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TECHNICAL MEMORANDUM

Date: 12.17.18

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From: Ronald T. Milam, AICP, PTP and Jason Pack, PE

Subject: Review and Assessment of Existing Planning/Travel Demand Tools for SB 743   OC18-0567

This technical memorandum presents a review of existing sketch planning tools and travel demand forecasting models available for SB 743 VMT analysis in the WRCOG region. We identified three travel forecasting models and 11 sketch planning tools that produce VMT forecasts or test VMT reduction strategies. However, SB 743 has an additional requirement that limits which models or tools are potentially acceptable for VMT analysis. The *Technical Advisory on Evaluating Transportation Impacts in CEQA*, State of California, Governor's Office of Planning and Research, April 2018 contains the following specification for models and methodologies.

> *Models and methodologies used to calculate thresholds, estimate project VMT, and estimate VMT reduction due to mitigation should be comparable. For example:*
>
> > *• A tour-based assessment of project VMT should be compared to a tour-based threshold, or a trip-based assessment to a trip-based VMT threshold.*
> >
> > *• Where a travel demand model is used to determine thresholds, the same model should also be used to provide trip lengths as part of assessing project VMT.*
> >
> > *• Where only trip-based estimates of VMT reduction from mitigation are available, a trip-based threshold should be used, and project VMT should be assessed in a trip-based manner.*

Presuming that WRCOG member agencies will rely on the RIVTAM or SCAG travel forecasting models to establish VMT thresholds, then these models (or their inputs/outputs) would need to be used for project analysis. As a result, current sketch tools would not be used to estimate VMT for SB 743 purposes. Instead, these tools would largely be used for testing VMT mitigation measures such as transportation demand management (TDM) strategies.

Travel Forecasting Models

Three travel forecasting models are available for VMT forecasting in the WRCOG region including the California Statewide Travel Demand Model (CSTDM), the SCAG travel forecasting model, and the RIVTAM travel forecasting model. The CSTDM was developed by Caltrans and produces passenger travel demand forecasts. Details about the model can be found at the following website.

- http://www.dot.ca.gov/hq/tpp/offices/omsp/statewide_modeling/cstdm.html

In addition, Caltrans has produced VMT output data by traffic analysis zone (TAZ) for purposes of SB 743 implementation and that data can be accessed at the following website.

- http://www.dot.ca.gov/hq/tpp/offices/omsp/SB743.html

As a statewide model, the level of detail for local project applications may not be sufficient to produce reasonable results since the model was not validated at a local scale. The traffic analysis zones (TAZs) are large as shown in the map excerpt below; so the resulting VMT outputs would have limited sensitivity to small scale land use projects and the influences of land use context.

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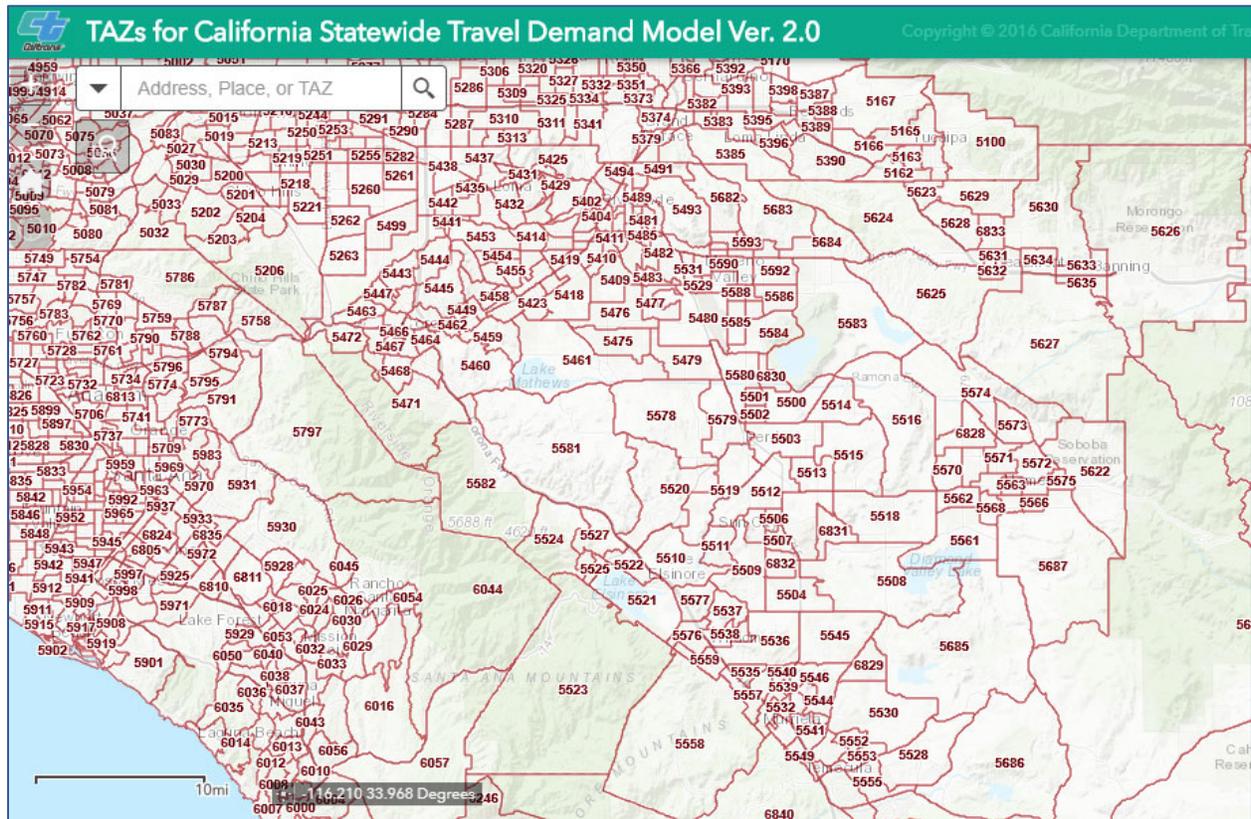
SCAG has developed its own models for regional planning purposes including a trip-based model and an activity-based model (ABM). A variety of other models have also been created for specific purposes related to sub-regional modeling, heavy duty trucks, air quality, and scenario planning. As shown in the image below, SCAG is transitioning from the trip-based model, which was used for previous regional transportation plans/sustainable communities strategies (RTP/SCS) to the ABM for future versions.

The SCAG trip-based and ABM model outputs can be post-processed to produce total VMT estimates at the traffic analysis zone (TAZ) level or for any aggregation of TAZs. The ABM can also produce household generated VMT estimates. These estimates are limited to trips that have origins and destinations within the model boundary. Trips to or from external model origins and destinations are not included. The models are sensitive to built-environment effects and have been calibrated and validated to represent the SCAG region as explained in the model development documentation available at the following website.

- http://www.scag.ca.gov/DataAndTools/Pages/TransportationModels.aspx

Since Riverside County is located at the edge of the SCAG model area, some modifications to the models may be necessary to provide a full accounting of VMT effects as recommended in the OPR Technical Advisory for SB 743 implementation. The specific modifications would be to adjust the lengths of trips entering and exiting the model boundary area to capture their full travel distance and not just the distance they travel inside the model area.

The final model evaluated is the RIVTAM travel forecasting model, which represents a sub-area version of the SCAG model. RIVTAM was completed in May 2009 and includes a 2008 base year and a 2035 forecast year. The model was designed to provide a greater level of detail and sensitivity in Riverside County compared to regional SCAG model (see image below of the current TAZ system.
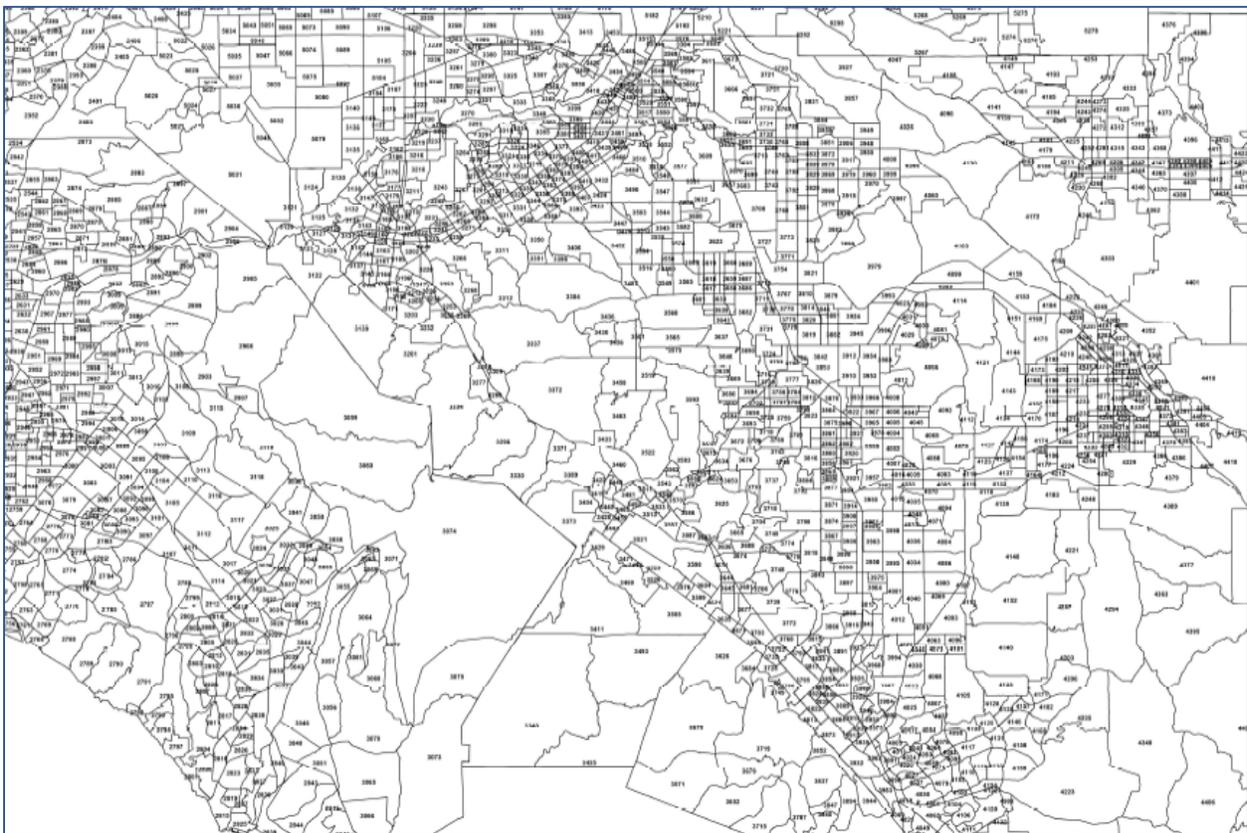
As part of an update to the TUMF program, a new 2012 base year was established and the forecast year was extended to 2040. A major update of the model was started in July of 2018 and will extend into 2019. The current and updated models will be capable of producing VMT estimates for each TAZ or larger areas. To provide the full-accounting of VMT that is recommended for SB 743, the current model outputs will likely need further refinements similar to those described above for the SCAG model. The updated model is anticipated to include these changes.

Sketch Planning Tools

This review evaluated 11 sketch model tools using the following criteria. We also incorporated information from reviews conducted through academic research by UC Davis and UC Berkeley.

1. Defensibility – How defensible is the use of this tool in terms of the accuracy of its outputs and frequency of use by other agencies.

2. Sensitivity - How sensitive is to the tool to the specific land use contexts and TDM strategies (e.g., does the tool allow the user to import details related to the context surrounding the project site and the proposed TDM mitigation measures).

3. Utility – How easy is the tool to use to evaluate VMT and TDM strategies.

The 11 sketch model tools reviewed are listed below:

- **CalEEMod** - is a statewide computer model designed to estimate emissions of criteria air pollutant and greenhouse gas (GHG) associated with land use projects. This model also provides VMT estimates that are a part of the emissions modeling process.

- **Sketch 7** - is a spreadsheet tool that estimates percent reductions to VMT based on the 7 Ds (i.e., density, diversity, distance, design, destination, demographics, and development scale).

- **VMT Impact Tool/Salon** – is a spreadsheet tool created by Deborah Salon at UC Davis for the California Air Resources Board that quantifies how much VMT will change in response to changes in land use and transportation system variables.

- **GreenTRIP Connect** - is an online tool for residential projects that allows users to evaluate the VMT and GHG emissions of their project and to test a limited set of built-in TDM strategies.

- **MXD/MXD+** - is a mixed-use development trip generation tool developed for U.S. EPA that adjusts ITE daily trip generation estimates to reflect built environment effects. MXD+ incorporates the ITE mixed-use trip generation method to produce a.m. and p.m. peak hour trip generation estimates for mixed use projects. To estimate VMT, the trip generation results from

MXD/MXD+ must be multiplied by trip lengths from observed data or regional/local travel forecasting models.

- **UrbanFootprint (UF)** - is a scenario planning tools that produces VMT estimates relying on the MXD trip generation methodology. Trip lengths are calculated within the model but do not reflect network-based routing. SCAG uses a version of UF as part of its sketch planning model.

- **Envision Tomorrow** - is a scenario planning tool that produces VMT estimates.

- **California Smart-Growth Trip Generation Adjustment Tool** – is a spreadsheet tool that provides the number of trips generated by land use projects implementing smart growth principles.

- **TRIMMS** – is a visual basic application spreadsheet model that estimates mode share and VMT changes brought about by a number of TDM strategies.

- **VMT+** - is a web-based application that estimates VMT and emissions using ITE trip rates and user-defined trip and land use inputs.

- **TDM+** - is a spreadsheet tool that estimates the percent reduction in VMT due to the implementation of one or many different TDM strategies identified in the *Quantifying Greenhouse Gas Mitigation Measures*, CAPCOA, 2010.

The matrix in Attachment A provides a summary of the tool review. Each of the sketch models reviewed, except for the CA Smart Growth Tool and MXD/MXD+, provide direct estimates of 'project generated VMT' or calculates the percent change in VMT. None of the models are capable of fully evaluating the 'project's effect on VMT' or evaluating cumulative VMT impacts. Only CalEEMod, GreenTRIP Connect, TRIMMS, and TDM+ evaluate the impacts of TDM strategies for VMT mitigation.

Tool Recommendations for WRCOG Member Jurisdictions

According to the OPR technical advisory, the tools used to evaluate VMT must be consistent with the methodology used to determine VMT thresholds. To maintain consistency between methods and thresholds, we do not recommend using the available sketch planning tools to estimate project-generated VMT for land use projects if thresholds are based on the RIVTAM or SCAG model. However, the sketch tools may be useful for evaluating the impacts of potential TDM strategies.

If an efficiency form of VMT (VMT per service population, VMT per resident, or VMT per employee) is selected as the metric that is used to define the VMT thresholds, then we would recommend the development of a customized screening and forecasting tool (i.e., web-app). This tool would reflect the

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specific transportation and land use context of the WRCOG region by relying on RIVTAM model inputs and outputs. The tool could be used for the following assessment and forecasting steps.

- Identify the TAZ associated with the project location.
- Identify the local jurisdiction of the project, based on the project's associated TAZ.
- Determine if the project meets screening criteria related to being located within a transit priority area (TPA).
- Determine if project meets screening criteria related to being located within a low VMT generating TAZ. This test would largely apply to residential and work-related land uses. Retail land uses have a separate screening related to whether the project is local serving, which could be based on size (e.g., less than 50,000 square feet) This step would rely on the model's base year (or baseline) estimate of the TAZ VMT per service population and would compare that value to the proposed threshold measured at the jurisdictional or a reasonable sub-regional area (i.e., WRCOG or TUMF districts).
- Provide baseline and cumulative estimates of project generated VMT if the project fails to be screened out including VMT estimates for use in other sections of CEQA analysis, such as air quality, greenhouse gases, and energy based on TAZ VMT averages.

Tool setup would include running the base year and future year scenarios of the travel demand model to obtain VMT and land use data for each TAZ, jurisdiction, and reasonable sub-region. Key features of this tool are described in Table 1.

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Table 1: VMT Screening and Forecasting Tool Specifications			
Feature	**Description**	**Elements**	**Comments**
Setup inputs	Parcel boundaries, TPA boundaries, and travel demand model data required to prepare tool for use	• Parcel boundaries • TPA boundaries • Model data for each TAZ, jurisdiction, TUMF district under base year and future year conditions: 　○ TUMF districts 　○ Jurisdiction boundaries 　○ Land use, population, employment (and possibly students) 　○ Total VMT 　○ Total VMT per service population	Only needs to be updated when model is updated
Project inputs	Data required for each project	• Project baseline year (year Notice of Preparation is filed) • Land use, population, employment (and possibly students) • Is project consistent with General Plan? (yes/no) • Is project consistent with RTP/SCS? (yes/no) • Does the project consist exclusively of local serving retail uses with a total project size of less than 50,000 square feet? (yes/no)	
Tool outputs	Results provided for each project	• Does project satisfy screening criteria? If yes, basis for determination • Estimated project total VMT per service population (project baseline and future years) • Estimated project total VMT (project baseline and future years)	VMT estimates based on TAZ average

For evaluating the impacts of TDM strategies for VMT mitigation, CalEEMod, GreenTRIP Connect, and TDM+ are available sketch tools, but each as potential limitations. The data supporting the VMT reductions associated with the TDM strategies in these tools is largely derived from urban areas. Their application in suburban and especially rural areas may not be valid without a detailed assessment of how the strategy is affected by the background land use context. As to individual tool limitations, GreenTrip Connect only applies to residential projects with just a few TDM strategies. CalEEMod includes the TDM strategies from *Quantifying Greenhouse Gas Mitigation Strategies*, CAPCOA, 2010, but has operational issues noted in the tool review in Attachment A that can misrepresent project generated VMT. TDM+ also includes the CAPCOA strategies plus recent ARB research documented in the "SB 743 Implementation TDM Strategy Assessment," June 11, 2018; however, this tool is proprietary and would need to be applied through Fehr & Peers.

ATTACHMENT A – Review of Available Sketch Models

ATTACHMENT A: SKETCH MODEL TOOL APPLICABILITY FINDINGS

Sketch Tool	Output	Defensibility	Sensitivity	Utility	Comments	User Experience: Benefits (UC Davis[1])	User Experience: Drawbacks (UC Davis[1])	Conclusions (UC Berkeley[2])	Conclusion
CalEEMod	VMT	++ Widespread use by air districts. Defensibility depends on use by others due to lack of documentation for trip lengths and known calculation problems.	+ Many parameters, but limited sensitivity to land use context, requires use of mitigation function to accurately represent mixed-use or infill projects, does not directly capture internalization, and mitigation function is not current or fully sensitive to TDM strategies.	++ Requires installation, which can cause errors due to older programming (not updated since 2016). Use of the tool is relatively straightforward but use of mitigation function is often necessary to accurately represent proposed projects.	CAPCOA/Trinity Consultants product, may not be able to make changes.	Many, customizable inputs; program interface reduces back-end error.	Many, customizable inputs; defaults and land use categories may misrepresent project and/or context area.	Easier data demands; difficult to determine location attributes, especially to avoid double counting; documentation did not provide enough guidance on method selection.	Not recommended for VMT calculations but could be used for TDM mitigation evaluation.
Sketch 7	% Change in VMT	+ Household (HH) VMT only. Hasn't been updated since 2012.	+ No internalization, no TDM reduction, no trip purpose. Produces % change in VMT, generic place types.	+ Must have regional travel demand model data as input.		Straightforward inputs & interface; system-level outputs; outputs include walk, bike, and transit trips.	Spreadsheet interface can become "buggy", break; regional TAZ data used to calibrate tool may be difficult to obtain.	[Not reviewed]	Not recommended.
VMT Impact Tool/Salon	% Change in VMT	+ HH VMT only	+ No internalization, no TDM reduction, no trip purpose.	+ Not intuitive as a project analysis tool.	Scenario testing for census tract level & above; not project-level.	[Not reviewed]	[Not reviewed]	[Not reviewed]	Not recommended.
GreenTRIP Connect	VMT; Change in VMT	+ HH VMT only	+ Affordable housing, TDM credit for 4 strategies,	++ Easy to use, but limited to residential land uses.	Would need to work with TransForm.	Simple user interface; straightforward outputs.	Measures only residential travel, even in mixed-use projects.	[Not reviewed]	Not recommended for VMT calculations, but could be used for TDM mitigation evaluation. Application in rural areas may not be valid.
UrbanFootprint	VMT	++ Uses MXD for trip generation. Trip lengths not based on observed data.	++ Many parameters. Sensitive to land use changes from adjacent parcels. No TDM reduction.	+ Robust tool but requires training to learn.	California acquired licenses for all cities and counties.	[Not reviewed]	[Not reviewed]	[Not reviewed]	Not recommended.
Envision Tomorrow	VMT	+ Added parameters diluted research.	++ Many parameters. No TDM reduction.	+ Open source, complex spreadsheet tool.	Primarily scenario planning; owned by Fregonese.	[Not reviewed]	[Not reviewed]	[Not reviewed]	Not recommended.
CA Smart Growth Tool	Trips	++	+ No trip purposes, no TDM reduction.	+		Few, intuitive inputs with direction of where to find them.	Calculates trips one land use at a time, and in limited context areas; calculates trips, not VMT.	[Not reviewed]	Not recommended.
TRIMMS	VMT	++ Used by SJCOG.	++ Includes TDM reductions for employees (not LU).	+	Has a few elements that do not exist in CAPCOA.	[Not reviewed]	[Not reviewed]	[Not reviewed]	Not recommended.
MXD/MXD+	Trips	+++	++ Many parameters, no TDM reduction.	++		Simple inputs categories; straightforward outputs.	Important input data may be difficult to find.	High data input demands; obtaining data required GIS capability.[3]	Not recommended.
VMT+	VMT	+ Educational Tool.	+ Limited parameters.	++ Easy to use.		[Not reviewed]	[Not reviewed]	[Not reviewed]	Not recommended.
TDM+	% Change in VMT	+++ CAPCOA-based.	++	++	Only does TDM reductions; needs to be coupled with VMT estimator. Being updated based on new TDM research from ARB Net Zero Building Feasibility Study.	[Not reviewed]	[Not reviewed]	[Not reviewed]	Could be used for TDM mitigation evaluation. Application in rural areas may not be valid.

Sources: Fehr & Peers, 2018; UC Davis, 2017; UC Berkeley, 2018.

Notes: + = lowest score, +++ = highest score

[1]Amy Lee, Kevin Fang, and Susan Handy; "Evaluation of Sketch-Level Vehicle Miles Traveled (VMT) Quantification Tools," National Center for Sustainable Transportation, August 2017.

[2]Elisa Barbour, Dan Chatman, Sarah Doggett, Stella Yip, and Manuel Santana; "SB 743 implementation: Challenges and Opportunities [Draft Final]," June 5, 2018.

[3]Analysis based on earlier, public spreadsheet tool; more advanced proprietary versions available.