



## Subtask 2.1

# TWG Air Quality Planning Technical Issues Analysis

## Evaluation of TxDOT's Non-Road Fleet Activity Data

### TECHNICAL MEMORANDUM

Prepared for the Texas Department of Transportation

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## Environment and Air Quality Division

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## TECHNICAL MEMORANDUM

Inter-Agency Contract (Contract No: IAC 00000015198)

Subtask 2.1 TWG Air Quality Planning Technical Issues Analysis  
Evaluation of TxDOT's Non-Road Fleet Activity Data

**DATE:** October 30, 2018

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# TWG AIR QUALITY PLANNING TECHNICAL ISSUES ANALYSIS: EVALUATION OF TXDOT'S NON-ROAD FLEET ACTIVITY DATA

This memorandum summarizes work performed by Texas A&M Transportation Institute (TTI) staff on evaluating TxDOT's non-road fleet activity data for potential air quality applications. This work was conducted as part of Subtask 2.1 (Technical Working Group [TWG] Air Quality Planning Technical Issues Analysis) of the TTI-TxDOT Air Quality and Conformity Interagency Contract 00000015198. The activities on this topic were initiated as part of a larger effort of interest to TxDOT and the TWG members to obtain and analyze non-road equipment activity data. This analysis can generate various information items in support of air quality initiatives in Texas.

The goal of the effort is to support TxDOT, TWG, and other stakeholders such as Texas Commission on Environmental Quality (TCEQ) in using non-road equipment activity data for air quality-related purposes and specifically updating activity parameters for developing future emissions inventories. The TxDOT Fleet Operations Division is also interested in using the non-road fleet activity data to identify pieces of TxDOT's non-road equipment operating in nonattainment areas of the state that are best suited for replacement using funding sources such as grants and rebates under the Diesel Emissions Reduction Act (DERA) and TCEQ's Texas Volkswagen Environmental Mitigation Program. The replacement of TxDOT's older heavy-duty non-road diesel equipment operating in nonattainment areas is expected to provide emission reductions in these areas.

The remainder of this memorandum covers the background and summarizes the activities on this task to date.

## BACKGROUND AND ACTIVITIES

Since 2014, the TxDOT Fleet Operations Division has been using the Fleet Navigator system, a telematics-based fleet management system developed by AssetWorks, to track and manage TxDOT fleet activities throughout the state. Using GPS and vehicle telematics systems, Fleet Navigator enables the TxDOT fleet managers to track and monitor the usage, movement, and fuel purchases for each piece of equipment in near

real-time. All the data from each piece of equipment and vehicle are wirelessly transmitted to and recorded in a database.

TxDOT's Fleet Navigator database has a large amount of equipment and vehicle usage data detailing the temporal and spatial distribution of activity parameters for each piece of equipment. This database is a rich source of information that can be used in support of efforts to improve air quality in Texas and update current and future emissions inventories. TxDOT may use the information generated from the data set to:

- Support and update conformity emission inventories.
- Identify best candidates for equipment replacement programs in nonattainment areas that are expected to result in emission reductions in Texas nonattainment areas.
- Develop accurate estimates of the expected local and regional emissions reduction benefits.

TTI staff were tasked to evaluate the potential use of TxDOT's non-road equipment activity data to support these applications. TTI staff performed the following activities under this subtask:

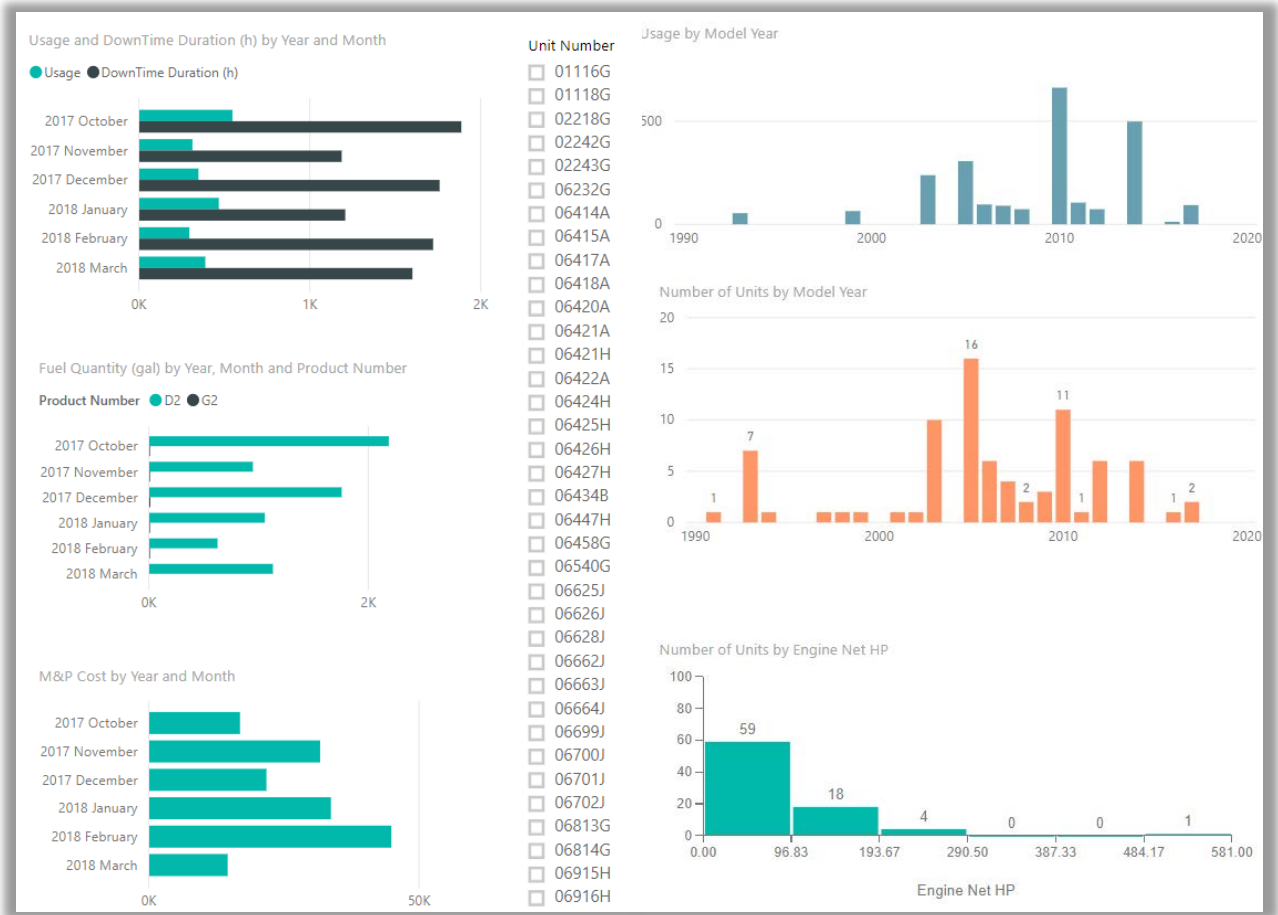
- Evaluated the data needs for the EPA's NONROAD model.
- Engaged in preliminary discussions with TxDOT Fleet Operations Division. Explained the potential air quality applications of TxDOT's fleet operations data. TxDOT staff provided an overview of the Fleet Navigator system.
- TxDOT provided a small extract of the fleet operations data to TTI (April 2018). The sample contained 6 months of data (October 2017 to March 2018) for non-road equipment operating in the Houston District.
- TTI staff imported the sample data into an integrated data system (Microsoft Power BI) to prepare/process the raw data, build a data structure model, analyze, and visualize the equipment usage. The TTI team automated all the steps from reading data to generating graphs and summary tables in Power BI with no

manual intermediate steps. The TTI team developed codes in the DAX<sup>1</sup> language to extract the relevant information from the raw data.

- In addition to its data processing and analysis functions, the interactive visual dashboarding and mapping capabilities of Power BI enabled the TTI team to perform quality control, examine multiple scenarios, and isolate and evaluate the impacts of specific combinations of parameters. TTI staff developed a sample data evaluation and visualization dashboard for this purpose. Figure 1 shows one of the dashboards that were developed by the team. As shown in the figure, the TTI team could evaluate the usage hours and fuel consumption by time, age, engine power rating, and equipment type.
- TTI team presented the visual dashboards and interim results to TxDOT staff in May and discussed the potential applications and expanding the analysis to the entire state. TxDOT Fleet Operations staff expressed interest in using the system developed by TTI to help them on identifying equipment units that are most suitable for replacement and estimating the expected emission reduction benefits.
- TxDOT Fleet Operations provided the statewide data tables for non-road equipment in mid-June. In the meantime, TTI staff continued expanding reporting capabilities of the sample database for Houston.
- After receiving the statewide non-road activity data tables, TTI has started cleaning up the data tables, importing them into Microsoft Power BI, and preprocessing them into a standard format.

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<sup>1</sup> DAX: Data Analysis eXpressions – is the formula and query language for Microsoft Power BI Desktop and SQL Server Analysis Services (SSAS) Tabular models.



**Figure 1. Sample Interactive Dashboard Summarizing Equipment Activity Data.**

## NEXT STEPS

Activities for FY2019 will be continued in discussion with TxDOT and TWG members, and are anticipated to include the following steps:

- Finish importing the data tables into Power BI in the standard tabular format.
- Develop and implement a quality assurance/quality control (QA/QC) process to ensure that there are no major errors in the data used in generating activity summaries. At a minimum, the QA/QC process will include checking the data for the following errors or omissions:
  - Check the timestamps on each data set to ensure that there are no missing gaps in the data sets.

- Check all usage hours to make sure no incorrect usage are being recorded, such as usage hours that exceed maximum realistic hours based on input from TxDOT staff.
- Check equipment type to make sure that all units are assigned to correct equipment categories and subcategories.
- Establish proper data model for the data tables (i.e., identify, implement, and test relationships between the data tables).
- Conduct data analysis to extract and summarize equipment usage parameters, and to address questions raised by TxDOT as interim results are presented and additional data applications discussed. The data analysis is anticipated to focus on (but is not limited to):
  - Developing a ranking process to identify the equipment units that their replacement will provide the maximum benefit to TxDOT and Texas nonattainment areas (including emission reduction benefits).
  - Characterizing equipment activity parameters by time, equipment type, and other key factors.