MEMORANDUM

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SUBJECT: **Use of Sketch Planning Tools in Transportation and Air Quality Planning**
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INTRODUCTION

This document summarizes findings of the task focused on clarifying the use of sketch planning tools in transportation air quality planning. The emphasis is on providing information to the Technical Working Group (TWG) stakeholders, to initiate a discussion on future needs in Texas.

OVERVIEW OF SKETCH PLANNING TOOLS

Definition

In transportation planning, sketch planning tools and methods are those that provide a *"general order-of-magnitude estimates of travel demand and traffic operations in response to transportation improvements"* (*1*). In the specific context of transportation air quality, one of the earliest references to sketch planning methods was in a two-part guidance document published by the United States Environmental Protection Agency (EPA) in 1979 (*2*). Here, sketch-planning techniques were defined as those that provide a first-cut estimate of a transportation measure's impact for a relatively small investment of time and effort. In this guidance, approaches to obtain sketch-level estimates of

emissions impacts included analyses of travel demand, facility operations, or other emissions and energy estimations; computational methods included manual or computer-based approaches.

Some other sources have employed a more strict definition of sketch-planning tools as those that provide **macroscopic, area-wide** estimation of travel demand and emissions changes (*3*). This approach to sketch planning methods is seen in an assessment conducted for the United States Environmental Protection Agency that focused on regional emissions impacts of vehicle miles traveled (VMT) reduction strategies (*4*). Other reviews and discussions of sketch planning methods have included a broader range of methods, including those that provide corridor-level or strategy-specific assessments (*5*). Examples from non-Texas sources of such tools that could support sketch-level analyses of emissions impacts include the Atlanta Regional Council's Congestion Mitigation and Air Quality (CMAQ) calculator (*6*), and FHWA's CMAQ Calculator Toolkit (*7*).

Whether sketch planning tools and methods are defined more broadly or narrowly, it is seen that they follow the same principles of any transportation emissions analysis, in which total emissions are a function of vehicle activity and vehicle emissions rates (per unit activity). Most of the existing sketch planning methods either assess *changes in activity* (i.e. VMT) and translate this to emissions reductions, or assess the impact of changed *emissions rates* (due to operational efficiencies, fleet changes, or other factors) on overall emissions.

Texas-Specific Sketch Planning Tool Initiatives

There have been several initiatives in Texas to document and develop sketch-planning tools for air quality analyses, starting in the early 1990s. Some of these activities were performed as part of TxDOT-sponsored research projects, including:

- A Critical Analysis of Sketch Planning Tools for Evaluation of Transportation Control Measures (TCMs) (*8*) – a 1993 research study conducted by TTI, which described the existing state of practice on sketch planning tools, and conducted a scenario analysis, sensitivity analysis and comparisons of two existing sketch planning tools for TCM evaluation. In a follow-up study conducted in 1994 (*9*), a spreadsheet-based sketch planning tool (TCM Analyst) was developed for TCM analyses in Texas.

- Congestion Management and Air Quality Benefits of Transportation Improvements (*10*) - a 1995 research study that developed a TTI CM/AQ Evaluation Model, which used a sketch planning approach to CMAQ project evaluations, based on project-specific data.

- Comprehensive Evaluation of Transportation Projects: A Toolkit for Sketch Planning (*11*) – a project completed in 2010 by the Center for Transportation Research (CTR), which developed a toolkit to assess impacts of transportation network improvements on congestion, safety and emissions.

In addition to the above Texas-specific examples developed over the years, the North Central Texas Council of Governments' (NCTCOG's) sketch planning methods were also included in a FHWA report on emissions analysis techniques for TCMs (*5*). More recently, the *Texas Guide to Accepted Mobile Source Emissions Reduction Strategies* (MOSERS Manual) has emerged as an established resource for practitioners that can be used for assessing emissions impacts of a variety of transportation strategies, and potentially support sketch planning efforts. The 2007 edition of the MOSERS guide (*12)* is in the process of being updated and will be housed in the Texas Air Quality Portal (*13*).

Finally, the El Paso Transportation Air Quality Sketch Planning Tool is the newest example of a sketch planning tool developed in Texas. It was developed by TTI for the El Paso Metropolitan Planning Organization (MPO) in 2016, as part of the Rider 8/Rider 7 State and Local Air Quality Planning Program administered by the Texas Commission on Environmental Quality (TCEQ). This tool was presented to the TWG in 2016 (*14*). Key features of this tool are described briefly below (*15*):

1. The tool is intended to be used for estimating the emissions impacts of transportation strategies or plans, including those modeled in the regional travel demand model (TDM), and other strategies that may not be reflected in the TDM.

2. The tool is currently in the form of an MS-Excel spreadsheet that consists of two distinct modules: a TDM-based module that uses TDM outputs to estimate network emissions for different scenarios, and a non-TDM

component that estimates emissions benefits of individual projects/strategies based on user inputs (consistent with methodologies in the MOSERS guide).

3. The tool has built in emissions factors based on the EPA's Motor Vehicle Emissions Simulator (MOVES) model. The pollutants estimated include ozone precursors (oxides of nitrogen and volatile organic compounds) and other pollutants including particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide, and carbon dioxide.

The TDM-based module of the tool is designed to allow for TDM files to be loaded into the tool. The tool extracts pertinent information for emissions estimation and provides emissions link, traffic analysis zone, district, and network levels. This information will allow for an evaluation of directional changes or potential indication of emissions impacts for alternative scenarios modeled in the TDM. The tool is designed to compare two alternative TDM scenarios (a base case and an alternative). While it also estimates regional emissions, it has been emphasized to stakeholders that the TDM-based module *should not be used for conformity* or other regulatory purposes.

Emerging Issues and Considerations

As discussed in the previous sections, the term "sketch planning tool" or "sketch planning methods" in the context of transportation air quality have been applied broadly to methodologies that provide relatively quick and rough estimates of the impacts of different regional strategies or more localized projects.

In the past, sketch planning tools were based on simple equations or used spreadsheet-based calculators with limited complexity and generalized equations. In recent years, advances in computation and transportation- and emissions- modeling have increased the speeds at which the emissions impacts of transportation scenarios can be evaluated. This has resulted in the ability for transportation agencies to conduct rapid analyses with relatively sophisticated modeling and analytical tools, even with limited time and effort. An example of this is the El Paso Sketch Planning Tool, which allows for a regional emissions estimate to be obtained with relatively low time and effort, based on outputs of a TDM run.

In this context it is especially important to understand where sketch planning tools can be applied (for example, in research, scenario planning, trends analyses, to assess potential impacts of programs, for assessments for grant applications including CMAQ),

and where they cannot (for emissions analyses that follow a mandated regulatory process such as conformity). Stakeholder enagement and information is key in this regard, to ensure that available tools for emissions analyses are not misused and misinterpreted due to their increasing complexity, speed and percieved accuracy.

KEY MESSAGES AND FUTURE CONSIDERATIONS FOR TWG

Some key messages and future considerations for TxDOT and TWG stakeholders are outlined below:

- Terminology - There is no established standardized terminology for what consitutes a "sketch planning tool", though they are broadly interpreted as methods that can provide estimates of regional or local emissions impacts of various transportation strategies. The stricter definition of a sketch planning tool is one that is focused on macroscopic, regional-level assessments.
- Uses - There are several appropriate uses of sketch planning tools and methods, including:
    - Research studies that involve estimation of emissions from transportation networks
    - Scenario planning and assessment of various transportation plans or networks
    - Assessment of emssions impacts of strategies for grant applications
    - Decision-making and project selection processes
    - To support quality assurance/quality control (QA/QC) processes
    - To conduct sensitivity analyses and risk assessments
    - To support public engagement and outreach
- Linkage to Conformity Processes - For sketch-planning approaches conducted at the regional level in nonattainment areas, it is important to note that they cannot bypass or subsitute the existing conformity demonstration process. Further, the use of sketch planning tools in these regions should also include approriate

messaging and communication to avoid any confusion regarding interpretation of the results.

- Working Definition - For purposes of Texas air quality practioners and the TWG, it is recommended that we define sketch planning tools to include approaches that provide us an understanding of emissions impacts of transportation system or network changes, or impact of programs and policies ***without any regulatory significance or implications for existing conformity practices.***

- Impacts of Advanced Modeling Techniques – It is becoming easier to rapidly model emissions impacts of transportation scenarios, and even include greater level of detail in sketch-planning analyses that can bring results closer to official emissions inventories. While this may be beneficial for certain tasks (QA/QC, sensitivity analyses), it can also create confusion with the established conformity processes. As mentioned previously, it is therefore important to communicate to stakeholders the analytical rigor, interagency consultation, and existing procedures that exist in the conformity process that do not form a part of sketch-level analyses.

- Leveraging TTI's Existing Utilities and Methods **–** The emissions inventories and conformity analysis support activities conducted by TTI have produced extensive documentation of methods, procedures, and utilities and data (including emssions rates) that can support the development of sketch-planning tools in Texas. Some of these existing resources can be used to improve sketch planning tools and analyses, though it is important to balance resource constraints with level-of-detail, and to ensure that sketch planning tools do not end up completely replicating conformity processes.

- Communication to Stakeholders - This is a cross-cutting issue that covers many of the points discussed above. It is important that stakeholders understand that sketch-planning tools and approaches: 1. can complement but not replace existing conformity processes, 2. must balance analytical rigor with resource constraints and the need for providing quick analyses with limited level of detail, 3. should leverage existing resources and methods wherever possible.

- Expansion of El Paso Tool for Statewide Applications – Some TWG stakeholders had expressed interest in a statewide tool similar to the TDM-based module of the El Paso Sketch Planning Tool. TTI does not recommend a "one size fits all" approach to the development of a tool statewide, given differences in local MPO needs, differences in the type and structure of TDMs, and in nonattainment status. Tools customized to the needs of different regions can instead be developed, subject to local stakeholder interest and avaiability of funds to support such an initiative. It is recommended that the TWG serve as a platform for informing stakeholders of the development of such tools, to ensure coordination of efforts, and leveraging of existing resources whereever possible.

CONCLUSIONS AND NEXT STEPS

This document summarized key issues related to terminology, scope, and current use of sketch planning tools and methods to support air quality and conformity efforts in Texas. As discussed in previous sections, it is important for TWG members and stakeholders to understand appropriate uses of these tools, and to ensure that these tools do not conflict with or cause confusion with existing conformity procedures in nonattainment areas.

There is also the potential to leverage work performed by TTI on development of emissions inventories and other regional emissions analyses to support the development of sketch planning tools or to conduct similar analyses in nonattainment areas. While the development of a statewide sketch planning tool is not recommended, there is potential for individual regions to pursue development of customized tools to meet their needs.

On TxDOT review and approval of this document, it is recommended that key findings be presented to the TWG at an upcoming quarterly meeting, and/or be made available to stakeholders through the Air Quality Portal.

REFERENCES

1. Federal Highway Administration, Types of Traffic Planning Tools https://ops.fhwa.dot.gov/trafficanalysistools/type_tools.htm

2. Transportation Air Quality Analysis Sketch Planning Methods (Part 1 and 2), USEPA, December 1979

3. Dowling, Richard. *National Cooperative Highway Research Program (NCHRP) Report 535: Predicting Air Quality Effects of Traffic-Flow Improvements: Final Report and User's Guide*. Transportation Research Board. (2005). http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_535.pdf.

4. ICF International. *Estimating Emission Reductions from Travel Efficiency Strategies: Three Sketch Modeling Case Studies*, Environmental Protection Agency, EPA-420-R-14-003a, June 2014

5. Federal Highway Administration, A Sampling of Emissions Analysis Techniques for Transportation Control Measures, Final Report , October 2000 https://www.fhwa.dot.gov/ENVIRonment/air_quality/conformity/research/transportation_control_measures/emissions_analysis_techniques/

6. Atlanta Regional Commission, *CMAQ Emissions Calculator*, https://atlantaregional.org/natural-resources/air-quality/air-quality/

7. Federal Highway Administration, CMAQ Emissions Calculator Toolkit https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/

8. Crawford, J.A., and Krammes, R.A., *A Critical Analysis of Sketch-Planning tools for Evaluating the Emission Benefits of Transportation Control Measures,* Report to the Texas Department of Transportation, Prepared by the Texas A&M Transportation Institute, December 1993 http://tti.tamu.edu/documents/1279-5.pdf.

9. Crawford, J. A., Rao, K. S., & Krammes, R. A. (1994). TCM Analyst 1.0 and User's Guide (Vol. 1279, No. 7). Texas Transportation Institute. https://static.tti.tamu.edu/tti.tamu.edu/documents/1279-7.pdf

10. Dresser, G. B., & Walters, C. (1995). TTI CM/AQ Evaluation Model User's Guide and Workshop Training Materials (No. FHWA/TX-95/1358-1). https://static.tti.tamu.edu/tti.tamu.edu/documents/1358-1.pdf

11. Kockelman, K., Xie, C., Fagnant, D., Thompson, T., McDonald-Buller, E., & Waller, T. (2010). Comprehensive evaluation of transportation projects: a toolkit for sketch planning (No. FHWA/TX-11/0-6235-1). University of Texas at Austin. Center for Transportation Research. https://ctr.utexas.edu/wp-content/uploads/pubs/0_6235_1.pdf

12. Texas A&M Transportation Institute. *Texas Guide to Accepted Mobile Source Emissions Reduction Strategies*, https://moser.tti.tamu.edu/docs/Texas.Guide.to.Accepted.Mobile.Source.Emission.Reduction.Strategies_August.2007.pdf

13. Texas Air Quality Portal – MOSERS Section https://txaqportal.org/mosers

14. Transportation Air Quality Sketch Planning Tool – Presentation to TWG http://www.texastwg.org/wp-content/uploads/2011/11/Trans_AirQuality_SketchPlanningTool-1.pdf

15. Texas A&M Transportation Institute, *Development of a Transportation Air Quality Sketch Planning Tool for the El Paso Region,* Prepared for the El Paso MPO, June 2016.