AQRP Monthly Technical Report

PROJECT TITLE	MOVES-Based NO_x Analyses for Urban Case Studies in Texas	**PROJECT #**	16-010
PROJECT PARTICIPANTS	Sonoma Technology, Inc. (STI)	**DATE SUBMITTED**	June 8, 2017
REPORTING PERIOD	**From:** May 1, 2017 **To:** May 31, 2017	**REPORT #**	8

A Financial Status Report (FSR) and Invoice will be submitted separately from each of the Project Participants reflecting charges for this Reporting Period. I understand that the FSR and Invoice are due to the AQRP by the 15th of the month following the reporting period shown above.

Detailed Accomplishments by Task

During this reporting period, the STI team continued work on Task 2 MOVES Sensitivity Analyses by identifying key testing parameters, developing testing scenarios, and conducting MOVES modeling runs.

Preliminary Analysis

The project team has completed the MOVES modeling runs designed for each of the three analysis areas (Fort Worth, Houston, and El Paso) to test how NO_x emissions change with respect to four key factors identified as the focus in developing MOVES modeling scenarios: fleet mix (truck percentage), vehicle speed (VMT by speed distribution), vehicle age (VMT by age distribution), and meteorology (ambient temperature and relative humidity). In general, the modeling is in emission inventory mode at county scale for each month, weekday/weekend, and each hour during the morning peak hour (6 AM to 9 AM). In addition, three modeling scenarios at national scale are also conducted to identify whether any impact from model scale. For each of the scenario, the morning peak CO to NO_x molar ratio (i.e. CO/NO_x ratio) based on annualized CO and NO_x are calculated and analyzed to find out the correlation between key MOVES inputs and CO/NO_x ratio. The remaining section provides the preliminary results.

Fleet Mix

Seven scenarios have been designed to model the impact of varying fleet mix (ranging from 0% to 30% trucks) on morning peak CO/NO_x ratio. Figure 1 summarizes the correlation of CO/NO_x ratio to truck percentage. The three dash lines with circular markers in Figure 1 show the CO/NO_x ratios from the scenarios with varying truck percentage from 0% to 30% while the triangle, square and star markers show the ratios from base, default, and default-national scenarios, respectively. According to Figure 1, the CO/NO_x ratio decreases while truck

percentage increase. Also, the rate of decrease is much larger at low truck percentage (less than 10%). The CO/NO_x ratio from base, default, and default-national scenarios are consistent with the CO/NO_x ratio curves except for those at Fort Worth. Comparing to El Paso and Houston, Fort Worth has a much higher CO/NO_x ratio; the team is working on further analysis to explain this result.

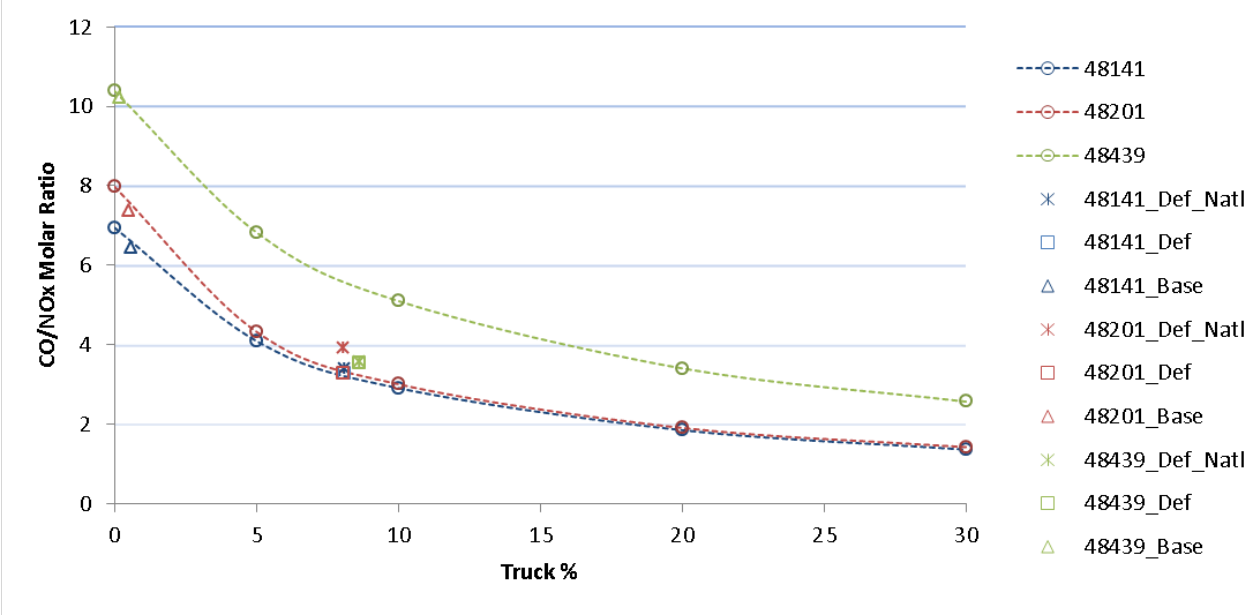

Figure 1. CO/NOx molar ratio for each fleet mix scenario. The five digit county FIPS codes represents the three urban analysis areas (48141: El Paso, 48201: Houston, 48439: Fort Worth). "Def_Natl" represents the scenario at national scale using MOVES default inputs, "Def" represents the scenario at county scale using MOVES default inputs, and "Base" represents the scenario at county scale using inputs same as Base scenario.

Vehicle Speed

Seven scenarios have been designed to model the impact of varying vehicle speed distributions on morning peak CO/NO_x ratio. Except for the default and base speed distributions, three distributions representing low, medium, and high speed levels retrieved from TCEQ's MOVES County Database (CDBs) prepared under AERR for 2014 National Emissions Inventory (NEI) have been used in MOVES modeling for Low, Mid, and High speed scenarios. Figure 2 summarizes the CO/NO_x ratio for each speed scenario. For Fort Worth, the ratio decreases while speed increases. For El Paso and Houston, similar as emissions versus speed curve, CO/NO_x ratio first decreases and then increase while speed increases. This confirms that CO/NO_x ratio is impacted by vehicle speed. However, the ratios of the scenarios with only varying speed (i.e., Base, Low, Mid, High, and Base_Def) are much higher than ratios of two default scenarios, which suggest the impact from vehicle speed may not as significant as other key factors (i.e., truck percentage). The team is working on further analysis to quantify the impacts from vehicle speed so that comparison among key factors is possible.

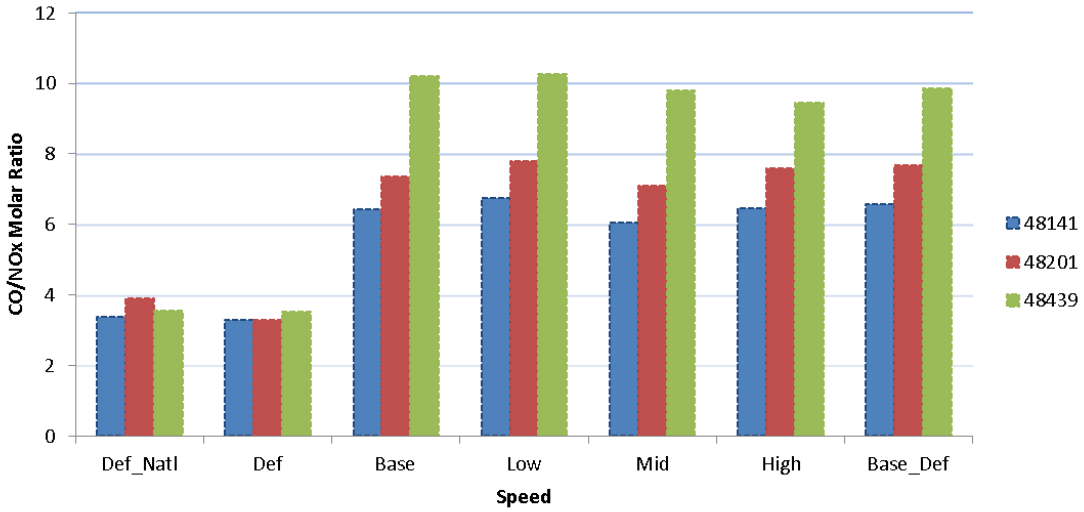

Figure 2. CO/NO_x molar ratio for each vehicle speed scenario. Note that, the five digit county FIPS codes represents the three analysis areas: 48141 (El Paso), 48201 (Houston), 48439 (Fort Worth). "Def_Natl" represents the scenario at national scale using MOVES default inputs, "Def" represents the scenario at county scale using MOVES default inputs, and "Base_Def" represents the scenario at county scale using inputs same as Base scenario except for speed distribution (which is the MOVES default).

Vehicle Age

Seven scenarios have been designed to model the impact of varying vehicle age distributions on morning peak CO/NO_x ratio. Except for the default and base age distributions, three distributions representing new, medium, and old fleet retrieved from TCEQ's MOVES County Database (CDBs) prepared under AERR for 2014 NEI have been used in MOVES modeling for New, Mid, and Old age scenarios. Figure 3 summarizes the CO/NO_x ratio for each age scenario. Looking at New, Mid and Old age scenarios, CO/NO_x ratio decreases while fleet age increases for all three areas. This confirms that CO/NO_x ratio is impacted by vehicle speed. However, the ratios of the scenarios with only varying age (i.e., Base, New, Mid, Old, and Base_Def) are much higher than ratios of two default scenarios, which suggest the impact from vehicle age is not as significant as other key factors (e.g., truck percentage). The team is working on further analysis to quantify the impacts from vehicle age so that comparison among key factors is appropriate.

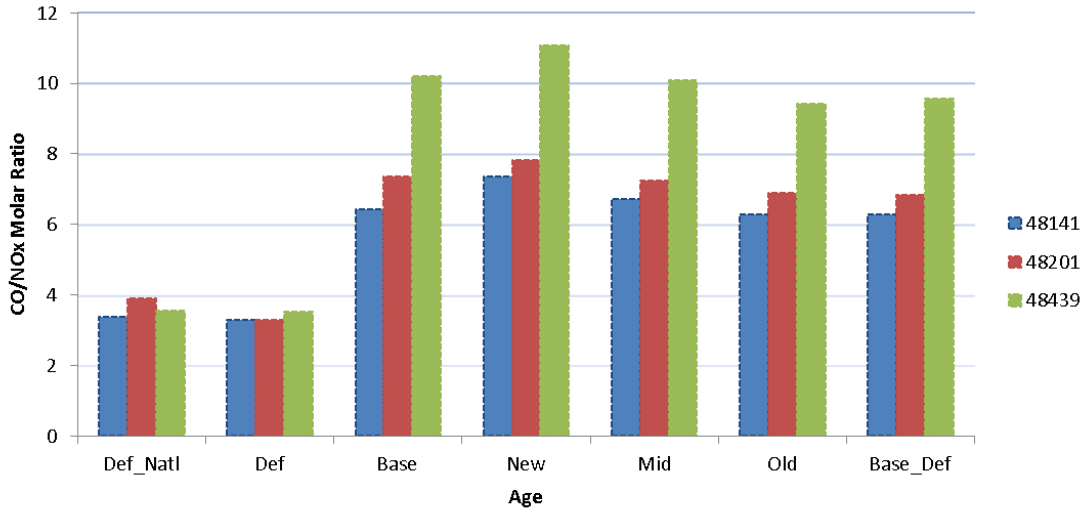

Figure 3. CO/NO_x molar ratio for each vehicle age scenario. The five digit county FIPS codes represents the three analysis areas:48141 (El Paso), 48201 (Houston), 48439 (Fort Worth). "Def_Natl" represents the scenario at national scale using MOVES default inputs, "Def" represents the scenario at county scale using MOVES default inputs, and "Base_Def" represents the scenario at county scale using inputs same as Base scenario except for speed distribution (which is the MOVES default).

Meteorology

Seven scenarios have been designed to model the impact on morning peak CO/NO_x ratio due to varying meteorological conditions derived from various data sources and using different averaging approaches as listed below:

- Default: data retrieved from MOVES2014 default database (averaged over 10 years).
- Base: data retrieved from TCEQ MOVES CDBs prepared under AERR for 2014 NEI.
- Site_Sum_Win: data derived from hourly temperature and relative humidity measured at the near-road sites using a six month averaging window, i.e., using the average of data from April through September for the summer average, and the average of data from October through March for the winter average.
- Site_Season: data derived from hourly temperature and relative humidity measured at the near-road sites using a three-month averaging window (i.e., using the average of data from June, July, and August for the summer average, and November, December, and January for the winter average).
- Site_Month: data derived from hourly temperature and relative humidity measured at the near-road sites using monthly average for each season (i.e., using the average of data from July for the summer average, and the average of data from December for the winter average).

Figure 4 summarizes the CO/NO_x ratio for each meteorology scenario. By comparing the scenarios with only varying meteorology (i.e., Base, Site_Sum_Win, Site_Season, Site_Month, and Base_Def), the CO/NO_x ratios vary with the meteorological data from different sources or averaging approaches. Among these sceniarios, the largest difference between the ratios by site given different meteorological data inputs is less than 2. These ratios are also much higher than those based on the default scenarios (Def_Natl and Def). This suggests that variations in

meteorological data input may not as significant on CO/NO_x emission ratios as other key factors (e.g., truck percentage). The team is working on further analysis to quantify the impacts from meteorological inputs so that comparison among key factors is appropriate.

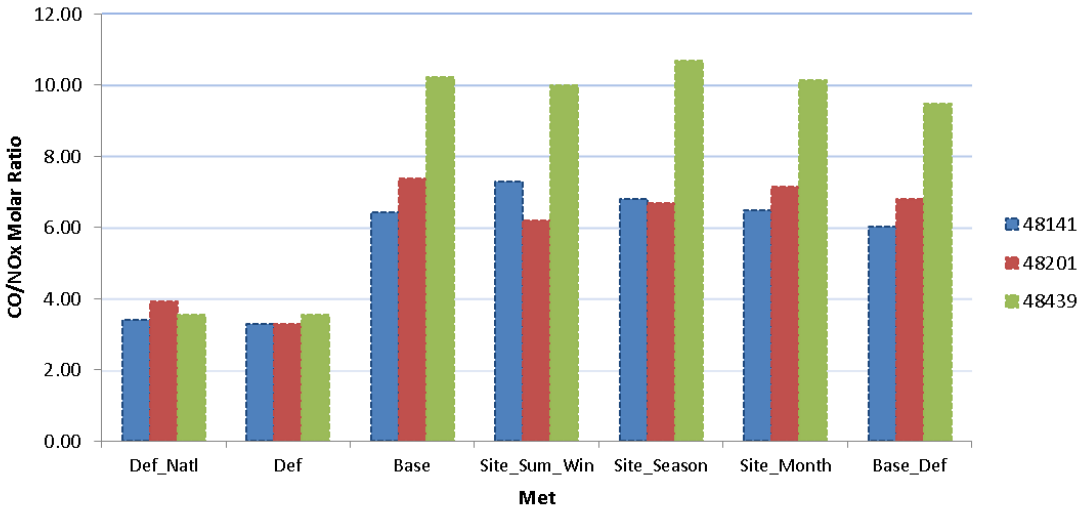

Figure 4. CO/NOx molar ratio for each meteorology scenario. The five digit county FIPS codes represents the three analysis areas: 48141 (El Paso), 48201 (Houston), 48439 (Fort Worth). "Def_Natl" represents the scenario at national scale using MOVES default inputs, "Def" represents the scenario at county scale using MOVES default inputs, and "Base_Def" represents the scenario at county scale using inputs same as Base scenario except for speed distribution (which is the MOVES default).

Data Collected

Year 2015 hourly temperature and relative humidity data were retrieved from EPA's AQS for the three near-road sites in the study areas to derive meteorology data used in the MOVES sensitivity analysis. For Houston, relative humidity data were not available at the near-road site 48-201-1052; met data from a nearby AQS site 48-201-0024 were used as surrogate.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

The team continued to follow the analysis strategy described in previous monthly technical reports; no additional problems or issues were encountered during the reporting period.

Goals and Anticipated Issues for the Succeeding Reporting Period

The team continued work on the planned emissions reconciliation analysis and MOVES sensitivity analyses. No significant issues are expected in the next reporting period.

Detailed Analysis of the Progress of the Task Order to Date

The completion of project tasks and the project deliverables are expected to follow the schedule from the work plan and quality assurance project plan.

Do you have any publications related to this project currently under development? If so, please provide a working title, and the journals you plan to submit to.

___Yes _x_No

Do you have any publications related to this project currently under review by a journal? If so, what is the working title and the journal name? Have you sent a copy of the article to your AQRP Project Manager and your TCEQ Liaison?

___Yes _x_No

Do you have any bibliographic publications related to this project that have been published? If so, please list the reference information. List all items for the lifetime of the project.

___Yes _x_No

Do you have any presentations related to this project currently under development? If so, please provide working title, and the conference you plan to present it (this does not include presentations for the AQRP Workshop).

_x_Yes ___No

Working title: MOVES-Based NO_x Analyses for Urban Case Studies in Texas
Conference: US EPA Emissions Inventory Conference, Baltimore, MD, August 14-18, 2017
Podium session: Reconciling NO_x Emission Inventories with Ambient Observations

Do you have any presentations related to this project that have been published? If so, please list reference information. List all items for the lifetime of the project.

___Yes _x_No

Submitted to AQRP by Song Bai sbai@sonomatech.com

Principal Investigator Stephen Reid, Song Bai