Recommendation 5

Background. One of the practical difficulties in producing accurate vehicle emissions inventories is estimating travel speeds. Speed data are important because they are used for properly matching traffic activities with associated vehicle emission factors (California Air Resources Board, 2002; US Environmental Protection Agency, 2004). However, travel speeds are also used to refine travel modeling parameters and output as the travel demand models are calibrated. In addition, most travel models (and all of those in the SJV) do not generally have resolved or accurate enough speed estimates (Stopher and Fu, 1998).

It is not an understatement to say that the usual land use planning and transportation investment decisions of today's metropolitan planning organizations (MPOs) are stretched to respond to a variety of considerations unheard of when travel models were first introduced, and used primarily to identify additional capacity needs. Previously, the required accuracy of speed estimates was less of a concern than the estimated capacity-flow relationship. Contemporary issues range from air quality conformity and environmental justice issues to informing regulatory processes and addressing reporting requirements associated with government accountability. With these kinds of analyses come different types of sensitivities to particular factors, like speed.

Linkage to Air Quality Modeling. Transportation modeling and air quality modeling have not been consistently integrated. The traffic activity data, particularly link speed data from travel demand models are normally not as finely resolved as needed for estimating mobile source emissions. Consequently, some additional post-processing of travel model output is often required (NRC 2001). The post-processing procedures employed can have a significant impact on subsequent emissions estimates.

In terms of travel model outputs, critical parameters in mobile source modeling are volume, speed and time–of-day distributions of travel activity. Speed is a particularly critical input source. There are two difficulties associated with improving speed estimates from travel demand models. First, a complete validation for speed estimates is seldom done in practice due to limited data, technical expertise and/or easily applied methods. Second, there is a wide variety of link performance functions that can be used in the travel models, and they can produce substantial variations in post-processed speed estimates. Although speed post-processors (SPPs) have been accepted as good practice (NRC 2001), most MPOs have not yet implemented them, primarily because the need for identifying new or enhanced infrastructure capacity (as opposed to air quality impacts) is what mostly drives modeling refinements.

Research has suggested that using different speed-flow functions or post-processing methods may result in significantly different emissions estimations (Bai et al., 2004). Very little research has been done to identify how an MPO should select a speed-flow function for any post-processing that is performed. That is, there is very little research that would suggest which post-processor is the "right one" for a given municipality. Although most post-processing approaches have reported producing speeds comparable to those derived from operational/simulation models or field observations, there has been little to no research exploring the impact of such improvements on regional emissions inventories. It is well documented that speeds can non-linearly affect emissions through emission factors (California Air Resources Board, 2004; Ntziachristos and Samaras, 2000), but it remains unclear to air quality analysts how overall regional emissions inventories would vary when speeds are improved by post-processing, and what the impact of using different types of speed processors might be.

Project Tasks. Recommendation 5 of the CCOS project has been revised to reflect an exploratory study aimed at clarifying when and what type of speed post-processor is suitable for counties within the SJV as well as the Sacramento region. The goal of this work is to identify those circumstances in which post-processing of speed data would greatly improve the translation of travel demand modeling outputs for air quality modeling inputs.

The study effort would be collaborative with CARB staff. Four primary tasks would be completed:

Task 1: Select and apply one or more SPPs for each of the SJV counties and SACOG travel demand models that do not currently use an SPP in the preparation of data for mobile source emissions modeling.

> This effort would involve selecting one or more SPPs for application to Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus and Tulare and the Sacramento model. The five most well-documented and reasonably accessible (to local planners and modelers) SPPs would be evaluated. Most of the SPPs also require that one or more parameters be set. These are often qualitatively and quantitatively selected to best represent general traffic flows characteristics. As part of this task, we'll identify ranges of acceptable parameter values and conduct sensitivity analysis for each of the parameters required to use the selected SPPs.
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> Although this will be a task primarily handled by UCD, we will provide training and guidance to CARB staff to facilitate CARB's processing of county data for other regions across the state.

Task 2: This is a collaborative task to be conducted with CARB staff. Working with CARB staff, prepare post-processing runs for EMFAC.

> We will work with CARB staff to identify as many SPP runs as thought necessary to characterize the impacts of speed post-processing on emissions. This will include examining variability in post-processed speed results, expected impacts on mobile source emissions and finally CARB staff capacity for conducting EMFAC runs.

Task 3: To be conducted by CARB staff. Evaluate the changes in mobile source emissions on photochemistry.

> CARB staff will perform EMFAC modeling and multiple air quality model runs to assist in the evaluation of the impacts of post-processing of speed (and speed variability) on modeled pollutant concentrations.

Task 4: Analyze the results of the photochemistry runs.

> Using the air quality modeling results, a detailed evaluation will be conducted and results will be characterized. The evaluation of the results will be reviewed and refined in collaboration with CARB staff.

Task 5: Prepare a peer-reviewed publication and a white paper.

> In collaboration with the CARB staff, a paper suitable for a peer-reviewed publication will be prepared detailing scientific findings. In addition, we will prepare a white paper

suitable for the general planning organization that characterizes major findings with respect to the impacts of speed post-processing on emissions, and ultimately pollutant concentrations.

Estimated Workflow

Task	**Mo 1**	**Mo 2**	**Mo 3**	**Mo 4**	**Mo 5**
Task 1	*DN- UCD*				
Task 2			*DN-UCD, w/ CARB*		
Task 3			*CARB*		
Task 4				*DN- UCD, w/ CARB*	
Task 5			*DN-UCD, w/CARB*		

DN-UCD: Task completed by DN and UCD
DN-UCD: Task completed by DN and UCD, in collaboration with CARB
CARB: Task to be completed by CARB staff