a TAZ
- Add 10,000 households to a TAZ
- Increase/Decrease toll rates
- Increase/Decrease transit fares
- Increase transit speeds

Review of the dynamic validation tests should indicate that changes to the model volumes occurred in the appropriate direction and magnitude before the model is used in policy analysis or planning.

The list below specifies possible transit assignment validation criteria that can be applied to transportation models:

- Difference between actual counts to model results for a given year by route group (i.e., Local Bus, Express Bus, etc.): +/- 20%
- Difference between actual counts to model results for a given year by Transit Mode (i.e., Light Rail, Bus, etc.): +/- 10%

Key model validation statistics should be documented, showing the correspondence of the model prediction for a validation year to empirical data.

Model Sensitivity Testing Recommendations:

- Models should be tested for sensitivity to changes in inputs, parameter values, and policies. Elasticities for several variables should be calculated and compared to theory and those generated by other models.

- As part of the model development process, all models should, as applicable to the region, be sensitive to the following items, or acknowledge the model limitations:

  a. Price sensitivity, such as in tolling or congestion-pricing applications

  b. Destination-proximity: accessibility of an area to other activities

  c. Density, or clustered development

  d. Diversity, or mixture of land uses

  e. Distance to transit

  f. Design and layout of an area's transportation facilities

  g. Evaluation of development in known industrial areas

  h. Equity and environmental justice sensitivities, such as effects of transportation and development scenarios on low-income, minority and transit-dependent households

i. Sensitivity to different types of transportation options, including transit (broken down by mode), walking and bicycling

j. Sensitivity to different economic/income growth rates

- Experimental sensitivity tests, wherein a single factor or variable is adjusted higher and lower from its baseline value, should be run to determine the corresponding changes in model output variables. Results should be documented. Minimally, the outputs shown would be: total VMT; light-duty vehicle VMT total and per capita; light-duty vehicle greenhouse gas total and per capita; total person trips; person trips by automobile modes; person trips by transit modes; and person trips by bike and walk modes.

- Results of planning scenario tests, wherein the modeled results of planning scenarios are tabulated and correlated to show the overall sensitivity of the travel demand model to a combination of factors and policies included in the planning scenario should be documented.

- The documentation of the sensitivity tests should identify the range of reasonable sensitivity based on research literature, and account for where in this range the travel demand model sensitivity falls.

- Where results of planning scenario tests are reported, the MPO should show a correspondence between the planning scenario test results and the experimental, single factor sensitivity testing. Part of this documentation should assess the degree of interaction of factors and policies (i.e. the difference between the sum of all scenario variables taken individually, and the total change in modeled results).

- Model assessment and documentation should identify areas where the model lacks capacity for analysis of a factor or policy, and any factors or policy for which the model sensitivities fall outside the range of results documented in research literature.

A Manual of Regional Transportation Modeling Practice for Air Quality Analysis

- Models should feed back travel times resulting from the traffic assignment step to the mode choice and trip distribution (and possibly, to the trip generation) steps, and should be run to an approximate equilibrium. Model systems which omit such feedback loops in most cases should be upgraded.

- In addition, individual models should be upgraded, where necessary, to incorporate key variables that are widely agreed to be strong determinants of travel behavior and that are needed to analyze key policy options. For example, common shortcomings of models in current use include: (1) no trip generation variables beyond auto ownership and income (e.g., household composition: workers per household); (2) inadequate representation of trip attractions; (3) trip distribution models which omit transit and walking accessibility (needed in areas where transit and walk modes are important); (4) lack of peaking information on trips by type and market segment; (5) simplistic representation of socioeconomic variables affecting travel behavior; and (6) simplistic characterization and modeling of non-work travel.80 Improvements to address these shortcomings would be in order.

- Among the variables that some areas have omitted from their models, and should add as soon as possible, are: (1) household income (a key variable that should appear wherever cost appears); (2) parking charges and auto operating costs (without which analyses of parking pricing strategies, congestion pricing, toll roads, etc. can only be done off-line); and (3) the number of workers in the household (a key variable affecting ridesharing).

Transportation-Air Quality Planning: Issues & Analysis Needs

- The basic goal of RTP conformity analyses is to determine whether a region's adopted long range transportation plan is consistent with attainment and maintenance of national ambient latest planning assumptions and emissions models, and must show timely implementation of TCMs from the applicable State Implementation Plan (SIP). In addition the analysis must include all regionally significant transportation facilities and operations expected to be in place by the target years of the analysis(interim milestone years and attainment and horizon years)

EPA Section 187 VMT Forecasting and Tracking Guidance

The model needs to accurate and confident that:

- The travel demand forecasting model is validated with the most recent calendar year ground counts according to generally accepted modeling procedures;
- The methods and measures used to validate the model and the results of that validation;
- The extent to which the traffic assignment matched the base year ground count for groups of links ranked by average daily traffic volume;
- That the travel demand forecasting model method uses a constrained equilibrium approach to allocating trips among links;
- That a distinction is made between peak versus off-peak trip volumes and travel times;
- That model outputs on zone-to-zone travel times are recycled as inputs until a self-consistent equilibrium trip assignment among zones is achieved and that this recycling is done until a self-consistent equilibrium trip assignment is achieved among modes as well ,if transit trips make up a significant portion of historical or expected future travel on the network;
- That no link is loaded beyond its responsible capacity;
- That the travel demand forecasting model forecasts of future year VMT are based upon the future demographic and land-use assumptions of the agency responsible for making such forecasts for transportation planning purposes and upon the future highway and transit network, and that the demographic land-use assumptions for future years are reasonable in light of the planned highway and transit network, local land-use policy ,and other relevant influences on public and private development and location decisions.
- That the highway and transit network assumptions are consistent with the attainment strategy and demonstration through the attainment date, and (if a model scenario year falls after the attainment date) that beyond the attainment date the network assumptions are based on reasonable expectations.

Federal Conformity Regulation Latest Planning Assumptions (Section 93.110)

Pursuant to Section 93.122(b)(1) of the transportation conformity regulation, the following network modeling assumptions must be documented. Once modeling capabilities have been established to address these assumptions, any future "backsliding" (i.e., reducing model capability and functionality) is not acceptable and can provide the basis for a non-conformance finding.

i. Network Model Validation
ii. Land Use, Population, and Employment
iii. Consistency of Land Development and Use with Future Transportation System Alternatives
iv. Capacity Sensitive Assignment
v. Zone-to-zone Travel Impedances between Trip Distribution and Trip Assignment
vi. Model Sensitivity to Time(s), Cost(s) and Other Factors Affecting Travel Choices

Pursuant to Section 93.122(b)(2) – Reasonable Methods to estimate traffic speeds and delay

Pursuant to Section 93.122(b)(3) – HPMS Estimates of Regional VMT (see Section 187, Section 93.110)

Guidance for the Use of Latest Planning Assumptions in Transportation Conformity Determinations (January 2001)

- Using the "latest" planning assumptions means that the conformity determination is based on the most current information that is available to state and local planners (e.g., the MPO or other agency can obtain the information from another agency, the information is appropriate for the current conformity determination, the information is readily transferable for use in transportation and/or emissions modeling, etc.).

- Latest planning assumptions must be derived from the population, employment, travel, and congestion estimates that have been most recently developed by the MPO (or other agency authorized to make such estimates), and approved by the MPO. Once approved, these estimates must be used for determining the latest planning assumptions. In areas using network-based travel models, scenarios of land development and use must be consistent with the future transportation system for which emissions are being estimated, and the distribution of employment and residences for the transportation system must be reasonable. The

- The interagency consultation process must be used to determine which planning assumptions are considered the latest and best assumptions for conformity determinations. The conformity rule specifically requires that the interagency consultation process be used to evaluate and choose assumptions to be used in conformity analyses.

- The consultation process should be used to evaluate assumptions for quality and accuracy as needed prior to use in conformity. Whenever

Highway Performance Monitoring System (HPMS) data is used for current and future years in conformity analyses, the most recently available HPMS estimates of vehicle miles traveled (VMT) must be used. Historical trends and other factors should be considered as a primary source of information from which planning assumptions should be evaluated (e.g., population, employment). If assumptions are used that contradict historical trends, the conformity determination should include an explanation regarding why the assumptions are appropriate. This explanation should be included when the conformity determination is provided for public comment. The consultation process should not be used to unduly delay or exclude the use of new information or to selectively employ it for the convenience of the conformity process.

- Areas that rely on the U.S. Census for certain planning assumptions must use the most recent estimates available from the Census Bureau. Areas that are using assumptions based on data collected through local or state surveys or other mechanisms should use the consultation process to determine whether older state or local

Methodology for estimating Vehicle Miles Traveled and Greenhouse Gas Reductions in the 2016 Regional Transportation Plan Sustainable Communities Strategy Update.

Overview

This appendix describes the draft methodology developed by the Tahoe Regional Planning Agency (TRPA) for calculating vehicle miles traveled and greenhouse gas emission reductions for the Lake Tahoe Region for use in Linking Tahoe, the 2016 Regional Transportation Plan. The methodology utilizes four components:

- Lake Tahoe's Activity-Based Transportation Model
- The Trip Reduction Impact Analysis Tool (TRIA), a post-processor model
- Calculation of the share of vehicle miles traveled (VMT) attributable to the California portion of the Lake Tahoe Region
- Greenhouse Gas Emissions Estimation

Background

Since the development of the bi-state Tahoe Regional Planning Compact (Public Law 96-551) in 1969, planning efforts in the Lake Tahoe Basin have engaged citizens in creating a vision for the future of Tahoe that will balance preservation of its natural beauty with its economic viability. A significant part of this vision is a reduction in dependence on automobiles as the primary means of transportation, in order to reduce the impacts on the environment and on the built form.

TRPA currently upholds a threshold standard of a reduction in VMT and must also show compliance with greenhouse gas reduction targets set by the California Air Resources Board, as well as meeting other environmental thresholds and standards. The integrated land use policies from the Regional Plan and the transportation policies from the Regional Transportation Plan (which also serve as the Transportation Element of the Regional Plan) must demonstrate achievement of these thresholds and standards. VMT is the primary input for understanding the impacts of the land use and transportation package on multiple thresholds and standards. The sections below describe a methodology and assumptions used for estimating the vehicle miles traveled as well as the of the integrated strategy package.

Part 1 – Methodology for estimating Vehicle Miles Traveled Reductions

Component 1: The Lake Tahoe Transportation Model and Assumptions

Model Description:

TRPA maintains an activity-based travel demand model for the Tahoe Region. This model is an enhancement over the more common four-step trip-based models because it considers non-home based travel and linked characteristics of a household's travel patterns in addition to planned land uses and transportation system. The travel demand model predicts travel based on the daily activities of persons, households, or traveler groups. Several distinct groups are modeled in the TRPA model including year-round residents, seasonal residents, external workers, day-use visitors, and overnight visitors. Separate algorithms are included within the model to simulate each group's population, demographics, socioeconomic characteristics, and travel preferences. The model aggregates the travel behavior of each travel group (known as tour types), estimates the expected mode split (auto, transit, walk, bike), and produces traffic projections for intersections and roadways on a peak summer day, and for peak periods during that day. Since these estimates are based on regional data, they are useful for understanding region-wide impacts. For additional information concerning the Lake Tahoe Transportation Model please refer to the Lake Tahoe Resident and Visitor Model; Model Description and Final Results, August 2007.

For the 2016 Regional Transportation Plan, there are two model base years, 2005 and 2014, and three forecast model years, 2020, 2035, and 2040. Staff selected the 2005, 2020 and 2035 model years based on requirements by the California Air Resources Board (ARB) to show reductions in greenhouse gas (GHG) emissions for the forecast years 2020 and 2035 as compared to 2005. Staff selected 2014 as an additional base year in order to make comparisons between future estimates and what we know if happening on the ground today. 2040 is the forecast year of Linking Tahoe, the 2016 Regional Transportation Plan, so it is also considered, although for modeling purposes 2035 and 2040 are very similar.

The potential impact of Linking Tahoe is influenced by the amount and distribution of new development (i.e. residential units, commercial floor area (CFA), and tourist accommodation units (TAUs), and the rate of utilization of visitor accommodations, such as hotels, motels, and vacation rentals. Because the modeling process is extremely lengthy, began development of the Linking Tahoe model inputs in the summer of 2015. Since land use regulations and information regarding existing and available development rights is constantly being updated, running the model necessitates selecting a cutoff date and loading the model with the best available data as of that date. Staff selected December 31, 2014 as the cutoff date. Staff therefore modeled the land-use scenario that included all regulations in place as of December 31, 2014, and all data on existing and available development in place up to December 31, 2014, with the documentation available by August 2015[1]. To do this, staff updated the TransCAD model to include the total residential, commercial, and tourist development that was constructed (for base years) and that will be allowable (for forecast years). Since it is not possible to know the exact distribution of future development, TRPA had to make a series of assumptions related to the distribution of residential allocations, residential bonus units, commercial floor area, and tourist accommodation units. A description of each of these types of development rights (sometimes called "commodities") is below, as well as a description of the transfer of development rights program that was instituted with approval of the 2012 Regional Plan. This description is followed by detailed modeling assumptions for each type of development right.

Land Use Policies Overview:

[1] New data that has become available since August 2015 is documented in Part 2 of this memo.

In 2012, the TRPA approved an update to the Regional Plan. This update affirmed major components of the Region's existing land use policies, such as requirements to obtain development rights before constructing new residential, commercial, or tourist development, and also included important changes to the development rights program, including a new transfer of development program. Because these programs help shape the rate and location of development, they are captured in the model. The following description of the three different commodity types has been adapted from the Lake Tahoe Sustainable Communities Program Documents Series #7, "Development Commodities Transfer Policies Analysis," December 2013.

Residential Development Rights

To develop a residential parcel a property owner must have a residential development right, a residential development allocation, and the necessary amount of land coverage for the project. As an alternative, a property owner may acquire and remove an existing residential unit of use from a property, or, in the case where a residence does not yet exist, remove a development right and transfer it to a different property, per the transfer of development regulations outlined below.

Residential development rights are the right to develop a vacant, privately-owned, residential parcel. The upper limit on residential development rights has been established by prohibiting any new land subdivisions. The upper limit on residential development rights in the Basin is approximately 51,000.

The annual level of residential allocations has been set by the Regional Plan. The 1987 Regional Plan had 300 allocations per year for 20 years (i.e., 6,000). The 2012 Regional Plan has a significantly reduced level allowing for a maximum of 130 allocations per year (i.e., 2,600). These allocations are distributed to jurisdictions annually based on a number of criteria including compliance with code requirements and implementation of water quality improvement projects.

Commercial Development Rights

Commercial floor area is generally defined as the square footage of the floor area on all levels of a commercial building. To develop a commercial project both commercial floor area and coverage are required. The 1987 Regional Plan allowed coverage to be transferred on a

sliding scale up to a "two-to-one" basis (i.e. two square feet of coverage removed for each new square foot placed). The 2012 Regional Plan changed the coverage transfer basis to "one-to-one" when coverage is transferred off of sensitive lands to provide an incentive to remove coverage from where it is most environmentally impactful (pursuant TRPA Code Section 30.4.3).

The 1987 Regional Plan also allowed commercial floor area to be transferred on a "one-to-one" basis. To create an incentive to move commercial floor area from more sensitive lands to targeted mixed use redevelopment areas, the 2012 Regional Plan changed the commercial floor area transfer ratio to a sliding scale as described below.

At the time of model development, staff estimated that there were approximately 6.4 million square feet of commercial floor area in the Lake Tahoe Basin. The 1987 Regional Plan allocated 800,000 square feet for commercial development. When the 2012 Regional Plan was prepared, slightly less than 400,000 square feet were remaining and available for use. Hence, the 2012 Regional Plan did not allocate additional commercial floor area to the jurisdictions, but a pool of 200,000 square feet of CFA was established to only be distributed once the remaining CFA from the 1987 plan has been utilized. However, as mentioned above, the 2012 Regional Plan did change the transfer ratio for commercial development so commercial floor area can be transferred on a sliding scale ranging from "one-to-one" to "one-to-three", depending on the sensitivity of land from which it is being transferred (i.e. three square feet of commercial floor area can be placed for each square foot removed from the most sensitive lands).

Tourist Accommodation Unit Development Rights

A tourist accommodation unit, or TAU, is generally defined as a hotel, motel or other rental lodging unit with one or more bedrooms primarily designed to be rented temporarily by the day or week. To develop a tourist accommodation project both TAUs and coverage are required. As also described above, the 2012 Regional Plan changed the coverage transfer basis to "one-to-one" when coverage is transferred from sensitive lands to provide an incentive to remove coverage from where it is most impactful. The 2012 Regional Plan also changed the TAU transfer ratio so TAUs can be transferred on a sliding scale ranging from "one-to-one" to "one-to-three", depending on the sensitivity of land from which it is being transferred (i.e. three TAUs can be placed for each TAU removed from the most sensitive lands).

At the time of model development, staff estimated that there were 11,947[2] TAUs in the Lake Tahoe Basin. Because there are TAUs from the 1987 Regional Plan that have remained unused, the 2012 Regional Plan does not include any additional TAUs. However, as mentioned above, the 2012 Regional Plan did change the transfer ratio for TAUs.

Transfer of Development Rights (TDR) Program[3]

Transfer of development rights, otherwise known as TDR, is a TRPA regulatory strategy used to manage growth within the Lake Tahoe Basin. Voluntary and incentive-based, TDR capitalizes on market forces to direct development away from sensitive lands into more desirable areas such as town centers. TDR is based on the designation of standard sending and receiving areas, as well as the distinction between land ownership and the rights necessary to develop a parcel.

Sending areas are typically lands that have been identified for preservation or deemed environmentally sensitive and therefore are not suitable for development. Receiving lands on the other hand are areas in which additional growth is desirable and beneficial. Development rights, or commodities as they are sometimes called, serve to quantify development and act as the building blocks for growth management. By transferring the rights from a sending to a receiving parcel, TDR works to implement programs designed to increase affordable housing as well as other desirable development and restoration of sensitive lands and achieve the following:

- help direct growth away from sensitive areas, facilitating achievement of environmental goals
- contribute to more compact development patterns thus making downtown areas more walkable, reducing the need for vehicle trips and reducing greenhouse gas emissions (GHG)

[2] Regional Plan Update Final EIS, Response to Comments, Volume 1, Chapter 3, p. 3-46, Table 3-8.

[3] The description of the TDR program is adapted from the TRPA webpage, "Transferring Development Rights," http://www.trpa.org/permitting/transfer-development-rights/. It also encompasses transfer of existing development.

- allow property owners to realize value through sales of rights from their parcels

In Tahoe, transferable development rights are those that can be banked and/or verified as legally existing by TRPA. These rights include:

- land coverage (existing and potential) (not captured in the Transportation model)
- commercial floor area (CFA)
- existing residential units of use (ERU)
- tourist accommodation units (TAU)
- residential development rights (RDR)
- residential allocations
- restoration credits (not captured in the Transportation model)

Table 1 shows the amount of estimated development that was known to be on the ground in the two base years at the time of the model development. The amount known to be on the ground in 2012 is also shown for comparison purposes. These amounts represent the basic land use assumptions for the base year modeling.

Table 1. Existing development in 2005, 2012 and 2014

	2005 Existing[1]	2012 Existing[2]	2014 Existing[3]
Residential Units	46,359	46,962	47,092
CFA	6,338,000	6,403,893	6,417,970
TAUs	11,583	11,947	11,947

Notes:

1 - "Existing" refers to estimated units that have been constructed. Source: TRPA Transportation Model, 2000 Census.

2 - Included for comparison purposes only. Source: Regional Plan Update Final EIS, Response to Comments, Volume 1, Chapter 3, p. 3-46, Table 3-8.

3 – The estimated development as of 2014 was modeled using best available information at the time of the model run. TRPA has since published an updated accounting of development rights in the Draft 2015 Threshold Evaluation Report (see TRPA 2015 Draft Threshold Evaluation Report, Implementation Chapter, http://www.trpa.org/wp-content/uploads/18_Ch12_Implementation_FINAL_9_30_2016.pdf). Part 2 of this memo provides a detailed explanation of the difference between these analyses, and the implications of the differences in existing development on the environmental analysis.

Table 2 shows the amount of development potential remaining in 2012 (as reported in the Regional Plan Update Final EIS) compared against the amount known to be used in 2013 and 2014, with the amount of total development potential known to be remaining as of December 31, 2014.

Table 2. Development rights used or constructed in 2013 and 2014 compared to remaining development potential

	Remaining from 1987 plan in 2012[1]	**Authorized in the 2012 RPU[1]**	**Total Potential Development Remaining in 2012**	**2013 and 2014 Construction[2]**	**Total Potential Development Remaining December 31, 2014[3]**
Residential Allocations	114	2,600	2,714	130	2,584
Residential Bonus Units	874	600	1,474	0	1,474
CFA	383,579	200,000	583,579	14,077	569,502
TAUs	342	-	342	0	342

Notes:
1 - Source: Regional Plan Update Final EIS, Response to Comments, Volume 1, Chapter 3, p. 3-46, Table 3-8; excludes banked units.
2 - Source: TRPA Permit Data and Research and Analysis Division tracking, August 17,2015. Additional units that have been allocated but not built are shown in Table .
3- The potential remaining development as of 2014 was compiled using best available information at the time of the model run. TRPA has since published an updated accounting of development rights in the Draft 2015 Threshold Evaluation Report (see TRPA 2015 Draft Threshold Evaluation Report, Implementation Chapter, http://www.trpa.org/wp-content/uploads/18_Ch12_Implementation_FINAL_9_30_2016.pdf). Part 2 of this memo provides a detailed explanation of the difference between these analyses, and the implications of the differences in existing

development on the environmental analysis.

Remaining Development Potential Modeling Assumptions

To forecast development patterns in the two forecast years, 2020 and 2035 (2040 land use assumptions are the same as 2035, since development rights are forecast to be used up by 2035), remaining development potential had to be allocated in the model to the different planning jurisdictions, as well as across time. Table 3 provides a summary of how all of the remaining development potential was allocated. The individual sections below provide additional detail.

Table 3. Modeling Forecast Assumptions Summary

		Model Timeframe		
Commodity Type		2020	2035[1]	Totals[2]
Residential Allocations	Already assigned	232		
	Distributed per methodology	792	1,560	2,584
Residential Bonus Units (RBUs)	Already assigned	36	349	
	Distributed per methodology	363	726	1,474
Commercial Floor Area	Already assigned	209,155		569,502

(CFA)	Distributed per methodology		360,347	
Tourist Accommodation Units (TAUs)	Already assigned	180		
	Distributed per methodology		162	342

Notes:

1 - The 2,600 new allocations authorized by the 2012 Regional Plan are modeled to be exhausted after 2032, at the current pace of 130 units released per year. For 2033-2035, no new residential allocations are modeled.

2- The potential remaining development as of 2014 was compiled using best available information at the time of the model run. TRPA has since published an updated accounting of development rights in the Draft 2015 Threshold Evaluation Report (see TRPA 2015 Draft Threshold Evaluation Report, Implementation Chapter, http://www.trpa.org/wp-content/uploads/18_Ch12_Implementation_FINAL_9_30_2016.pdf). Part 2 of this memo provides a detailed explanation of the difference between these analyses, and the implications of the differences in existing development on the environmental analysis.

Source: Regional Plan Update FEIS; TRPA Code of Ordinances February 9, 2013; Research and Analysis 2015

Residential Allocations: Remaining residential development potential includes residential allocations remaining from the 1987 Plan, and new allocations authorized in the 2012 Regional Plan Update. The text and tables below describe the modeling assumptions for geographic distribution of these allocations, and their distribution over time. Table 4 provides a summary of how these allocations were distributed, and Table 5 and Table 6 provide more detail.

The 1987 Regional Plan authorized 6,000 residential allocations. At the time of the model development, best available data showed that by the end of 2012, all but 114 of these allocations had been used. The remaining 114 allocations had been distributed to local jurisdictions, but not

yet used. The model assumes that all of these remaining allocations will result in residential development by the year 2020, and that they will remain in the jurisdiction, to which they were allocated. See Table 5 below for the distribution of these units by jurisdiction.[4]

In addition, the 2012 Regional Plan permits regular releases of 2,600 Residential Allocations not to exceed 130 per year (pursuant TRPA Code of Ordinance Section 50.5.1). Since the Regional Plan was adopted in December 2012, 248 Residential Allocations were released in 2013 and 2014[5].

In 2013 and 2014, 130 allocations were used to construct residential development projects, including 38 allocations from the 2009/2011 releases (1987 Plan) and 92 allocations from the 2013/2014 releases[6] . Consequently, 232 Residential Allocations remain unused (248+114, minus 130). The model assumes these remaining 232 Residential Allocations are available to local jurisdictions as allocated, and that these will result in constructed residential units by 2020.

Finally, 2,352 Residential Allocations remaining from the 2,600 authorized in the 2012 Regional Plan Update were considered to be available for future releases between 2015 and 2032[7]. For the model, these 2,352 remaining allocations not yet released were assumed to be released to the local jurisdictions at a rate of 130 per year, and distributed proportionately between the counties based on the percent of developable parcels

[4] The number of remaining allocations per the 2012 FEIS used best available information at the time. TRPA has since published an updated accounting of development rights in the Draft 2015 Threshold Evaluation Report (see TRPA 2015 Draft Threshold Evaluation Report, Implementation Chapter, http://www.trpa.org/wp-content/uploads/18_Ch12_Implementation_FINAL_9_30_2016.pdf), which updated the number of remaining allocations from the 1987 plan to 149 units. See Part 2 of this memo for a detailed explanation of the difference between these analyses, and the implications of the differences in existing development on the environmental analysis.

[5] Ten allocations were also put into the TRPA Pool during this period, for a total of 258 allocations.

[6] Source: TRPA LakeTahoeInfo.org/Parcel Tracker and TRPA permit tracking in Accela. The allocation release is pursuant Ordinance 2014-07 and TRPA Code of Ordinance Section 50.5.1.

[7] Although the timeframe for modeling is 2035, allocations are released up until 2032. Between 2032 and 2035, it is assumed that no new residential allocations will be released.

Table 4. Summary of Residential Allocation Distribution over the 2020 and 2035 Model Years

	Model Timeframe			
Residential Allocation Type	**2015 – 2020 (6 years)**		**2021 – 2032 (12 years)**[8]	**Totals**
Remaining from 1987 Plan	114			114
Allocated in 2013/2014(non TRPA Pool)	248			248
Units constructed in 2013/2014	-130			-130
Subtotal	*232*			
New units authorized in 2012, remaining after 2013/2014 release	780 (130 units x 6 years)	10 units allocated to the TRPA Pool in 2013/2014	1,560 (130 x 12)	2,350
Subtotal	*790*		*1,560*	*2,350*

[8] Although the timeframe for modeling is 2035, allocations are released up until 2032. Between 2032 and 2035, it is assumed that no new residential allocations will be released.

Total	1,022	1,560	2,582

Table 5. Remaining Residential Allocations as of December 2014 within each jurisdiction

Jurisdiction	Estimated Remaining Residential Allocations as of December 2012[1]	2013/2014 New Residential Allocations[2]	Allocations Redeemed (built) in 2013/2014	Total Estimated Remaining Residential Allocations as of December 2014, assumed to be constructed by 2020
City of South Lake Tahoe	3	38	-23	18
Douglas County	10	17	-16	11
El Dorado County	40	92	-68	64
Placer County	32	57	-18	71
Washoe County	29	44	-5	68
TOTAL	**114**	**248**	**-130**	**232**

Notes:

1- The estimated development as of 2014 was modeled using best available information at the time of the model run. TRPA has since published an updated accounting of development rights in the Draft 2015 Threshold Evaluation Report (see TRPA 2015 Draft Threshold Evaluation Report, Implementation Chapter, http://www.trpa.org/wp-content/uploads/18_Ch12_Implementation_FINAL_9_30_2016.pdf). Part 2 of this memo provides a detailed explanation of the

difference between these analyses, and the implications of the differences in existing development on the environmental analysis.
2- In 2013/2014 258 Residential Allocations were issued; however 10 units were allocated to the TRPA Pool.

Source: TRPA LakeTahoeInfo.org/Parcel Tracker and TRPA permit tracking in Accela. The allocation release is pursuant Ordinance 2014-07 and TRPA Code of Ordinance Section 50.5.1.

Table 6. The estimated number and percent of total developable parcels with a development right within each county, for determining the Residential Allocation potential[1]

County	**Approximate developable parcels with Development Rights**	**Percent of Total Developable Parcels**
Douglas County, NV	197	4%
El Dorado County, CA (including the CSLT)	3,015	60%
Placer County, CA	1,169	23%
Washoe County, NV	670	13%
TOTAL	*5,051*	100%

Notes:
1-The determination of the number of vacant developable parcels outside of Centers required the selection of parcels (local Property Assessors) outside of a TRPA-designated Center with an IPES score greater than 0 (TRPA), within either Residential, Mixed Use, and Tourist Regional Land Use Areas (TRPA), not including building footprints (pursuant the Impervious Surface GIS dataset, produced by Spatial Informatics in 2010).

Residential Bonus Units (RBU): Based on what is remaining from the 1987 Plan and authorized in the 2012 Regional Plan, the model assumed a total of 1,474 Residential Bonus Units will be available between the years 2015 and 2035. For modeling purposes, all of these RBUs were assumed to be distributed to TRPA-designated Centers (also referred to as Receiving Areas) because of the requirements associated with their use. These requirements are:

- The 600 RBUs authorized through the 2012 Regional Plan Update can only be allocated as transfer bonus units in TRPA-designated Centers.
- Among the total RBUs, 385 RBUs are already allocated to specific Community Plan Areas or Community Enhancement Projects in the different jurisdictions; consequently the model assigned them to these jurisdictions. See Table 7.
- Finally, 489 bonus units carried over from the 1987 Plan can be used for transfers or the construction of deed-restricted affordable housing, and the majority of areas zoned for multi-family housing are in Centers.

Table 7 below gives an overview of the available Residential Bonus Units and how they were modeled. Those units that are assigned to CEP Projects were assumed to be used by 2020, and those to Community Plan Areas by 2035 (shown as 2032 in the table below for consistency with the Regional plan timeframe). See Table 8 and the "Residential and Commercial Transfer Assumptions" section for an accounting of how the remaining Residential Bonus Units were accounted for in the model.

Table 7. Residential Bonus Units (RBUs) Remaining from the 1987 Plan Accounting Summary[9]

Community Plan Area or Community Enhancement Program (CEP) Project	**CEP Project RBUs (assumed to be used by 2020)**	**Community Plan RBUs remaining from 1987 Plan (assumed to be used by 2035)**	**Total**
Tahoe City, Placer County		20	20
Tahoe Vista, Placer County		20	20
California North Stateline, Placer County		13	13
Nevada North Stateline, Washoe County		37	37
Incline Commercial, Washoe County		14	14
Incline Tourist, Washoe County		19	19
Ponderosa Ranch, Washoe County		50	50
South Shore Area Plan, Douglas County (formerly referred to as the Kingsbury Community Plan)		67	67
Tourist Core Area Plan, City of South Lake Tahoe (formerly referred to as the Stateline/Ski Run Community Plan)		89	89
Bijou/Al Tahoe, City of South Lake Tahoe		20	20

[9] Source: Regional Plan Update Draft EIS, Page 3.2-9, Table 3.2-3. Per conversation with Paul Nielsen, Current Planning Division Manager, August 25, RBUs for all CEP Projects except for Homewood and Boulder Bay were returned to the TRPA Pool.

Homewood CEP	12		12
Boulder Bay CEP	24		24
Subtotal	*36*	*349*	*385*
TRPA Residential Bonus Pool	0	489	489
Total	36	838	874
Grand Total	874		

Table 8. Residential Bonus Units distribution in the Transportation Model

Residential Bonus Unit Type	**Modeled in 2015 – 2020 (6 years)**	**Modeled in 2021 – 2032 (12 years)**[10]	**Total**
Residential Bonus Units remaining from the 1987 Plan, assigned to Community Plan Areas and CEP Projects	36	349	385
TRPA Residential Bonus Pool, remaining from 1987 (489 RBUS) + **Bonus Units allowed from 2012**	Approximately 10% are assumed to be used for affordable housing, metered out at a rate of approximately 6 per year (36)	Approximately 10% are assumed to be used for affordable housing, metered out at a rate of approximately 6 per year (72)	108

[10] This is the 2035 model year.

Regional Plan (600 RBUS) (1,089 total)	Remaining amount are used for transfer match and metered out at a rate of approximately 55 per year (327)	Remaining amount are used for transfer match and are metered out at a rate of approximately 43 per year (654)	981
Total	399	1,075	1,474

Commercial Floor Area (CFA): The model assumed a total of 569,502 square feet (sq. ft.) of unused CFA. This included 209,155 sq. ft. of CFA remaining from the 1987 plan assigned to jurisdictions or CEP Projects (Homewood), 160,347 sq. ft. of bonus CFA remaining from the 1987 Regional Plan for Special Projects and Community Enhancement; and the 200,000 sq. ft. of bonus CFA that was authorized by the 2012 Regional Plan that may be released once the remaining 1987 plan supply is depleted. The model assumed that the remaining CFA assigned to jurisdictions (209,155) will be constructed within those jurisdictions by 2020. The remaining 360,347 sq. ft. of CFA is assumed to be used by 2035. See Table 9. An explanation of how the CFA available for transfers was distributed is in the Residential and Commercial Transfer Assumptions section.

Table 9. Commercial Floor Area (CFA) Accounting[11]

JURISDICTION	REMAINING FROM 1987 PLAN AND 2012 PLAN	CFA CONSTRUCTED IN 2013 AND 2014	ACCOUNTING AS OF END OF 2014 (assumed to be constructed by 2020)	CFA REMAINING FROM THE 1987 PLAN, ACCOUNTING AS OF END OF 2014 (assumed to be constructed by 2035)	
CSLT (various eligible areas)	52,986	8,847	44,139		
Douglas County (South Shore Area Plan is the eligible area)	36,250	2,730	33,520		
El Dorado County (Meyers CP is the eligible area)	36,150	2,500	33,650		
Placer County (eligible areas include Carnelian Bay CP, Kings Beach CP, Kings Beach Industrial CP, North Stateline CP, Placer non CP, and Tahoe City CP)	72,609	0	72,609		
Washoe County (eligible area is non CP areas)	2,000	0	2,000		
Homewood CEP			23,237		

[11] The estimated development as of 2014 was modeled using best available information at the time of the model run. TRPA has since published an updated accounting of development rights in the Draft 2015 Threshold Evaluation Report (see TRPA 2015 Draft Threshold Evaluation Report, Implementation Chapter, http://www.trpa.org/wp-content/uploads/18_Ch12_Implementation_FINAL_9_30_2016.pdf). Part 2 of this memo provides a detailed explanation of the difference between these analyses, and the implications of the differences in existing development on the environmental analysis.

TRPA pool for transfer match from sensitive lands (referred to as TRPA Special Project, CEP Pool)	0	0	0	160,347	
TRPA pool for transfer match from sensitive lands (2012 Regional Plan update, available after 1987 Plan is exhausted)					200,000
Totals	199,995	14,077	**209,155**	**360,347**	

Source: TRPA Code of Ordinances, effective February 9, 2013, Section 50.4, Allocation of Commodities and Development Rights Accounting, Table 50.4.1-1; and Research and Analysis Division, August 2015.

Tourist Accommodation Units (TAUs): The model assumed 342 TAUs were remaining from the 1987 plan as of December 31, 2014. Of these remaining TAUs, a total of 180 were already assigned to individual Community Plans or CEP projects, and these TAUs were distributed in the model as assigned, and assumed to be used by 2020. Based on supply and demand and market considerations, all of the remaining 162 TAUs were assigned as a bonus unit match for the hypothetical transfer of a South Lake Tahoe motel located in a Stream Environment Zone outside of a Center. A parcel in Tahoe City (within the Center) in Placer County is modeled as the receiving area for this transfer. See Table 10.

Table 10. Tourist Accommodation Unit Distribution Summary[12]

Jurisdiction	**Remaining from 1987 Plan,** assumed to be used by 2020	**Remaining TAUs** (assumed to be used by 2035)	**Total**
City of South Lake Tahoe	*25*		25
Douglas	*25*		25
El Dorado	*10*		10
Placer	*25*		25
Homewood[13]	*50*		50
Washoe	*45*		45
TRPA Pool		162	162
Total	180	162	342

[12] Note this table shows modeled numbers. Current accounting differs slightly from the modeled numbers. The difference is shown in Part 2.

[13] These were taken from the TRPA Pool.

Residential and Commercial Transfer Assumptions

Residential Bonus Units: As noted in the Residential Bonus Unit description above, a total of 1,474 RBUs are available for adopted programs including the Special Projects or Community Enhancement Programs (CEP) which allocate bonus units for projects that result in substantial or threshold-related environmental gain and/or rehabilitation of substandard development (see Code Chapters 50-53); and as an incentive to property owners who transfer existing residential development or development rights from areas less suitable for development to within Town Centers, the Regional Center, or the High Density Tourist District (collectively referred to as Centers or Receiving Areas). For transfers, different numbers of RBUs are offered depending on whether existing development is torn down and the parcel restored or whether a development right is transferred off of an undeveloped parcel and the parcel is then protected from future development. More RBUs are offered for transfers of development from more sensitive lands than for transfers from less sensitive lands. More RBUs are also offered for transfers that are from parcels further from major transportation routes. Any one parcel may combine RBUs offered based on the sensitivity of the sending parcel with RBUs offered based on the distance from transportation routes or receiving areas. This results in a total of 30 different possible transfer ratios based on the land capability of the sending site, its distance from primary transit routes, and whether existing development is present. Based on these factors, each eligible parcel could earn a total of between 0 and 5 RBUs. Table shows the RBU transfer ratios for different categories of sending parcels.

To evaluate the potential effects of the residential transfer incentives shown in Table , TRPA modeled likely transfers of residential uses. Since it is impossible to know exactly how many and which parcels would utilize the residential transfer incentives, it was necessary to make a series of reasonable assumptions based on the best available information. These assumptions are described in more detail below, and relate to the following: 1) the total number and rate of RBU utilization, 2) the proportion of units assigned to existing development transfers and development rights transfers; 3) the number of transfers from each combination of land capability and distance categories; and 4) the proportion of development transferred to each receiving area. Once these assumptions were made, the resulting changes in the distribution and number of residential units were incorporated into the transportation model.

Table 11. Residential Bonus Unit incentives for transfers of development to Centers.

1) Land Capability Classification		
	Transfer Existing Development (ERU, CFA, TAU) to Town Centers, Regional Centers and/or the High Density Tourist District and restore and retire parcel	Transfer Development Right to Town Centers, Regional Centers and/or the High Density Tourist District and retire parcel
Stream Environment Zone (SEZ)	1:3	1:1.5
Sensitive Lands (1a, 1c, 2 and 3) other than a SEZ	1:2	1:1.25
Non-Sensitive lands (4, 5, 6 and 7)	1:1	1:1
2) Distance from Primary Transit Routes (additional transfer ratio only available for transfers of residential development and development rights into Centers)		
Less than ¼ Mile or on the Lake-ward side of primary transit routes	1:1	
¼ Mile to ½ Mile	1:1.25	
½ Mile to 1 Mile	1:1.5	
1 Mile to 1½ Mile	1:1.75	
Greater than 1½ Mile	1:2	

Total Number and Rate of RBU Utilization: A total of 1,089 RBUs were modeled as available and unassigned (i.e. not already allocated to a pending development project). This included an estimated 489 RBUs carried over and available from the RBUs authorized in the 1987 Regional Plan, as well as 600 new RBUs. Under the existing Regional Plan, these RBUs can only be assigned in the following ways: for projects that construct deed-restricted, affordable housing, they can be earned through completion of mitigation above and beyond that required for project approval (pursuant Code section 52.3.3); or they can be assigned as incentives for transfer of existing development or development rights into Centers.[14]

The existing sensitive lot retirement program has demonstrated that demand exists for incentives that encourage property owners to retire sensitive lots. The sensitive lot retirement program provides an allocation to property owners who retire a sensitive lot. Since the sensitive lot retirement program went into effect in 1999, 233 lots have been retired in exchange for an allocation. The allocation offered under this program is substantially less of an incentive than the bonus units (i.e. the one allocation earned under the sensitive lot program still needs to be paired with a development right, whereas the 2012 Regional Plan allows up to 5 bonus units to be earned for transferring one unit, and these bonus units do not require a development right). In addition, several 2012 TRPA Regional Plan policies encourage the reservation of Residential Bonus Units for transfers since they support the restoration of Sensitive Lands and incentivize the transfer of development from Sensitive Lands and outlying residential areas to Centers (LU-3.5, LU-3.6, LU-3.7, and LU-3.8). Given the large number of properties that would be eligible for the residential transfer incentives, the additional incentives, the Regional Plan goals, and the high amount of demand demonstrated by participation in a more limited program that offered fewer incentives, it is reasonable to assume that the majority of available RBUs would be used for the transfer of residential development. Of the total supply of Residential Bonus Unit supply available in the TRPA pools, 10% were set aside for affordable housing projects, leaving a total of 981 Residential Bonus Units available for residential transfers.

[14] In addition to RBU transfer incentives; there are other programs to incentivize transfer of development into Centers. These include: increasing the maximum coverage allowed for a redevelopment project in a receiving area (pursuant to Section 30.4.2.B in the TRPA Code), allowing transfers of non-conforming coverage from sensitive land (pursuant to Section 30.4.2.C in the TRPA Code), and increasing allowable multi-family residential density (pursuant to Section 31.3 and 31.4 in the TRPA Code and with the adoption of an Area Plan, Centers can receive up to 25 units per acre of Multi-Family Development), among other incentives. In combination with the residential bonus units, these measures serve to incentivize transfers of residential units for redevelopment projects in receiving areas.

Therefore, the model assumes that approximately 80% of the available RBUs (785 out of a total of 981) would be used to facilitate the transfer of residential development right transfers and 20% (196 out of a total of 981) would be used to facilitate the transfer of existing residential development. This results in utilization of 196 Residential Bonus Units for Existing Residential Development and 785 for Development Right transfers and a total of 981 Residential Bonus Units used for all the modeled transfers (Tables 13 and 14).

Proportion of units assigned to Existing Development Transfers and Development Rights Transfers: It is necessary to make an assumption about the proportion of transfers that would occur from developed and from undeveloped parcels. Two different sets of residential transfer incentives are available including the transfer of residential development rights to Centers which requires sending development rights from vacant eligible parcels (TRPA Code Section 51.3) and the transfer of existing residential development to Centers which requires transferring existing residential development from eligible built parcels (TRPA Code Section 51.5). Undeveloped parcels are less expensive to purchase than developed parcels and therefore more likely to be acquired by a project proponent acquiring development rights for a transfer. In addition, the transfer of existing development requires investment involved with the demolition of development and restoration of land. Many undeveloped parcels eligible for RBUs are in Sensitive Lands. These Sensitive parcels are subject to greater development restrictions and, therefore, they are very unlikely to be developed. The most likely use for these parcels is a transfer of development rights. While there are more eligible developed parcels than undeveloped parcels and a higher number of RBUs are offered for transfers of existing development, the lower cost and limited uses of undeveloped sensitive parcels would make it likely that significantly more development rights would be transferred than existing development. Therefore, the model assumed that approximately 80% (or 785 Residential Bonus Units and 1,109development rights) of transfers would be sent from undeveloped parcels and approximately 20% (or 196 Residential Bonus Units and 143existing units) would be sent from developed parcels.

Number of Transfers from Each Combination of Land Capability and Distance Categories: Fourteen possible combinations of land capability categories and distance categories provide bonus unit incentives for transfers of existing residential development, and an additional fourteen categories provide bonus unit incentives for transfers of development rights (although fifteen combinations are shown in the tables below, one of them has a transfer ratio of 1:1, and is therefore not considered to provide an incentive). Once the proportion of transfers of existing development and transfers of development rights was established, it was necessary to make assumptions about the number of units moved

within each category. Table 13 and Table 14 show each possible combination of land capability and distance categories for both developed and undeveloped parcels, list the transfer ratio for each combination, and show the number of bonus units received for modeled transfers. The tables show the number of units transferred and bonus units provided by the years 2020 and 2035, and the percent of all eligible parcels utilizing the transfer incentive program within each category.

As described above, fewer transfers are expected from existing residentially developed parcels. The transfers from existing residentially developed parcels are anticipated to follow a similar pattern as the transfers from undeveloped lands. More transfers are assumed to come from Sensitive Lands because they receive more transfer incentives, and redevelopment and expansion of those parcels is constrained by coverage limitations and other restrictions. A total of 34 eligible developed SEZ parcels (out of a total of 3,387 eligible parcels) and 22 sensitive parcels (out of a total of 2,163 eligible parcels) are assumed to participate in the transfer program. A lower proportion of developed parcels on high capability lands are assumed to transfer due to the lower incentives offered for those parcels and the lack of constraints to redevelopment. A total of 87 eligible high capability developed parcels (out of a total of 12,794 parcels eligible for transfer bonus incentives) are assumed to participate (Tables 13 and 14.

Proportion of Development Transferred to Each Receiving Area: Once the assumptions described above were made regarding sending parcels, an assumption was necessary about the distribution of the transferred development rights and RBUs within the various receiving areas. The proportion of transferred development rights and RBUs assigned to each receiving area was determined based on the level of redevelopment that has already occurred within each receiving area and the size of receiving areas. TRPA and local jurisdiction staff familiar with development trends in the receiving areas were consulted to determine the level of development or redevelopment likely to occur within each receiving area. Receiving areas that have experienced more redevelopment recently were expected to provide fewer opportunities for future redevelopment and receive fewer transferred development rights and RBUs. Smaller receiving areas were presumed to offer fewer opportunities for receiving transferred development rights and RBUs than larger receiving areas. The assumed percent of development transferred to each TRPA designated Center (or receiving area) is provided in **Table** .

Table 12. Proportion of development transferred to each receiving area

Jurisdiction	Center	Percent
City of South Lake Tahoe	Regional Center	20%
	South "Y"	20%
Placer County	Kings Beach	15%
	Tahoe City	5%
	North Stateline	2.50%
Washoe County	Incline Village	5%
	North Stateline	2.50%
Douglas County	High Density Tourist District	20%
	Kingsbury	5%
El Dorado County	Meyers	5%
Total		*100%*

Residential Bonus Unit Modeling Approach

To input the residential transfer assumptions into the transportation model, TRPA used the best available GIS data to perform the following steps (described generally):

Existing Residential Development Transfers:

1. Identify eligible Sending parcels in the Region by selecting parcels outside of TRPA designated Centers, not owned by public agencies. Then, pursuant the respective property assessor descriptions, select only the parcels described as having existing residential development (such as Single Family dwelling) and as a safeguard, retain only the parcels with building footprint(s) as indicated by the 2010 impervious dataset (Spatial Informatics, Inc.).

2. Identified the land capability category (e.g. 1b), pursuant to the Bailey-Sinclair land capability classifications and transfer ratio data, and the distance category (e.g. > 1.5 miles) measured as "a crow flies" for each of the selected parcels in the Region. Then randomly select the appropriate number of existing residential parcels within each combination of land capability, distance, and development categories based on the assumptions shown in Table 13.

3. Removed those existing residential development sending parcels from the sending Traffic Analysis Zone (TAZ). TAZs are a modeling unit in the transportation model. Then assigned those residential units to receiving area TAZs as shown in above Table 12 (these parcels were evenly distributed to all the TAZs within each respective Center).

4. Calculated total number of units leaving each TAZ and total number to be received by each TAZ and incorporated into the transportation model.

Residential Development Rights Transfers:

1. Identify eligible Sending parcels in the Region by selecting parcels outside of TRPA designated Centers, not owned by public agencies. Next, pursuant the respective property assessor descriptions select only the parcels described as having vacant (private) existing land uses and as a safeguard, retain only the parcels without building footprint(s) as indicated by the 2010 impervious dataset (Spatial Informatics, Inc.).

2. Identified the land capability category (e.g. 1b), pursuant to the Bailey-Sinclair land capability classifications and transfer ratio data, and the distance category (e.g. > 1.5 miles) measured as "a crow flies" for each of the selected parcels in the Region. Then randomly select the appropriate number of existing residential parcels within each combination of land capability, distance, and development categories based on the assumptions shown in Table 14.

3. Removed those residential development rights sending parcels from the sending Traffic Analysis Zone (TAZ), and assigned those residential units to receiving areas at the proportions shown in above Table (these parcels were distributed evenly across all TAZs within each respective Center). For each transfer of development right, one new Residential Allocation was used (these Residential Allocations were evenly deducted from each model year) in conjunction with the transferred development right and the resulting residential unit was assigned to the receiving area.

4. Calculated total number of units leaving each TAZ and total number to be received by each TAZ and incorporated into the transportation model.

Table 13. The transfer ratios and number of bonus units earned for transfers of existing residential development, the percent of eligible parcels, the modeled number of units moved from each sending category, and the number of bonus units provided.

Existing Residential Development (See Section 51.5.3, Transfer of Existing Development to Centers)		Transfer Ratio (Sending: Receiving)	Bonus Units Per Transfer (TRPA Match)	Total Eligible Parcels (GIS Analysis Based Estimate[1])	Percent of Total Eligible Parcels from Each Category (Eligible units/total)	**Adjusted Existing Units Transferred 2015-2020 (Sending Parcels)	**Adjusted Existing Units Transferred 2021-2035 (Sending Parcels)	Total Bonus Units Available for 2015-2020 (Rounded down***)	Bonus Units Available for 2021-2035 (Rounded down***)	*Total Bonus Units Availab for bo model years (Rounde down**
Less than 1/4 mile from primary transit routes	SEZ	1:3	**2**	2,292	12%	3	6	*6*	*12*	*18*
	Sensitive	1:2	**1**	1,197	7%	2	3	*2*	*3*	*5*
	High Capability	1:1	**0**							
1/4 to 1/2 mile from primary transit routes	SEZ	1:3.75	**2.75**	287	2%	2	4	*5*	*11*	*16*
	Sensitive	1:2.5	**1.5**	337	2%	1	2	*1*	*3*	*4*
	High Capability	1:1.25	**0.25**	5,291	29%	12	20	*3*	*5*	*8*
1/2 mile to 1 mile from primary transit routes	SEZ	1:4.5	**3.5**	409	2%	3	5	*10*	*17*	*27*
	Sensitive	1:3	**2**	493	3%	2	6	*4*	*12*	*16*
	High Capability	1:1.5	**0.5**	3,885	21%	12	20	*6*	*10*	*16*
1 mile to 1.5 mile from primary transit routes	SEZ	1:5.25	**4.25**	109	1%	2	3	*8*	*12*	*20*
	Sensitive	1:3.5	**2.5**	59	0%	1	2	*2*	*5*	*7*
	High Capability	1:1.75	**0.75**	1,998	11%	3	8	*2*	*6*	*8*
Greater than 1.5 mile from primary transit routes	SEZ	1:6	**5**	290	2%	2	4	*10*	*20*	*30*
	Sensitive	1:4	**3**	77	0%	1	2	*3*	*6*	*9*

	High Capability	1:2	**1**	1,620	9%	3	9	*3*	*9*	*12*
				18,344	100%	49	94	65	131	*196*

Notes:

*Distance measured 'as a crow flies'. Total bonus units, rounded down correspond with above Table 8.

***After calculating the Bonus Units gained per transfer ratios, these numbers are rounded down (pursuant policy/procedures, Current Planning).

GIS analysis was used to determine the number of eligible parcels (property assessor information, TRPA Regional Land Uses, TRPA IPES data, and the Impervious Surface data produced in 2010 by Spatial Informatics).

Table 14. The transfer ratios and number of bonus units earned for transfers of residential development rights, the modeled number of units moved from each sending category, the number of bonus units provided, and the percent of eligible parcels.

Residential Development Rights (See Section 51.3. and Table 51.3.6-1, Transfer of Development Rights to Centers)		**Transfer Ratio (Sending: Receiving)**	**Bonus Units Per Transfer (TRPA Match)**	**Total Eligible Parcels (GIS Analysis Based Estimate[2])**	**Percent of Total Eligible Parcels from Each Category (Eligible units/total)**	****Adjusted Existing Units Transferred 2015-2020 (Sending Parcels)**	****Adjusted Existing Units Transferred 2021-2035 (Sending Parcels)**	**Total Bonus Units Available for 2015-2020 (Rounded down***)**	**Bonus Units Available for 2021-2035 (Rounded down***)**	***Total Bonus Units Availabl for bo model years (Rounde down***
Less than 1/4 mile from primary transit routes	SEZ	1:1.5	**0.5**	158	5%	16	40	*8*	*20*	*28*
	Sensitive	1:1.25	**0.25**	207	6%	12	40	*3*	*10*	*13*
	High Capability	1:1	**0**							
1/4 to 1/2 mile from primary transit routes	SEZ	1:1.875	**0.875**	33	1%	2	6	*1*	*5*	*6*
	Sensitive	1:1.5625	**0.5625**	51	1%	3	8	*1*	*4*	*5*

	High Capability	1:1.25	**0.25**	751	22%	80	160	*20*	*40*	*60*
1/2 mile to 1 mile from primary transit routes	SEZ	1:2.25	**1.25**	82	2%	20	51	*25*	*63*	*88*
	Sensitive	1:1.875	**0.875**	77	2%	12	30	*10*	*26*	*36*
	High Capability	1:1.5	**0.5**	879	25%	80	160	*40*	*80*	*120*
1 mile to 1.5 mile from primary transit routes	SEZ	1:2.625	**1.625**	18	1%	4	6	*6*	*9*	*15*
	Sensitive	1:2.1875	**1.1875**	16	0%	2	4	*2*	*4*	*6*
	High Capability	1:1.75	**0.75**	572	17%	36	60	*27*	*45*	*72*
Greater than 1.5 mile from primary transit routes	SEZ	1:3	**2**	67	2%	18	38	*36*	*76*	*112*
	Sensitive	1:2.5	**1.5**	22	1%	2	4	*3*	*6*	*9*
	High Capability	1:2	**1**	526	15%	80	135	*80*	*135*	*215*
				3,459	100%	*367*	*742*	262	523	*785*

Notes:

1) Distance is measured as a crow flies from a primary transit route.
2) GIS analysis was used to determine the number of eligible parcels (property assessor information, TRPA Regional Land Uses, TRPA IPES data, and the Impervious Surface data produced in 2010 by Spatial Informatics).

Commercial Transfer Assumptions Overview: The model assumed 160,347 sq. ft. of Commercial Floor Area (CFA) remaining from the 1987 Regional Plan and 200,000 sq. ft. of CFA allocated in the 2012 Regional Plan would be available for transfers. Both of these supplies are in the TRPA pool and are assigned to incentivize transfers from environmentally sensitive land, anywhere in the Lake Tahoe Region. The model assumed that all 360,347 of this CFA would be distributed in the 2020-2035 model timeframe, while the 209,155 sq. ft. of CFA that has already been assigned to jurisdictions, but not yet constructed, was assumed to be used in the 2015 – 2020 timeframe. An overall total of 360,347 sq. ft. of CFA was included in the modeling of commercial related transfers. This CFA is available as an incentive to property owners who transfer existing eligible commercial development from environmentally sensitive areas, deemed less suitable for development, into Town Centers, the

Regional Center, or the High Density Tourist District. The following assumptions were made about the portion of development transferred from Sending Areas and to Receiving Areas.

Proportion of Commercial Development Transferred from Sending Areas: For transfers, more CFA sq. ft. is offered for transfers of existing development from more sensitive lands than for transfers from less sensitive lands. Specifically, the transfer ratio from Stream Environment Zones with a land capability classification of 1b (SEZs) is 1:3; meaning that for every square foot of CFA transferred from an SEZ into a Center, two square feet of CFA bonus units are available (see above Table 15 for more information). Additionally, the transfer ratio is 1:2 for transfers out of environmentally sensitive lands other than SEZs with a land capability classification of 1a, 1c, 2, or 3 into a Center. The model assumed that equal transfers would occur from SEZs and other environmentally sensitive lands since the incentives are comparable and higher than a transfer from non-environmentally sensitive lands. The model does not include transfers from non-environmentally sensitive, high capability lands since there would not be any transfer incentives for these types of transfers.

Proportion of Development Transferred to Each Receiving area: Under the existing Regional Plan, various policies act as incentives to promote transfers into Centers (receiving areas). These include: increasing the maximum coverage allowed for a redevelopment project in a receiving area (pursuant to Section 30.4.2.B in the TRPA Code), allowing transfers from sensitive land to transfer non-conforming coverage (pursuant to Section 30.4.2.C in the TRPA Code), among other incentives. In combination with the bonus units, these measures serve to incentivize transfers of commercial establishments for redevelopment projects into receiving areas.

Similarly to the Residential Bonus Unit transfer program, the proportion of transferred CFA assigned to each receiving area was determined based on the level of redevelopment that has already occurred within each Center and the size of receiving areas. These proportions were the same as those used for the Residential Bonus Unit transfers, and are shown in Table . The assumed percent of development transferred to each receiving area and the associated percent and amount of transferred CFA and bonus CFA from SEZs and other environmentally sensitive areas is provided below in Table 16, for the 2021-2035 model timeframe.

Table 15. Existing Development Transfer Ratios Pursuant TRPA Code Section 51.5.3

Existing Commercial Development	Transfer Ratio (Sending: Receiving)	Bonus Units Per Transfer (TRPA Match)	% of Eligible CFA Allocations Transferred from Each Category (Eligible units/total)
SEZs	1:3	2	50.00%
Other Sensitive Lands	1:2	1	50.00%

Table 16. The proportion of development transferred to each Receiving Area based on the supply, the transfer ratios, and number of units and bonus units earned for CFA transfers for the 2021-2035 modeled timeframe.

Proportion of Development Transferred to Each Receiving Area			Overall Modeled Totals				
Center Name (Receiving Areas for Transfers)	Jurisdiction	Percent to be Transferred	Total Existing Business Sq. Ft. of CFA Transferred from SEZ to Center	Total Bonus CFA Match for SEZ Transfers (Transfer Ratio of 1:3 or double of existing CFA)	Total Existing Business Sq. Ft. of CFA Transferred from Other Sensitive Lands to Center	Total Bonus CFA for Other Sensitive Land Transfers (Transfer Ratio of 1:2)	Total Bonus CFA (SEZ & Other Transfers)

High density tourist district	Douglas	20%	24,023	48,046	24,023	24,023	72,069
Kingsbury	Douglas	5%	6,006	12,012	6,006	6,006	18,017
Regional center	CSLT	20%	24,023	48,046	24,023	24,023	72,069
South "Y"	CSLT	20%	24,023	48,046	24,023	24,023	72,069
Meyers	El Dorado	5%	6,006	12,012	6,006	6,006	18,017
Incline Village	Washoe	5%	6,006	12,012	6,006	6,006	18,017
North Stateline, Washoe	Washoe	4%	4,420	8,841	4,420	4,420	13,261
North Stateline, Placer	Placer	1%	1,586	3,171	1,586	1,586	4,757
Tahoe City	Placer	5%	6,006	12,012	6,006	6,006	18,017
Kings Beach	Placer	15%	18,017	36,035	18,017	18,017	54,052
Total	0	100%	120,116	240,231	120,116	120,116	360,347

Notes: This spreadsheet can be found here: F:\Transportation\Planning\Regional Transportation Plan\2016 RTP\11_RTP Land Use scenarios\RevRTPLU_Scenarios\2Revised_TranModTables.xls. Details on the source for each separate transfer can also be found in this spreadsheet.

Commercial Transfer Assumptions Model Approach

To run the commercial transfer model and produce an output to be used in the transportation model, TRPA used the best available GIS data to perform the following steps:

1) Identified the commercial establishments using the InfoGroup Business dataset (2014) in the SEZ and Environmentally Sensitive lands other than SEZs based on the land capability category pursuant to the Bailey-Sinclair land capability designations. Included only the business establishments eligible for transfers (for example certain types were excluded, such as Automated Teller Machines - ATMs, Accessory CFA, tourist accommodation facilities, home businesses, and government/educated related establishments). Excluded those businesses located inside Centers. Accessory CFA is accessory commercial uses designed to serve the primary commercial uses and that

meet all the criteria specified in Code Chapter 21. Examples include: employee facilities, restricted gaming (Nevada only), ski rental shops in ski areas, gift shops in airports, tackle shops used by patrons of marinas, restaurants in a hotel, pro shops at golf courses, and cafeterias in hospitals. See Code Chapters 21, 50, and 90 for additional detail. Derived ground floor CFA for the above identified parcels with businesses eligible for CFA based on the building footprint areas provided in the 2010 Impervious Surface GIS dataset.

2) Assigned the appropriate transfer ratio to each eligible parcel based on land capability category.

3) Randomly selected the appropriate number of business establishments to meet the target CFA to be transferred to Centers. Businesses were selected in the corresponding jurisdiction where the Centers were located.

4) Removed the CFA from the sending Traffic Analysis Zone (TAZ) and assigned the CFA to receiving areas at the proportions shown in the above tables (and distributed evenly across all TAZs within the receiving area).

5) Calculated total number of units leaving each TAZ and total number to be received by each TAZ and incorporated into the transportation model.

Tourist Lodging Transfer Assumptions Model Approach

1) Identified the tourist lodging establishments using the InfoGroup Business dataset (2014) in the SEZ and Environmentally Sensitive lands other than SEZs based on the land capability category pursuant to the Bailey-Sinclair land capability designations. Excluded tourist lodging located inside Centers.

2) Assigned the appropriate transfer ratio to the eligible parcel based on land capability category (1:3 for transfer of existing development out of a SEZ to a Center).

3) Based on supply and demand and market considerations, all of the remaining 162 TAUs were assigned as a bonus unit match for the transfer of a South Lake Tahoe motel located in a Stream Environment Zone outside of a Center. A parcel in Tahoe City (within the Center) in Placer County is modeled as the receiving area for this transfer.

4) Removed the TAUs from the sending Traffic Analysis Zone (TAZ) and assigned the TAUs to receiving areas at the proportions shown in the above tables (and distributed evenly across all TAZs within the receiving area).

5) Calculated total number of units leaving each TAZ and total number to be received by each TAZ and incorporated into the transportation model inputs for TAU by TAZ.

Visitor Assumptions

In addition to assumptions about the distribution of development, another factor that influences transportation model outputs is the amount of visitation to the Region. There are two inputs to the model that most directly impact the model's estimation of visitation to the Region, and those are hotel and motel occupancies, and the percent of housing that is owned as a second home and operated as a seasonal residence or a vacation rental. The assumptions used in the 2020, 2035 and 2040 forecast years for the 2016 RTP are described below, as well as assumptions for day visitors.

Hotel/Motel Occupancies:

A key factor in estimating future traffic volumes and vehicle miles traveled are assumptions related to the number of overnight visitors coming to the Region. It is very difficult to predict future levels of visitation to the Region because visitation can be influenced by a number of external factors such as population growth in nearby counties, the overall state of the economy, gas prices, and the weather, to name a few. With the exception of population growth in nearby counties, there is very little in the way of statewide or nation-wide forecasts to assist with predictions.

In light of the available data, to develop reasonable assumptions about overnight visitor growth, TRPA considered a variety of sources: 1) population forecasts; 2) the recent "Bay to Tahoe Basin Recreation and Tourism Rural Roadway Impact Study" completed by El Dorado County in October 2014; and 3) input from local lodging representatives and visitor authorities, and the Strategic Marketing Group, a marketing consulting firm that provides marketing and strategic planning services for the tourism, recreation, and hospitality industries. The assumptions made in the model err on the side of high visitor growth, in order to maintain a conservative analysis of the potential increase in VMT over the next 20 years.

1) Population Forecasts. The state demographer's office for California and Nevada maintain population forecasts by county by decade. These were analyzed for the counties housing major population centers and that are a high source of tourists for the Lake Tahoe Region. On the California side these counties included Alameda, Contra Costa, El Dorado, Sacramento, San Francisco, Santa Clara, and Yolo counties which house the major population centers of the San Francisco Bay Area, San Jose, and Sacramento. Between 2010 and 2020, 2030, and 2040, population in these areas was projected to grow approximately 1% per year (California Department of Finance, Report P-1, State and County Population Projections by Major Age Groups, December 15, 2014). Growth in the working age population group, ages 25-64 years, was projected to grow even less in these counties, only slightly more than a half a percent per year. On the Nevada side, Washoe County projects 1-2% growth per year between 2013 and 2033, with an overall average annual growth rate of 1.2%. This estimate incorporates the addition of the Tesla factory (Nevada State Demographer's Office, Nevada October 2014 Population Projections).

2) Bay to Tahoe Basin Recreation and Tourism Rural Roadway Impact Study. The purpose of this study was to evaluate the impacts of regional tourism travel on the highway system within the Study Area, evaluate the existing and future tourism market, associated impacts and needs based upon existing conditions, and to provide an evaluation of existing transportation funding sources and programs and likely future funding opportunities. The Study Area for this report was comprised of four California counties: Amador, El Dorado, Placer, and Nevada, plus the Lake Tahoe Basin which included residents who live in the western-most sections of Washoe, Carson City, and Douglas counties, Nevada. The report analyzed visitor spending trends over the past ten to twelve years, as well as future planned developments and attractions that may influence visitor spending and travel. The study predicts that the North Shore of

Lake Tahoe will continue recent trends and realize visitor-spending growth in the range of three to five percent, per year. For the South Shore, the study predicts that visitor-spending growth will be relatively flat, due to recent downturns in visitor spending in the gaming economy, with perhaps a slight upward trend representing trends of the past two years. The report notes that if new approved facilities come online, such as the Edgewood Tahoe Lodge, the South Shore could see a modest rate of growth at between one and three percent per year (page 4-13, Bay to Tahoe Basin Recreation and Tourism Rural Roadway Impact Study).

3) Consultation with marketing and tourism experts. TRPA staff contacted marketing and tourism experts from both the North and South Shores to test visitor assumptions. These experts noted that a flat or no-growth scenario is not unrealistic, given recent reductions in visitation. They also noted that increases in revpar (revenue per available room--calculated by dividing a hotel's total guestroom revenue by the room count and the number of days in the period being measured) rather than overall occupancy could be expected, but much of that growth would be in increase in room rates, because the quality of hotel rooms is increasing. When demand goes up, hotel prices increase, and occupancies remain static. They noted that there is room for growth in winter and the off-season more so than summer. (Carl Ribaudo, Strategic Marketing Group, August 12, 2015; Sandy Evans-Hall, Executive Director, North Tahoe Resort Association, August 13, 2015; Jerry Bindel, Chairman of the South Lake Tahoe Tourism Improvement District, August 20, 2015.)

   Based on the above three sources, the model assumed between a ¼% to ¾% increase per year (the same as in the 2012 model), depending on location, for a total of between 6-19% between 2015 and 2035.

Seasonal and Vacation Use:

From a modeling perspective, it is important to understand what percentage of homes operate as seasonal homes or vacation rentals, because seasonal visitors and vacationers have different travel patterns than full-time residents. For instance, the average number of trips per day for a full-time residential household is approximately 9.6, while lodging properties geared towards visitors generate approximately 10.6 vehicle trips per day (Institute of Transportation Engineers (ITE) Trip Generation, 8th Edition, trip generation rates for Single –Family Detached Homes versus Recreation and Timeshare Homes).

Fluctuations in the economy have led to fluctuations over time in the levels of residential versus second homeownership. Census data shows that the proportion of total housing units that are in seasonal use or vacant has changed from 51 percent in 1990, to 45 percent in 2000, and back up to 51 percent in 2010 (Lake Tahoe RTP/SCS Final EIR/EIS, Volume 1, page 3-369)[15]. These percentages vary between the North Shore and the South Shore, with a greater proportion of housing units used seasonally on the North Shore (U.S. Census 1990, 2000, 2010) (Regional Transportation Plan EIR/EIS, page 3.12-5).

For the 2014 base year, the 2010 census data of occupancy rates by census tract were applied to the appropriate TAZs. Occupancy rates vary, but range from twelve percent to 71 percent Region-wide, indicating the percent of total housing in seasonal use or vacant ranges from 28 percent to 88 percent (Source: F:\Transportation\Planning\Modeling\Model, Forecasts and Data\TransCAD files 2016 RTP\2014\outputs_summer\SocioEcomWithLaborForce.xls). In the modeling for 2016 RTP forecast years 2020 and 2035, the percentage of existing housing units in seasonal/occasional use was assumed to remain unchanged from the base year because there are no forecasts available to indicate whether residential occupancy rates or second homeownership will increase or decrease in the future.

Finally, of the homes that are used seasonally or are vacant, 44 percent of these are assumed to be occupied on a peak day in August, the timeframe for the travel model analysis. This percentage is also carried through into the forecast years of 2020 and 2035 (Tahoe Regional Transportation Survey).

Day-Use Visitation, and Addition of External Trips from Development adjacent to TRPA Boundaries

In order to fully recognize the growth potential of recent proposed development adjacent to the TRPA Study Area, TRPA staff canvased those public transportation agencies responsible for modeling adjacent to the Basin. As shown in Table 17 below, TRPA staff contacted Caltrans, NDOT, SACOG, and the responsible Regional Transportation Commissions (RTCs) and their modeling staff to discern the relative differences

[15] The American Community Survey (2009-2013) shows a slightly higher percentage of seasonal+vacant (55%), however the numbers from the decennial census were used for consistency with other data used throughout the model.

in projected 2035 peak month average daily traffic volumes at the respective entry points. Of particular concern was recent proposed development along California State Route 89 (Squaw Valley) which was estimated to generate an additional 2,804 peak hour vehicle trips into the Lake Tahoe Basin, and along California State Route 267 where additional proposed development (Martis West) was proposed to generate an additional 1,051 peak hour traffic volumes into the Lake Tahoe Basin.

In order to account for this additional traffic growth, TRPA staff conducted a series of sensitivity analyses to better characterize the anticipated increase in day-use visitation and increase in projected traffic counts along the two corridors. Within the modeling framework, day-use visitation was originally generated from the 2005 travel survey records and has since been updated with the 2010 -2011 License Plate and Postcard Survey. External station cordon counts are then used to calibrate the day-use population size, which is then indexed to the overnight visitor population. Therefore, if the overnight visitor population increases, the day-use visitation component of the model increases accordingly. Another factor that affects the day use population in the model is increases in commercial center and recreational amenities (i.e. beach attractiveness and gaming). Each of these areas is assigned an attraction value, which influences the number of day visitors that are assumed to come to the Basin each day. To reflect the potential growth along the two north entry-corridors, TRPA staff made slight adjustments to the hotel-motel occupancies as well as to beach attractiveness factors to influence greater day- use visitation from the two projects along the SR 89 and SR 267 corridors. The purpose of the analysis was intended to match the forecasted entry volumes forecasted in the Squaw and Martis Valley analyses to be comenserate with the forecasted model values. The comparison of TRPA modeled traffic entry volumes and the modeled entry volumes by adjacent metropolitan planning organizations is shown in Table 17, below. For additional information concerning how the Lake Tahoe Transportation Model generates day visitation, refer to the Lake Tahoe Resident and Visitor Model; Model Description and Final Results, August 2007.

Table 17. Comparison of TRPA modeled entry volumes and modeled entry volumes of adjacent MPOs.

	2014	2014		2035 TRPA			2035 Outside					
California Entries	**Count**	**Model**		**Model Volumes**			**Model Volumes- Reference**					
SR 89 MP 0.00 Alpine-El Dorado	3600	4446		5309			5400		Caltrans PSR (April 2012)			
US 50 MP 65.62 Echo Lake Road	15300	13171		16053			17500		SACOG Model - Caltrans PSR			
SR 89 MP 13.72 Squaw Valley Rd	15000	21253		25520			22080	2804	Truckee Model (Shaw) Caltrans PSR 2012			
SR 267 MP 6.23 Martis Peak Rd	12900	16556		19243			16500	1051	Martis Valley Model (Shaw) Caltrans PSR 2012			
	46800	55426		66125			61480					
Nevada Entries												
SR 207 ATR 0531509- sta 0024	7301	8467		11503			8950		Douglas County (Jeff Foltz-Parsons)			
US 50 ATR 252125	15202	19894		21939			15900		Carson City RTC (John Long DKS)			
SR 431 sta 770	4949	11053		12317			9000		Washoe RTC (Xuan Wang)			
	27452	39414		45759			33850					
												3/10/2016

Component 2: The Trip Reduction Impact Analysis Tool (TRIA), a post-processor model

The TRPA maintains a Trip Reduction Impact Analysis (TRIA) spreadsheet tool to evaluate the trip and VMT reduction impacts of various transportation policies and programs under consideration as part of the Sustainable Communities effort. While the TransCAD model is robust, it cannot capture more nuanced strategies that can have a significant effect on travel demand such as parking policies, traveler information systems, new transit operations, or construction of new bike trails and sidewalks. The purpose of the TRIA is to provide planning-level, order-of-magnitude, comparative estimates of the quantitative impacts on auto trips, vehicle miles traveled and greenhouse gas emissions of the continuation of existing policies and programs compared to the impacts of implementing new policies and programs in the areas of transit service expansion, bicycling and walking, and transportation demand management.

TRIA Methodology

As noted above, the TRIA provides a way to make comparisons between different policy alternatives and their ultimate effect on greenhouse gas emissions. Using the tool allows the TRPA to develop a package of policies tailored to the Tahoe area that will help the Region meet the greenhouse gas emissions reduction targets set by the California Air Resources Board under California's Senate Bill 375.

As far as possible, the TRIA used estimates based on current conditions in the Tahoe Basin, or existing forecasts developed locally, particularly in the case of new transit services and new active transportation facilities such as bike trails and sidewalks. For policies or projects for which there are no local studies the impacts were estimated based on a review of the available literature and studies of places where these policies have already been implemented. Where research shows that a policy might vary in effectiveness the more conservative approach will be chosen, so as not to overstate the trip and VMT reduction potential.

The TRIA is built around the main modes of transportation and analysis of how the land use plan and transportation strategies and policies proposed in the Regional Transportation Plan will impact these modes. The main categories considered in the model are:

- Bicycling and walking
- Public transit
- Intelligent Transportation System (ITS) technologies
- Transportation Demand Management measures
- Parking policy changes

The model is structured in such a way as to estimate the potential growth for each mode, for example the potential for new transit riders who were previously vehicle riders, and to take this growth as reductions in vehicle trips. **See Appendix** A for an overview of the strategies analyzed and their trip reduction potential in 2020 and 2035.

Analysis by Mode

Bike and Pedestrian Facilities

The reductions for bicycle and pedestrian trips were developed based on the TRPA/TMPO Bicycle Trail User Model (available at http://www.trpa.org/transportation/monitoring/) and trip and VMT reduction estimates documented in the memo "Environmental, Economic, and Public Health Impacts of Shared Use Paths in Lake Tahoe,"
available at http://www.tahoempo.org/documents/Impacts_Memorandum_110107.pdf. This model and report estimate trip and VMT reduction from bicycle and pedestrian facilities planned along major travel corridors in the Tahoe Region. The TRIA assumes that the implementation of the bicycle and pedestrian network will happen at a uniform rate across the timeframe of Linking Tahoe, therefore by 2020 only a portion of the network will have been completed, and therefore the VMT reduction is not as great in 2020 as in 2035.

Transit Services and Facilities

The transit portion of the trip and VMT reductions are based on ridership projections from the most recent available data from published and draft short- and long-range transit systems plans. Investments included:

- Lake Tahoe Waterborne Transit
- Sacramento - South Shore Summer Transit Service
- Reno - Truckee - Tahoe Public Bus Service
- Minden/Gardnerville Vanpool Service to South Lake Tahoe
- Summer All-Day Service on Route 267
- Half-Hourly Service on US 50 -- Stateline to Y
- TART Evening Service Improvements

- Meyers - SLT Limited Transit Service
- Half-Hourly Service on All TART Routes
- Free Fare TART Service
- Summer Stateline - Zephyr Cove Service
- East Shore Transit Service Operational Enhancements
- Emerald Bay Parking Restrictions with Existing Trolley service

Transportation Demand Management (TDM) Measures and Intelligent Transportation System (ITS) Technologies

Several strategies to increase the functionality and usability of transit were included in the TRIA. These included:

- Improved transit coordination between local and regional providers, through simplified trip planning (for example Google Transit).
- Improved transit coordination between local and regional providers, through the elimination or shortened wait time of transfers, improvements to ticketing structure and agency cooperation to eliminate "transfer anxiety".
- Real-time arrival information at transit stops, online, and/or via web-enabled mobile devices.
- Dynamic ridesharing for inter-regional trips. This strategy assumes that the use of transportation networks for sharing trips into the Basin will become more prevalent.

The TRIA also compared the effect of improving the compliance rate of the existing Employer Trip Reduction ordinance through improved enforcement or updating of policies. Compliance rates and trip reduction potential were based on literature review and local mode share survey data.

Parking Management

The TRIA evaluated adjusting parking requirements (reduction or elimination of minimum parking standards; creation of maximum parking standards; shared parking; in-lieu payment to meet parking requirements) in Town Center Areas. The parking calculations used in the trip and VMT reduction estimates were based on observed parking occupancy statistics and estimates of the total parking supply provided by existing studies, compared to the total parking supply estimated to be available after parking management strategies proposed in the RTP go into effect. Where occupancy and turnover data was not available, trip generation rates were based on data from Trip Generation, 9th Edition[16].

Cumulative Effect

While the effect of each policy or project type will be analyzed individually, the cumulative effect of these policies will also be estimated. The cumulative effect of the policies cannot simply be the sum of individual effects. The impact of some policies depends on the origin and destination – for example whether they affect trips that start in Tahoe but end outside the region, or if the entire trip takes place within the Tahoe Basin. Other policies may be mutually exclusive – i.e. the measures could not reasonably be implemented at the same time. Where strategies are obviously mutually exclusive, only the project with the highest projected trip reduction was included.

Where there are several reduction measures that are not mutually exclusive, the total cumulative reduction does not equal Measure A + Measure B. Once Measure A has been applied, the Measure B will then apply to a base that has already been reduced by the measure A. For example, if two trip reduction measures would each give a 10% trip reduction, the total cumulative reduction is not 20%. Rather, it would be equal to 100% - (90%*90%) = 19%.

[16] Trip Generation, 9th Edition, Institute of Transportation Engineers (2012)

Other Off-Model Reductions – Greenhouse Gas Reduction for Increased Plug-In Electric Vehicle Usage

An additional off-model reduction was applied to overall greenhouse gas emissions, to capture the reduction in greenhouse gas emissions from increased deployment of plug-in electric vehicle charging infrastructure, based on the Region's anticipated completion of the Tahoe-Truckee Plug-In Electric Vehicle Infrastructure and Readiness Plan. Because of the improved access to charging infrastructure anticipated in the plan, TRPA forecasts that PEV owners will be able to travel more miles using electricity.

Component 3: Calculation of the share of vehicle miles traveled (VMT) attributable to the California portion of the Lake Tahoe Region

Because the Tahoe Transportation Model spans both California and Nevada in its region-wide VMT calculations, it is necessary to develop a methodology for splitting out the VMT attributable to the California portion of the Region. In addition, in accordance with the RTAC protocol for accounting for half of the VMT of all trips with an origin or destination outside the region, and none of the VMT for trips that cross through the region without stopping, additional post-processing of the transportation model results is necessary. This section explains how the TRIA is integrated into the model results, and how total VMT and GHG emissions for the California portion of the Region are calculated.

The TRPA developed an "accounting-based" approach to improve the accuracy of VMT estimates in the Tahoe Basin. As described below, this approach accounts for every vehicle trip in the TRPA model. By doing so, it does not have to rely on any interim assumptions, and produces accurate VMT estimates that can be readily reviewed/confirmed by others.

VMT Calculation for the TRPA Travel Demand Model

This section outlines the process the TRPA took to calculate the California-side VMT for the 2005, 2020, and 2035 model years. As noted, VMT is estimated for a peak summer weekday.

Step 1: Obtain Daily Trip Table

The daily trip table is a large matrix displaying the total number of vehicle trips on a daily basis that travel from one particular traffic analysis zone (TAZ) to another. Trip tables also include the number of trips that remain internal to a particular TAZ and trips that have an origin or destination to an external gateway. Below is an illustration of TRPA's trip table.

	1	2	3	4	5	6	7	9	10	11	12	13	
1	69.00	23.00	11.00	30.00	24.00	21.00	30.00	1.00	2.00	0.00	0.00	0.00	0.(
2	36.00	60.00	15.00	17.00	36.00	28.00	28.00	16.00	41.00	16.00	14.00	24.00	4.(
3	0.00	8.00	44.00	1.00	4.00	3.00	0.00	13.00	49.00	20.00	9.00	18.00	2.(
4	26.00	23.00	10.00	7.00	28.00	23.00	28.00	1.00	1.00	2.00	0.00	1.00	0.(
5	25.00	19.00	9.00	34.00	10.00	29.00	29.00	0.00	6.00	3.00	1.00	1.00	0.(
6	30.00	29.00	16.00	26.00	14.00	33.00	29.00	0.00	0.00	0.00	0.00	0.00	0.(
7	44.00	27.00	11.00	28.00	24.00	22.00	81.00	0.00	1.00	0.00	0.00	0.00	0.(
9	1.00	9.00	12.00	0.00	1.00	0.00	0.00	4.00	9.00	4.00	2.00	9.00	2.(
10	1.00	8.00	9.00	0.00	1.00	0.00	2.00	6.00	8.00	1.00	7.00	8.00	2.(
11	0.00	5.00	8.00	1.00	0.00	0.00	0.00	5.00	2.00	2.00	2.00	3.00	1.(
12	3.00	19.00	13.00	0.00	0.00	1.00	0.00	12.00	18.00	3.00	20.00	15.00	5.(
13	1.00	12.00	13.00	2.00	2.00	1.00	0.00	7.00	14.00	3.00	9.00	7.00	3.(
14	0.00	8.00	5.00	0.00	2.00	1.00	1.00	3.00	4.00	1.00	6.00	6.00	0.(
15	1.00	3.00	6.00	2.00	1.00	0.00	0.00	1.00	3.00	0.00	3.00	2.00	0.(

Step 2: Apply TRIA Adjustments

The TRIA quantifies the trip reduction benefits of various transportation programs and policies that are part of the SCS. Since the traffic model is not capable of modeling changes in behavior due to these strategies (e.g., employer shuttles, parking management, subsidized transit, etc.), it is necessary to model these behavior changes through 'post-processing' of the model results. TRPA will modify the daily trip table shown above by reducing trips in accordance with the percentages displayed in the TRIA in those TAZs where travel behavior would be affected by the SCS strategies.

Step 3: Estimate Distance of Trips

A distance-skim matrix is used to estimate the travel distance between all TAZs within a model. It is a matrix of identical size to a trip table, but whose contents are expressed as miles versus vehicle trips.

Step 4: Calculate Zone-to-Zone VMT

The TransCAD software program allows for matrix multiplication. The adjusted trip table from Step 2 is multiplied by the distance skim in Step 3 to yield a new matrix whose content is VMT (i.e., number of daily trips multiplied by distance) between all zones in the model.

Step 5: Aggregate Zones into California and Nevada Sides

To show achievement of the greenhouse gas targets associated with SB 375, VMT must be calculated for the California side only. The TRPA model contains 289 TAZs, of which 184 represent land uses on the California side of the Tahoe Basin and 105 represent land uses on the Nevada side of the Tahoe Basin and external gateways. The California and Nevada zones are identified so that Step 6 can be conducted.

Step 6: Apply RTAC's VMT Calculation Methodology

The Regional Targets Advisory Committee (RTAC) established under SB 375 recommends the following accounting of various trip types for VMT purposes[17]:

- Include 100% of internal-internal (I-I) trips
- Exclude external-external (X-X) trips
- Count 50% of internal-external (I-X) and external-internal (X-I) trips[18]

[17] Recommendations of the Regional Targets Advisory Committee (RTAC) Pursuant to Senate Bill 375. September, 2009. http://www.arb.ca.gov/cc/sb375/rtac/report/092909/finalreport.pdf

[18] TMPO has decided to count 100% of the modeled VMT for I-X and X-I trips with one trip end in the California side of the Basin and the other trip end to a California point.outside the Tahoe Basin, as the transportation model provides trip lengths only to the borders of the TMPO Region. For I-X and X-I trips occurring between the California portion of the Tahoe Basin and the Nevada portion of the Tahoe Basin, or external Nevada point, the TMPO will count 50% of the VMT, in recognition that not all of this VMT is attributable to the California side.

Since the SB 375 evaluation is for the California side of the Tahoe Basin, I-I trips are those that begin and end in this area. An example of an I-X trip is a trip from Meyers, CA to Incline Village, NV, or a trip from Sacramento to Tahoe City, CA. An example of an X-X trip is a trip from Echo Summit, CA to Incline Village, NV, or a trip from Placerville, CA to Carson City, NV.

The zone-to-zone VMT matrix from Step 4 was manipulated based on the aggregation of zones in Step 5 and the above VMT calculation methodology.

The results of this six-step process yield the VMT for the California side of the Tahoe Basin using the RTAC-recommended calculation method.

Component 4: Greenhouse Gas Emission Estimation

The California Air Resources Board requires MPOs to use the Emissions Factors (EMFAC) model to calculate greenhouse gas emissions associated with the SCS. In 2015 ARB released a memo entitled "*Methodology to Calculate CO2 Adjustment to EMFAC Output for SB 375 Target Demonstrations.*" The methodology states:

> *"In 2010, ARB established regional SB 375 greenhouse gas (GHG) targets in the form of a percent reduction per capita from 2005 for passenger vehicles using the ARB Emission Factor model, EMFAC 2007. EMFAC is a California-specific computer model that calculates weekday emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses. ARB updates the EMFAC model periodically to reflect the latest planning assumptions (such as vehicle fleet mix) and emissions estimation data and methods. Since the time when targets were set using EMFAC2007, ARB has released two subsequent versions, EMFAC2011 and EMFAC2014."*

The memo continues:

> "*As MPOs estimate GHG emissions reductions from subsequent RTP/SCSs, they will use the latest approved version of EMFAC, but using a different model will influence their estimates and their ability to achieve SB 375 targets. The goal of this methodology is to*

hold each MPO to the same level of stringency in achieving their SB 375 targets regardless of the version of EMFAC used for its second RTP/SCS."

The methodology describes a process for neutralizing the changes in fleet average emission rates between the version of EMFAC used for the first SCS and the version used for the second SCS. The methodology adjusts for the small benefit or dis-benefit resulting from the use of a different version of EMFAC by applying an adjustment when quantifying the percent reduction in per capita CO2 emissions using the newest version of EMFAC. .

In order to determine the emissions benefit from the Trip Reductions, the TMPO utilized the RTAC Method to break out the designated vehicle trips into the appropriate speed bins contained in EMFAC14. Finally, as noted above in the discussion in the "Other Off-Model Reductions – Greenhouse Gas Reduction for Increased Plug-In Electric Vehicle Usage" of the TRIA discussion in Component 2, an additional off-model reduction was applied to the final greenhouse gas emission output, to capture the reduction in greenhouse gas emissions from increased deployment of plug-in electric vehicle charging infrastructure, based on the Region's anticipated completion of the Tahoe-Truckee Plug-In Electric Vehicle Infrastructure and Readiness Plan.

As shown on the following tables, the results of the analysis indicates that the Tahoe Region will meet their Green House Gas Targets in 2020 and 2035 respectively.

	2005	2020	2035
Population Forecasts	41,377	43,341	45,166
Air Resources Board Targets			
% Reduction in CO_2 per capita from 2005 values (ARB Targets)		7.0%	5.0%
Sustainable Communities Strategy Forecast			
Total Daily VMT	1,041,890	1,038,998	1,149,601

Total Daily CO_2 equivalents (tons) from Daily VMT	445	430	469
Total Daily CO_2 equivalents reduced by additional use of electric vehicles		428	461
CO_2 per capita (lbs.)	21.5	19.8	20.4
% Reduction in CO_2 per capita from 2005 values – Linking Tahoe forecast		8.8%	5.0%

Vehicle Activity Data	Daily Trips	VMT
2014	281,032	1,937,070
2040	286,475	2,168,384
Net change from 2014	5,443	231,314
% change from 2014	1.94%	11.94%

EMFAC 2014	Total CO2*	Units	Conversion to CO2e (AR4)**	CO2e (TPD)	CO2e (MT/yr)	Reductions from EV measures (MTCO2e/yr)	New Waterborne Transit Emissions (MTCO2e/yr)
2014	1,130	Tons per day	1.011083720	1,142	265,294	-	-
2040	699	Tons per day	1.011083720	707	164,194	(2,521)	3,168
% change from 2014				-38.1%	-38.1%		
Net change					(101,099)		

*Emissions from electric vehicles excluded.

** Based on California's Statewide 2014 GHG Inventory for diesel and gasoline fuel types.

EMFAC 2014				
Pollutant (TPD)	**ROG**	**NOX**	**PM10**	**PM2.5**
2014	1.32	2.28	0.14	0.07
2040	0.20	0.41	0.13	0.05
% reduction	-84.7%	-82.0%	-11.3%	-28.0%
Pollutant (TPY)	**ROG**	**NOX**	**PM10**	**PM2.5**
2014	339	583	36	18
2040	52	105	32	13
Waterborne Transit Emissions	4	27	1	1
Total 2040 Emissions	55	132	33	14
net change	-283	-452	-3	-4

Appendix A

Trip Reduction Impact Analysis (TRIA) Estimates Draft Linking Tahoe

TRPA Sustainable Communities Strategy

Vehicle Trip Reduction Strategy	Primary Source of Reduced Vehicle Trips	Vehicle Trip Types Impacted		Percent Reduction in Vehicle Trips for SCS Horizon Year 2020 (Planning-Level Order-of-Magnitude Estimates)			Percent Reduction in Vehi Trips for SCS Horizon Year (Planning-Level Order-o Magnitude Estimates)	
				RP Alternative 3 Constrained	RP Alternative 4 Unconstrained	RP Alternative 5[2]	RP Alternative 3 Constrained	RP Alternati Unconstrai
Parking Management								
Adjust parking requirements (Reduction or elimination of minimum parking standards; Creation of maximum parking standards; Shared parking; In-lieu payment to meet parking requirements) (Town Center Areas) (Not included in Alternative 4 2035 scenario because it is assumed that Intercept lots and associated disincentive captures this.)	Reduced trip generation from new parking spaces.	Mandatory (work)	Existing development					
			New Development	0.24%	0.25%		1.32%	0.00%
		Non Mandatory (discretionary)	Existing development					
			New Development	0.24%	0.25%		1.32%	0.00%
On-street parking management (demand-responsive pricing in commercial areas with residential permits to prevent parking spillover into residential areas) (Town Center Areas)	Reduced trip generation from managed on-street parking spaces and reduced VMT from circling for parking for trips to and from managed areas.	Mandatory (work)	Existing development	On-Street Parking Management will have many localized transportation and economic ben including improved parking availability within commercial districts, but given the relatively s number of parking spaces to be managed (351 on-street parking spaces in commercial dis in Tahoe City and South Lake Tahoe, out of a total supply of more than 100,000 parking sp within the Tahoe Basin), and the widespread availability of public and private *off*-street par within these commercial districts, this strategy is not expected to have a significant impac vehicle trip reduction at the regional-level.				
			New Development					
		Non Mandatory (discretionary)	Existing development					
			New Development					
Transportation Demand Management								
Improve existing employer vehicle trip reduction program (carpool and vanpool matching programs, employee shuttles, on-site secure bicycle storage and shower facilities, flexible work hours, parking and transit use incentives.) (Town Center Areas)	Reduced peak-hour commuter trips.	Mandatory (work)	Existing development	0.89%	0.89%		0.89%	0.89%
			New Development	2.43%	2.43%		2.43%	2.43%
		Non Mandatory (discretionary)	Existing development					
			New Development					

Transit Service and Facilities								
Intra-regional transit capital projects (within Tahoe Basin; currently this only includes ferry service) (Region-wide)	Increased transit mode share, partially drawn from former vehicle trips.	Mandatory (work)	Existing development	0.20%	0.20%		0.19%	0.19%
			New Development	0.20%	0.20%		0.19%	0.19%
		Non Mandatory (discretionary)	Existing development	0.20%	0.20%		0.19%	0.19%
			New Development	0.20%	0.20%		0.19%	0.19%
Transit operational changes (Region-wide)	Increased transit mode share, partially drawn from former vehicle trips.	Mandatory (work)	Existing development	0.37%	0.37%		0.36%	0.36%
			New Development	0.37%	0.37%		0.36%	0.36%
		Non Mandatory (discretionary)	Existing development	0.37%	0.37%		0.36%	0.36%
			New Development	0.37%	0.37%		0.36%	0.36%
Transit operational changes (Non-Town Centers)	Increased transit mode share, partially drawn from former vehicle trips.	Mandatory (work)	Existing development	0.10%	0.10%		0.10%	0.10%
			New Development					
		Non Mandatory (discretionary)	Existing development					
			New Development					
Inter-Regional Transit Service. Applies to Internal-External and External-Internal Trips only (not counted in Alt 4, 2035 because Intercept Locations Strategy is assumed to capture these new trips as well)	Reduced commuter and recreational trips.	Mandatory (work)	Existing development	0.41%	0.41%		0.38%	0.00%
			New Development	0.41%	0.41%		0.38%	0.00%
		Non Mandatory (discretionary)	Existing development	0.41%	0.41%		0.38%	0.00%
			New Development	0.41%	0.41%		0.38%	0.00%
Inter-Regional Transit Service - Intercept Locations with Frequent Shuttles into the Region Applies to Internal-External and External-Internal Trips only	Reduced visitor trips		IX-XI Trips	0.00%	0.00%		0.00%	6.00%
ITS Strategies								
Improved transit coordination between local and regional providers, through simplified trip planning (for example Google Transit). (Town Center areas)	Increased transit mode share for trips in the corridor/district served by the project, partially drawn from former vehicle trips.	Mandatory (work)	Existing development	0.74%	0.74%		0.69%	0.69%
			New Development	0.74%	0.74%		0.69%	0.69%
		Non Mandatory (discretionary)	Existing development	0.74%	0.74%		0.69%	0.69%
			New Development	0.74%	0.74%		0.69%	0.69%
Improved transit coordination between local and regional providers, through the elimination or shortened wait time of transfers, improvements to ticketing structure and agency cooperation to eliminate "transfer anxiety". (Town Centers)	Increased transit mode share for trips in the corridor/district served by the project, partially drawn from former vehicle trips.	Mandatory (work)	Existing development	0.04%	0.04%		0.05%	0.05%
			New Development	0.04%	0.04%		0.05%	0.05%
		Non Mandatory (discretionary)	Existing development	0.04%	0.04%		0.05%	0.05%
			New Development	0.04%	0.04%		0.05%	0.05%
Enhanced transit trip planning (for example Google Transit). (Inter-Regional Trips)	Increased transit mode share for trips in the corridor/district served	Mandatory (work)	Existing development	0.17%	0.17%		0.15%	0.15%
			New Development	0.17%	0.17%		0.15%	0.15%

	by the project, partially drawn from former vehicle trips.	Non Mandatory (discretionary)	Existing development	0.17%	0.17%		0.15%	0.15%
			New Development	0.17%	0.17%		0.15%	0.15%
Real-time arrival information at transit stops, online, and/or via web-enabled mobile devices. (Town Center areas)	Increased transit mode share for trips in the corridor/district served by the project, partially drawn from former vehicle trips.	Mandatory (work)	Existing development	0.22%	0.22%		0.21%	0.21%
			New Development	0.22%	0.22%		0.21%	0.21%
		Non Mandatory (discretionary)	Existing development	0.22%	0.22%		0.21%	0.21%
			New Development	0.22%	0.22%		0.21%	0.21%
Regionally implemented dynamic ridesharing (conservative implementation). Applies to Internal-External and External-Internal Trips only.	Reduced commuter and recreational trips.	Mandatory (work)	Existing development	0.00%	0.00%		0.00%	0.00%
			New Development	0.00%	0.00%		0.00%	0.00%
		Non Mandatory (discretionary)	Existing development	1.00%	1.00%		1.00%	1.00%
			New Development	1.00%	1.00%		1.00%	1.00%
Bike and Pedestrian Facilities								
Complete regional network of bike and pedestrian facilities (includes expanded bike parking) (Region-wide)	Increased bike and pedestrian mode share for trips in the corridor/district served by the project, partially drawn from former vehicle trips of 3 miles or less.	Mandatory (work)	Existing development	0.30%	0.30%		0.75%	0.75%
			New Development	0.30%	0.30%		0.75%	0.75%
		Non Mandatory (discretionary)	Existing development	0.45%	0.45%		1.13%	1.13%
			New Development	0.45%	0.45%		1.13%	1.13%
Other Projects								
TOWN CENTERS								
Cumulative Estimate (for all vehicle trip reduction strategies currently under consideration in the TRPA SCS)	n/a	Mandatory (work)	Existing development	2.73%	2.73%		3.11%	3.11%
			New Development	4.47%	4.48%		5.86%	4.61%
		Non Mandatory (discretionary)	Existing development	2.00%	2.00%		2.60%	2.60%
			New Development	2.24%	2.25%		3.89%	2.60%
NON TOWN CENTERS								
Cumulative Estimate (for all vehicle trip reduction strategies currently under consideration in the TRPA SCS)	n/a	Mandatory (work)	Existing development	0.97%	0.97%		1.41%	1.41%
			New Development	0.97%	0.97%		1.41%	1.41%

		Non Mandatory (discretionary)	Existing development	1.12%	1.12%		1.78%	1.78%
			New Development	1.12%	1.12%		1.78%	1.78%
INTERNAL-EXTERNAL TRIPS								
Cumulative Estimate (for all vehicle trip reduction strategies currently under consideration in the TRPA SCS)	n/a	Mandatory (work)	Existing development	0.57%	0.57%		0.53%	6.14%
			New Development	0.57%	0.57%		0.53%	6.14%
		Non Mandatory (discretionary)	Existing development	1.57%	1.57%		1.52%	7.08%
			New Development	1.57%	1.57%		1.52%	7.08%

TOWN CENTERS	Alt 3	alt 4	alt 5	Alt 3	alt 4
Existing	2.16%	2.16%		2.72%	2
New	2.73%	2.74%		4.32%	3
Overall	2.18%	2.18%		2.83%	2
NON TOWN CENTERS					
Existing	1.08%	1.08%		1.70%	1
New	1.08%	1.08%		1.70%	1
Overall	1.08%	1.08%		1.70%	1
IX & XI Reductions					
Existing	1.35%	1.35%		1.31%	6
New	1.35%	1.35%		1.31%	6
Overall	1.35%	1.35%		1.31%	6

Notes

Per the TRPA TransCAD model, 22 percent of regional trips are mandatory and 78 percent are non-mandatory.