# MEMO

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**DATE:** September 23, 2020
**SUBJECT:** Knoxville MOVES Post-Processor Documentation & User Guide

To effectively analyze air-quality impacts associated with transportation planning scenarios – including roadway and land-use changes – one needs both projections of transportation related changes (vehicle flows, congestion, and travel times) and a means to conduct the complex calculations required to estimate vehicle emissions. The former typically comes from a detailed travel model and the latter from EPA's **M**otor **V**ehicle **E**missions **S**imulator (MOVES).

To facilitate the Knoxville Regional Transportation Organization's transportation-related air quality assessments, RSG has constructed a tool (KRTM_to_MOVES) to post-process outputs from the Knoxville Regional Travel Model (KRTM) and to translate these into inputs required to run EPA's MOVES air-quality emissions model.

Part 1.0 of the following memorandum presents a User Guide to the KRTM_to_MOVES tool, folder structure, and instructions for use. Part 2.0 describes the 5 travel-related files generated by the Knoxville MOVES post-processor for direct use in Knoxville TPO MOVES model runs and documents underlying assumptions and methodology.

# 1.0 KRTM_TO_MOVES USER GUIDE

The KRTM_to_MOVES post-processor is run through the KRTM regional model user-interface in TransCAD. The tool uses regional model run outputs (as reported in the final assigned network .dbd files) to generate the following 5 input files needed to run MOVES.

1. hourVmtFraction.csv
2. avgSpeedDistribution.csv
3. rampFraction.csv
4. roadTypeDistribution.csv
5. HPMSvTypeYear.csv[1]

[1] Projected for future-year scenarios.

Input and output files for the KRTM_to_MOVES tool are located in a “MOVES” folder within the main KRTM model folder. Figure 1 illustrates the contents of this folder and the contents of the required inputs folder (“1_inputs_to_post”).

**FIGURE 1: KRTM AND KRTM_TO_MOVES FOLDER STRUCTURE**

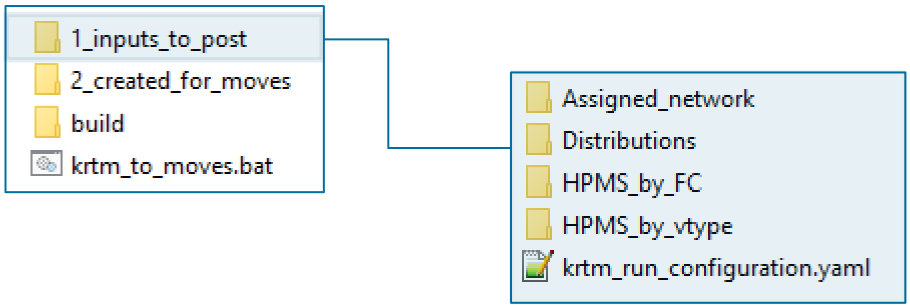



Figure 2 presents a summary and description of all input files, as well as indication if they are user-defined defaults (default), user-specified in the KRTM model graphical user interface (gui), or generated by the KRTM_to_MOVES post-processor (pp).

**FIGURE 2: INPUT FILE PATHS AND DESCRIPTIONS**

| File | Path | Description | Type |
|---|---|---|---|
| [scenario_name].csv | /1_inputs_to_post/Assigned_network | csv of KRTM model output network dvw | gui |
| hourly_distribution.csv | /1_inputs_to_post/Distributions | % of daily traffic by hour for rural and urban roads | default* |
| source_type_distribution.csv | /1_inputs_to_post/Distributions | % of hourly traffic by source type (per krtm veh type) | default* |
| truck_spd_perc_by_hour.csv | /1_inputs_to_post/Distributions | restricted road truck speeds as fraction of auto speeds by hour | default** |
| [county].csv | /1_inputs_to_post/Distributions/county_specific_hourly | county-specific % of daily traffic by hour for rural and urban roads | optional |
| 2018_hpms_data.csv | /1_inputs_to_post/HPMS_by_FC | 2018 HPMS VMT data by roadway functional class by county | default |
| calculated_base_year_adjustments.csv | /1_inputs_to_post/HPMS_by_FC | HPMS VMT scale factors calculated from base-year scenario | pp |
| 2018_hpms_data_vtype.csv | /1_inputs_to_post/HPMS_by_vtype | 2018 HPMS VMT by vehicle type by county | default |
| 2018_model_vmt_by_vtype.csv | /1_inputs_to_post/HPMS_by_vtype | record of base-year VMT by vehicle type for use in projecting future HPMS VMT | pp |
| krtm_run_configuration.yaml | /1_inputs_to_post | config file generated by GUI to specify user inputs for KRTM_to_MOVES run | gui |

gui: *selected in the KRTM GUI*
default: *provided by the user and generally static*
pp: *generated by the post-processor*
optional: *user provided over-ride to default distributions*

** carried over from previous KRTM MOVES post-processing*
*** calculated from 2018 NPRMDS data for Anderson, Blount, Knox, and Loudon Counties*

To create MOVES input files with the KRTM_to_MOVES processor the user must first complete a full model run with the KRTM regional model. In the case of future-year scenarios, the user must also have previously completed a full model run for the base-year No-Build condition and have also run the KRTM_to_MOVES processor for that base-year scenario.

The KRTM_to_MOVES processor is run through the KRTM model GUI “MOVES Inputs” tab (Figure 3). The user is prompted to input values specific to the desired model run, as summarized in Figure 4.

**FIGURE 3: KRTM GUI MOVES TAB**

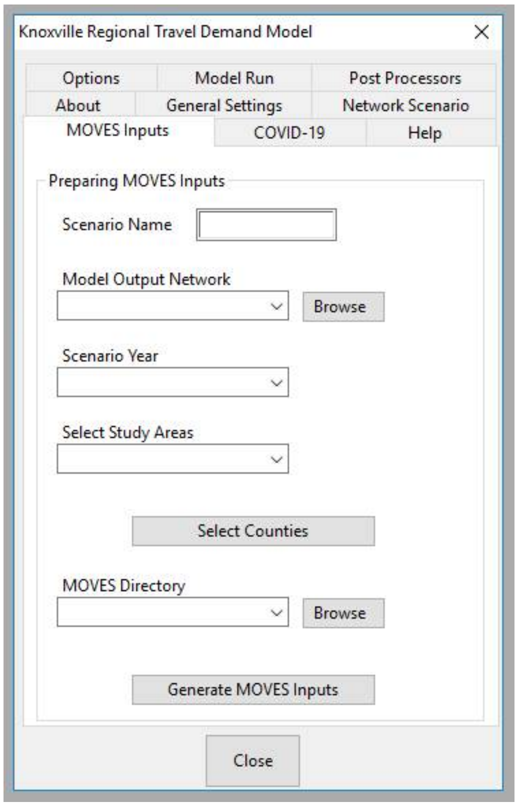



**FIGURE 4: KRTM_TO_MOVES USER INPUT SUMMARY**

| Field | Values | Description |
|---|---|---|
| Scenario Name | string | Enter a desired name for the scenario run to be used in naming the output folder. |
| Model Output Network | network file path | Navigate to and select the desired model run output networkd dbd file. |
| Scenario Year | integer (>= 2018) | Enter the scenario run's analysis year as integer. |
| Study Areas | 'General', 'PM25', 'O3' | Choose to process results for 'PM25' or 'O3' non-conformity areas, or 'General' to process results for all selected output counties regardless of conformity. |
| Counties | 'Anderson', 'Blount', 'Jefferson', 'Knox', 'Loudon', 'Roane', 'Sevier', 'Union', 'Grainger', 'Hamblen' | If processing for general outputs (rather than PM25 or O3 non-comformity areas), select counties for which to generate MOVES input files. |
| MOVES Directory | folder path | Path to KRTM _to_MOVES folders within KRTM model. |

Once user-inputs are selected, the KRTM_to_MOVES processor is run with a button push ("Generate MOVES Inputs") in the GUI, which launches the KRTM_to_MOVES.exe executable. This process creates output folders and files within the '2_created_for_moves' folder. A run-specific output folder named with the chosen "scenario_name" value is created and populated with sub-folders for all relevant counties – either relevant to the chosen non-conformity area or as selected by the user for a general run. A set of MOVES input files is then created for each county. A copy of the run-specific configuration file is saved in the main scenario output folder. For future-year runs, an additional .csv file is saved in the main scenario output folder with projected HPMS VMT values by county and by HPMS vehicle type ([scenario_year]_hpms_vmt.csv).

# 2.0 KRTM_TO_MOVES DOCUMENTATION

The KRTM_to_MOVES post-processor takes KRTM regional model outputs in the form of the final assigned network, combined with input distributions for hourly profiles and vehicle compositions to generate input files for the EPA MOVES emissions model.

The post-processor logic is divided into two-main components – first the tool collects the user-defined and default input files and translates the KRTM model run results into an extended table with hourly volumes, VMT, and speeds on each model link for each MOVES source type. The tool then filters this data table to include records only on relevant study-area links, based on the user's desired output (PM 2.5 area, ozone area, or user-specified counties) and creates the various MOVES input files separately for each county relevant to the desired output area.

## 2.1 KRTM_TO_MOVES DATA PROCESSING

### *Hourly Volumes*

The processor takes daily assigned volumes on all model links and extends these to 24 hourly volumes based on user-defined daily profiles for urban and rural roadways, as recorded in the */1_inputs_to_post/Distributions/hourly_distribution.csv* file. For this tool default hourly distributions were carried over from the previous Knoxville MOVES post-processor (PPSUITE). If the user has local data for any given county, these hourly distributions can be overridden by specifying county-specific hourly distributions in user-created distribution files saved in the */1_inputs_to_post/Distributions/county_specific_hourly* folder. Any such files should be named with the county name as the filename, saved as .csv, and be formatted as shown in Figure 5. For this file, and elsewhere in the processor, intermediate vehicle type classifications of "auto", "ltrk", and "truck" correspond to KRTM assignment types as follows:

- Auto: KRTM types XCAR, SOV, and HOV

- ltrk: KRTM type 4TCV
- truck: KRTM types SUTrk and MUTrk

**FIGURE 5: EXAMPLE OF COUNTY-SPECIFIC HOURLY DISTRIBUTION FILE**

| county | area | veh_type | hour | hour_fraction |
|---|---|---|---|---|
| Anderson | rural | auto | 1 | 0.010774 |
| Anderson | rural | auto | 2 | 0.007644 |
| Anderson | rural | auto | 3 | 0.006546 |
| Anderson | rural | auto | 4 | 0.006635 |
| Anderson | rural | auto | 5 | 0.009538 |
| Anderson | rural | auto | 6 | 0.020055 |
| Anderson | rural | auto | 7 | 0.04103 |
| Anderson | rural | auto | 8 | 0.057972 |
| Anderson | rural | auto | 9 | 0.053471 |
| Anderson | rural | auto | 10 | 0.052548 |
| Anderson | rural | auto | 11 | 0.055061 |
| Anderson | rural | auto | 12 | 0.057674 |
| Anderson | rural | auto | 13 | 0.059143 |
| Anderson | rural | auto | 14 | 0.060802 |
| Anderson | rural | auto | 15 | 0.065299 |
| Anderson | rural | auto | 16 | 0.072608 |
| Anderson | rural | auto | 17 | 0.077382 |
| Anderson | rural | auto | 18 | 0.075482 |
| Anderson | rural | auto | 19 | 0.058706 |
| Anderson | rural | auto | 20 | 0.043986 |
| Anderson | rural | auto | 21 | 0.035731 |
| Anderson | rural | auto | 22 | 0.030743 |
| Anderson | rural | auto | 23 | 0.023852 |
| Anderson | rural | auto | 24 | 0.017318 |
| Anderson | rural | ltrk | 1 | 0.010774 |
| Anderson | rural | ltrk | 2 | 0.007644 |
| Anderson | rural | ltrk | 3 | 0.006546 |

### *HPMS Adjustment for Highways and Arterials*

Base-year HPMS VMT data by county and by roadway functional class are used at two points in the data processing to adjust model output volumes to match HPMS control totals. The first HPMS adjustments are applied to highways and arterial roads prior to calculating hourly speeds. It is assumed that all interstates and arterial roads included in the HPMS VMT totals are also reflected in the KRTM model. This adjustment accounts for model error and is applied prior to calculating speeds to ensure control-total adjusted volumes are input to the speed calculations. A second round of HPMS adjustments is applied to ensure lower functional class VMT totals match HPMS control totals while not artificially impacting speeds due to any inconsistencies between the model network level of detail and the full HPMS network at the local level. Base-year HPMS VMT control totals are provided in the */1_inputs_to_post/HPMS_by_FC/2018_hpms_data.csv* file. Adjustment factors calculated for base-year runs are saved in the *1_inputs_to_post/HPMS_by_FC/calculated_base_year_adjustments.csv* file and stored for application to future-year runs.

### *Hourly Speeds*

With hourly volumes by link, the processor calculates hourly speeds for each link using the Bureau of Public Roads (BPR) equation and the KRTM model's link-specific parameters as presented below.

**EQUATION 1: LINK TRAVEL-TIME BY HOUR**

$$tt = afftime * (1 + \alpha * \left(\left(\frac{vol}{cap}\right)^{ß}\right))$$

**EQUATION 2: LINK SPEED BY HOUR**

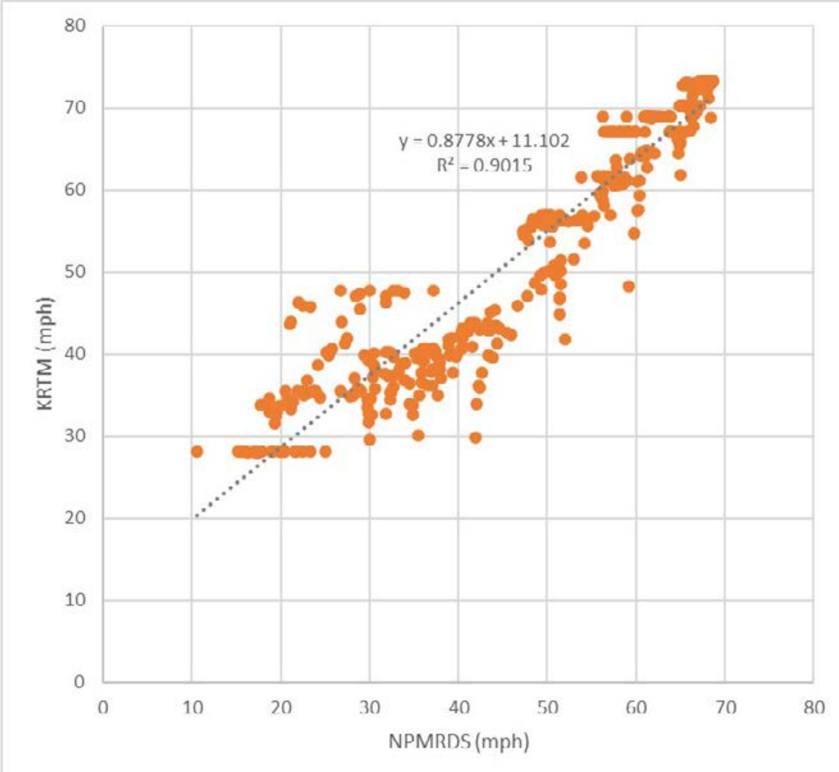
$$sp = \frac{\frac{L}{tt}}{60}$$

Where:

- tt = travel time (minutes)
- afftime = the KRTM model's calculated adjusted free-flow time (minutes)
- α = the KRTM model's link-specific alpha parameter
- ß = the KRTM model's link-specific beta parameter
- vol = the hourly volume as described above
- cap = the KRTM model's link-specific period capacity divided by the number of hours per period and mapped to the hourly volumes relevant to each period
- sp = speed (mph)
- L = link length (miles)

As a review, speed data from the National Performance Management Research Data Set (NPMRDS) for the counties of Anderson, Blount, Knox, and Loudon were compared with projected values. Because the NPMRDS data is associated with a network inconsistent with the KRTM model network in terms of link designations, break points and topography, a direct link-by-link comparison is not possible without significant effort to conflate the two networks. However, a high-level comparison can be done between average speeds by county, functional class, and hour between the two sets – understanding that the underlying set of links, link lengths, and break points differs between the two sets. As shown in Figure 6, the projected speeds in this comparison correlate well with NPMRDS data, particularly for the higher functional class roadways where the two networks and sets are most robust.

**FIGURE 6: COMPARISON OF PROJECTED SPEEDS AND NPMRDS DATA**




### *Hourly Volumes by MOVES Source Type*

The processor disaggregates hourly volumes into the 13 MOVES source types. This is accomplished by first disaggregating to three aggregated model-specific vehicle types of auto, ltrk, and truck (KRTM component assignment types described above) based on the proportion of vehicle-type specific model VMT by county and roadway type, and then disaggregating hourly flows further to the 13 MOVES source type categories using default distributions provided as input in the */1_inputs_to_post/Distributions/source_type_distribution.csv* file. Default source type distributions by model vehicle type by hour were carried over from the previous Knoxville MOVES post-processor (PPSUITE).

**FIGURE 7: VIEW OF SOURCE TYPE DISTRIBUTION INPUT FORMAT**

| veh_type | SID | ROADTYPI | HOUR01 | HOUR02 | HOUR03 | HOUR04 | HOUR05 | HOUR06 | HOUR07 | HOUR08 | HOUR09 | HOUR10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| auto | 11 | 2 | 1 | 1 | 1 | 1 | 1 | 0.932 | 0.932 | 0.932 | 0.932 | 0.93 |
| auto | 21 | 2 | 99 | 99 | 99 | 99 | 99 | 99.068 | 99.068 | 99.068 | 99.068 | 99.06 |
| auto | 31 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 32 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 41 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 42 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 43 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 51 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 52 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 53 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 54 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 61 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| auto | 62 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 11 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 21 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 31 | 2 | 75 | 75 | 75 | 75 | 75 | 74.957 | 74.957 | 74.957 | 74.957 | 74.95 |
| ltrk | 32 | 2 | 25 | 25 | 25 | 25 | 25 | 25.043 | 25.043 | 25.043 | 25.043 | 25.04 |
| ltrk | 41 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 42 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 43 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 51 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 52 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 53 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 54 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 61 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ltrk | 62 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| truck | 11 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| truck | 21 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| truck | 31 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| truck | 32 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| truck | 41 | 2 | 1 | 1 | 1 | 1 | 1 | 1.152 | 1.148 | 1.157 | 1.16 | 1.20 |
| truck | 42 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1.457 | 1.252 | 1.178 | 0.37 |
| truck | 43 | 2 | 0 | 0 | 0 | 0 | 0 | 4.883 | 3.799 | 3.263 | 3.072 | 0 |
| truck | 51 | 2 | 1 | 1 | 1 | 1 | 1 | 0.641 | 0.639 | 0.644 | 0.646 | 0.67 |
| truck | 52 | 2 | 30 | 30 | 30 | 30 | 30 | 28.921 | 28.808 | 29.033 | 29.113 | 30.2 |

### *Heavy Vehicle Speed Adjustments*

On unrestricted roadways where passenger vehicles and trucks are free to travel at differing speeds, post-processed hourly speeds are adjusted to reflect these differences for heavy vehicle source-types. Heavy vehicle speed adjustments are provided as inputs in the form of % of auto speeds by hour and are based on weighted average of data from the National Performance Management Research Data Set (NPMRDS) for the counties of Anderson, Blount, Knox, and Loudon. Adjustments are located in the */1_inputs_to_post/Distributions/truck_spd_perc_by_hour.csv* file

FIGURE 8: NPMRDS TRUCK SPEED AS PERCENT OF AUTO – URBAN HIGHWAYS

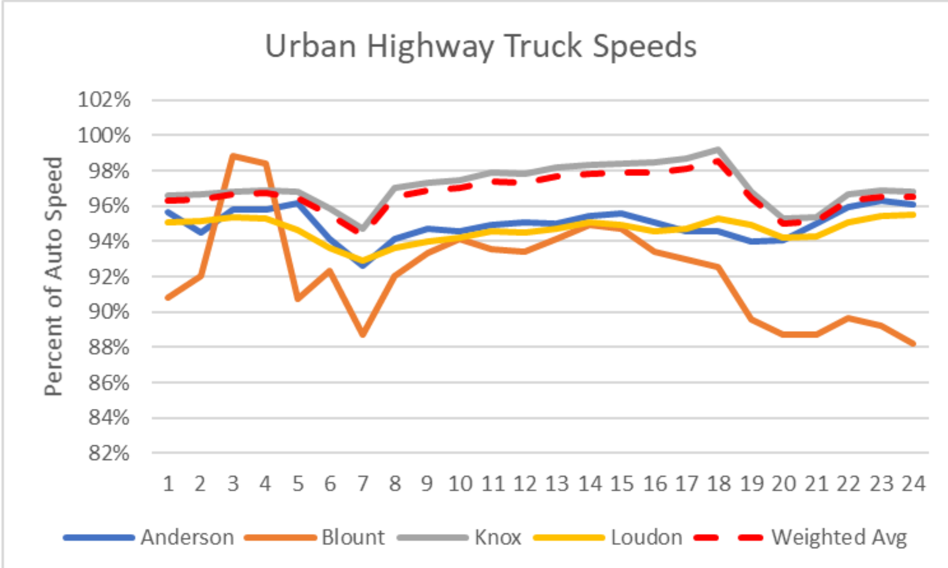
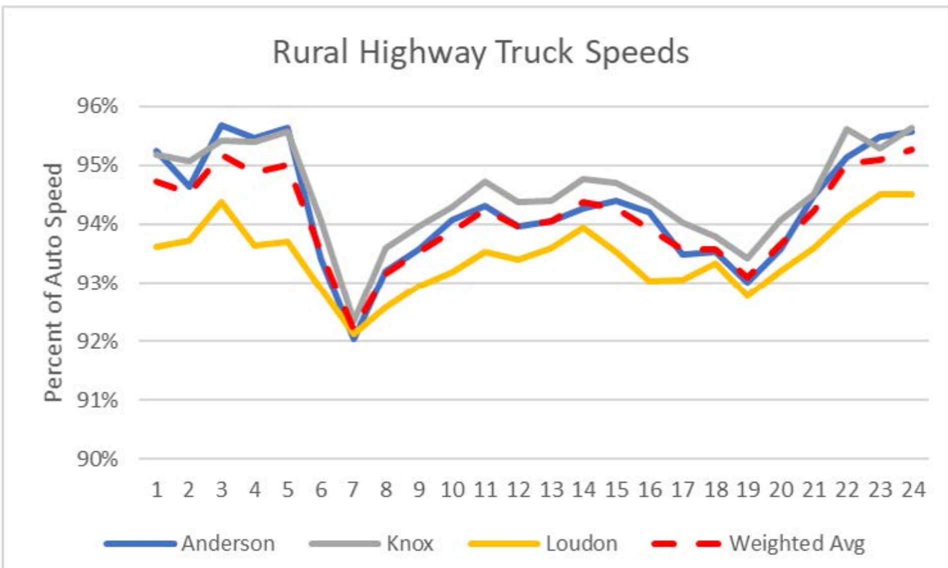



FIGURE 9: NPMRDS TRUCK SPEED AS PERCENT OF AUTO – RURAL HIGHWAYS




## 2.2 KRTM_TO_MOVES MOVES FILE CREATION

Once hourly volumes and speeds are established for each model link and source type, the KRTM_to_MOVES processor filters the data for links relevant to the desired output area – either PM 2.5 non-conformity area, ozone non-conformity area, or generally by specified counties, and then calculates the following 5 MOVES input files on the remaining relevant links by county. Output files are stored in the */2_created_for_moves/* folder within an output folder named with the “Scenario Name” parameter provided through the GUI. The post-processor generates sub-folders for each county of relevance and stores output .csv files within each.

## ITEM 1: hourVmtFraction.csv

Percent VMT by hour for each source type, road type, day ID[2] combination.

**FIGURE 10: HOURVMTFRACTION.CSV EXAMPLE**

| | A | B | C | D |
|---|---|---|---|---|
| 1 | sourceTypeID | roadTypeID | hourID | hourVMTFraction |
| 2 | 11 | 2 | 1 | 0.01134351 |
| 3 | 11 | 2 | 2 | 0.008039609 |
| 4 | 11 | 2 | 3 | 0.006881134 |
| 5 | 11 | 2 | 4 | 0.006969331 |
| 6 | 11 | 2 | 5 | 0.010021945 |
| 7 | 11 | 2 | 6 | 0.019680758 |
| 8 | 11 | 2 | 7 | 0.038442965 |
| 9 | 11 | 2 | 8 | 0.054368599 |
| 10 | 11 | 2 | 9 | 0.050109838 |
| 11 | 11 | 2 | 10 | 0.051587272 |
| 12 | 11 | 2 | 11 | 0.05402439 |
| 13 | 11 | 2 | 12 | 0.056610577 |
| 14 | 11 | 2 | 13 | 0.058073091 |
| 15 | 11 | 2 | 14 | 0.059688706 |
| 16 | 11 | 2 | 15 | 0.064102615 |
| 17 | 11 | 2 | 16 | 0.071297057 |
| 18 | 11 | 2 | 17 | 0.084034006 |
| 19 | 11 | 2 | 18 | 0.081996698 |
| 20 | 11 | 2 | 19 | 0.063767926 |
| 21 | 11 | 2 | 20 | 0.043206789 |
| 22 | 11 | 2 | 21 | 0.035091348 |
| 23 | 11 | 2 | 22 | 0.030207049 |
| 24 | 11 | 2 | 23 | 0.023438912 |
| 25 | 11 | 2 | 24 | 0.017015874 |
| 26 | 11 | 3 | 1 | 0.011402096 |
| 27 | 11 | 3 | 2 | 0.008089625 |

## ITEM 2: avgSpeedDistribution.csv

Percent distribution of VHT by 16 speed bins by road type, source type, and day ID[3].

[2] This is developed for dayID = 5 (weekday).
[3] This is developed for dayID = 5 (weekday).

#### FIGURE 11: AVGSPEEDDISTRIBUTION.CSV EXAMPLE

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | sourceTypeID | roadTypeID | hourDayID | avgSpeedBinID | avgSpeedFraction |
| 3162 | 31 | 4 | 75 | 1 | 0 |
| 3163 | 31 | 4 | 75 | 2 | 0 |
| 3164 | 31 | 4 | 75 | 3 | 0.000370588 |
| 3165 | 31 | 4 | 75 | 4 | 0.000969426 |
| 3166 | 31 | 4 | 75 | 5 | 0.012528548 |
| 3167 | 31 | 4 | 75 | 6 | 0.028508701 |
| 3168 | 31 | 4 | 75 | 7 | 0.010155494 |
| 3169 | 31 | 4 | 75 | 8 | 0.087199402 |
| 3170 | 31 | 4 | 75 | 9 | 0.000751039 |
| 3171 | 31 | 4 | 75 | 10 | 0.002295098 |
| 3172 | 31 | 4 | 75 | 11 | 0.012844846 |
| 3173 | 31 | 4 | 75 | 12 | 0.062635928 |
| 3174 | 31 | 4 | 75 | 13 | 0.05963073 |
| 3175 | 31 | 4 | 75 | 14 | 0.588233466 |
| 3176 | 31 | 4 | 75 | 15 | 0.133876733 |
| 3177 | 31 | 4 | 75 | 16 | 0 |
| 3178 | 31 | 4 | 85 | 1 | 0 |

### ITEM 3: rampFraction.csv

Percent of restricted VHT on ramps for urban and rural roadways (MOVES road types 2 and 4).

#### FIGURE 12: RAMPFRACTION.CSV EXAMPLE

| | A | B |
|---|---|---|
| 1 | roadTypeID | rampFraction |
| 2 | 2 | 0.013053628 |
| 3 | 4 | 0.127860555 |

### ITEM 4: roadTypeDistribution.csv

Percent of overall network VMT on each of the four MOVES road types.

#### FIGURE 13: ROADTYPEDISTRIBUTION.CSV EXAMPLE

| | A | B | C |
|---|---|---|---|
| 1 | sourceTypeID | roadTypeID | roadTypeVMTFraction |
| 2 | 11 | 2 | 0.026988447 |
| 3 | 11 | 3 | 0.027418011 |
| 4 | 11 | 4 | 0.350662398 |
| 5 | 11 | 5 | 0.594931145 |
| 6 | 21 | 2 | 0.026973569 |
| 7 | 21 | 3 | 0.027402368 |
| 8 | 21 | 4 | 0.350679584 |
| 9 | 21 | 5 | 0.594944478 |
| 10 | 31 | 2 | 0.005029446 |
| 11 | 31 | 3 | 0.021605747 |
| 12 | 31 | 4 | 0.290554516 |
| 13 | 31 | 5 | 0.682810291 |
| 14 | 32 | 2 | 0.005029434 |

## ITEM 5: HPMSvTypeYear

Total VMT by HPMS vehicle type for a given scenario year. This file is given as input for base-year scenarios (*\1_inputs_to_post\HPMS_by_vtype\2018_hpms_data_vtype.csv*) and is calculated based on growth in auto, single-unit truck, and multi-unit truck VMT by county observed in the KRTM model between the base year and scenario year. Future-year projected values are saved in the main scenario output folder with a filename based on the analysis year (*[scenario_year]_hpms_vmt.csv*).[4]

**FIGURE 14: [SCENARIO_YEAR]_HPMS_VMT.CSV EXAMPLE**

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | County | HPMSVTypeID | yearID | HPMSBaseYearVMT | growth | HPMS2026VMT |
| 2 | Anderson | 10 | 2018 | 6881345 | 1 | 6881345 |
| 3 | Anderson | 25 | 2018 | 843819410 | 1 | 843819410 |
| 4 | Anderson | 40 | 2018 | 677075 | 1 | 677075 |
| 5 | Anderson | 50 | 2018 | 18228100 | 1 | 18228100 |
| 6 | Anderson | 60 | 2018 | 67099775 | 1 | 67099775 |
| 7 | Blount | 10 | 2018 | 7996420 | 1 | 7996420 |
| 8 | Blount | 25 | 2018 | 1181311185 | 1 | 1181311185 |
| 9 | Blount | 40 | 2018 | 458075 | 1 | 458075 |
| 10 | Blount | 50 | 2018 | 21590845 | 1 | 21590845 |
| 11 | Blount | 60 | 2018 | 43263450 | 1 | 43263450 |
| 12 | Knox | 10 | 2018 | 33790605 | 1 | 33790605 |
| 13 | Knox | 25 | 2018 | 5587211950 | 1 | 5587211950 |
| 14 | Knox | 40 | 2018 | 4915090 | 1 | 4915090 |
| 15 | Knox | 50 | 2018 | 122615180 | 1 | 122615180 |
| 16 | Knox | 60 | 2018 | 484040370 | 1 | 484040370 |
| 17 | Loudon | 10 | 2018 | 6125795 | 1 | 6125795 |
| 18 | Loudon | 25 | 2018 | 760606710 | 1 | 760606710 |
| 19 | Loudon | 40 | 2018 | 981485 | 1 | 981485 |
| 20 | Loudon | 50 | 2018 | 19776065 | 1 | 19776065 |
| 21 | Loudon | 60 | 2018 | 95839510 | 1 | 95839510 |
| 22 | Roane | 10 | 2018 | 5056345 | 1 | 5056345 |
| 23 | Roane | 25 | 2018 | 659373960 | 1 | 659373960 |
| 24 | Roane | 40 | 2018 | 786575 | 1 | 786575 |
| 25 | Roane | 50 | 2018 | 16833070 | 1 | 16833070 |
| 26 | Roane | 60 | 2018 | 77411755 | 1 | 77411755 |
| 27 | | | | | | |

[4] Example created running a "future" year scenario with a base-year network so no growth is shown this is figure. Actual future-year network runs will include growth factors and scaled future-year VMT values.