Methodology for Using AEDT and MOVES for Airport Air Quality Analyses

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108th Air & Waste Management Association Annual Conference and Exhibition
Paper # 81
June 24th, 2015

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U.S. Department of Transportation
Office of the Secretary of Transportation
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Background - AEDT

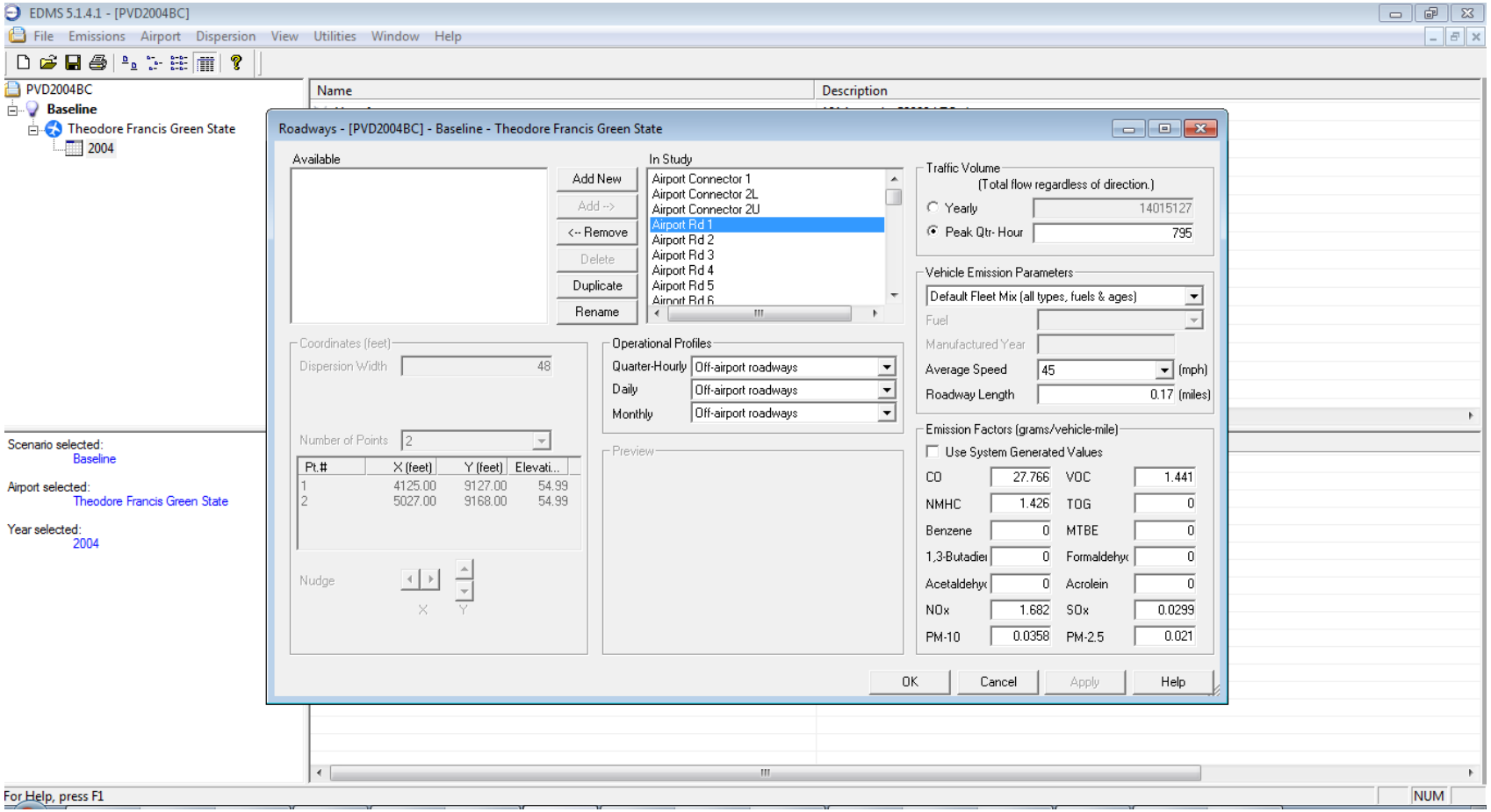
- **Aviation Environmental Design Tool (AEDT) version 2b released May 29th, 2015**
  - Replaces Emissions and Dispersion Modeling System (EDMS) 5.1.4.1 (August 2013) as the preferred model for airport air quality analyses
  - Replaces the Integrated Noise Model (INM)
  - EPA's MOtor Vehicle Emission Simulator (MOVES) is not embedded within AEDT 2b or EDMS 5.1.4.1
    - EDMS: The Usage of the U.S. Environmental Protection Agency's (USEPA) Motor Vehicle Emission Simulator (MOVES) with the Federal Aviation Administration's (FAA) Emissions and Dispersion Modeling System (EDMS) (February 28th, 2014)
  - AEDT 2b: Using MOVES with AEDT 2b Version 1.0
    - Available on AEDT website: https://aedt.faa.gov/

Background - MOVES

- MOVES is required model for estimating emissions from on-road mobile sources
  - Required as of March 2013
  - Replaces MOBILE6.2
- MOVES2014 is the current version
  - Released October 7th, 2014
  - Replaces MOVES2010b
  - 2 year grace period with exceptions
  - NONROAD2008 embedded

Background - EDMS

- EDMS – Roadway Input Interface



Using AEDT with MOVES

- Emissions Inventories
  - Analysts will generate emissions inventories for on-road and off-road (e.g. construction equipment) mobile sources independently of AEDT 2b
  - Emissions Inventory results may be imported in AEDT 2b
    - The following Emissions Inventory categories can be imported
      - Roadways
      - Parking Facilities
      - Construction

Using AEDT with MOVES

- Dispersion Modeling
  - Analysts will generate AERMOD input files for on-road and off-road (e.g. construction equipment) mobile sources independently of AEDT 2b
    - Analyst generated AERMOD input file (.inp)
    - Analyst generated AERMOD hourly emission rate file (.hre)
  - AERMOD .inp and .hre files may be imported into AEDT 2b
    - Merged with aircraft and other airport sources

Methodology – MOVES

- MOVES executed at Project Level Domain
  - Allows for Link (roadway segment) level emissions estimates
- Each MOVES run models a single hour
  - Single hour, month, and year for each MOVES run
- Number of MOVES runs required may vary
  - Use Case
    - Emission Inventory may require less runs
    - Dispersion modeling may require more runs
  - Meteorological variation
  - Traffic Variation

Methodology – MOVES

- Number of MOVES Runs
  - Determined by interagency coordination
- Meteorological and traffic variation
  - An example of a detailed set of runs is 16 MOVES runs
  - Quarterly seasonal variation (Table 1)
  - Daily traffic variation (Table 2)

Table 1. Quarters of the year for MOVES runs

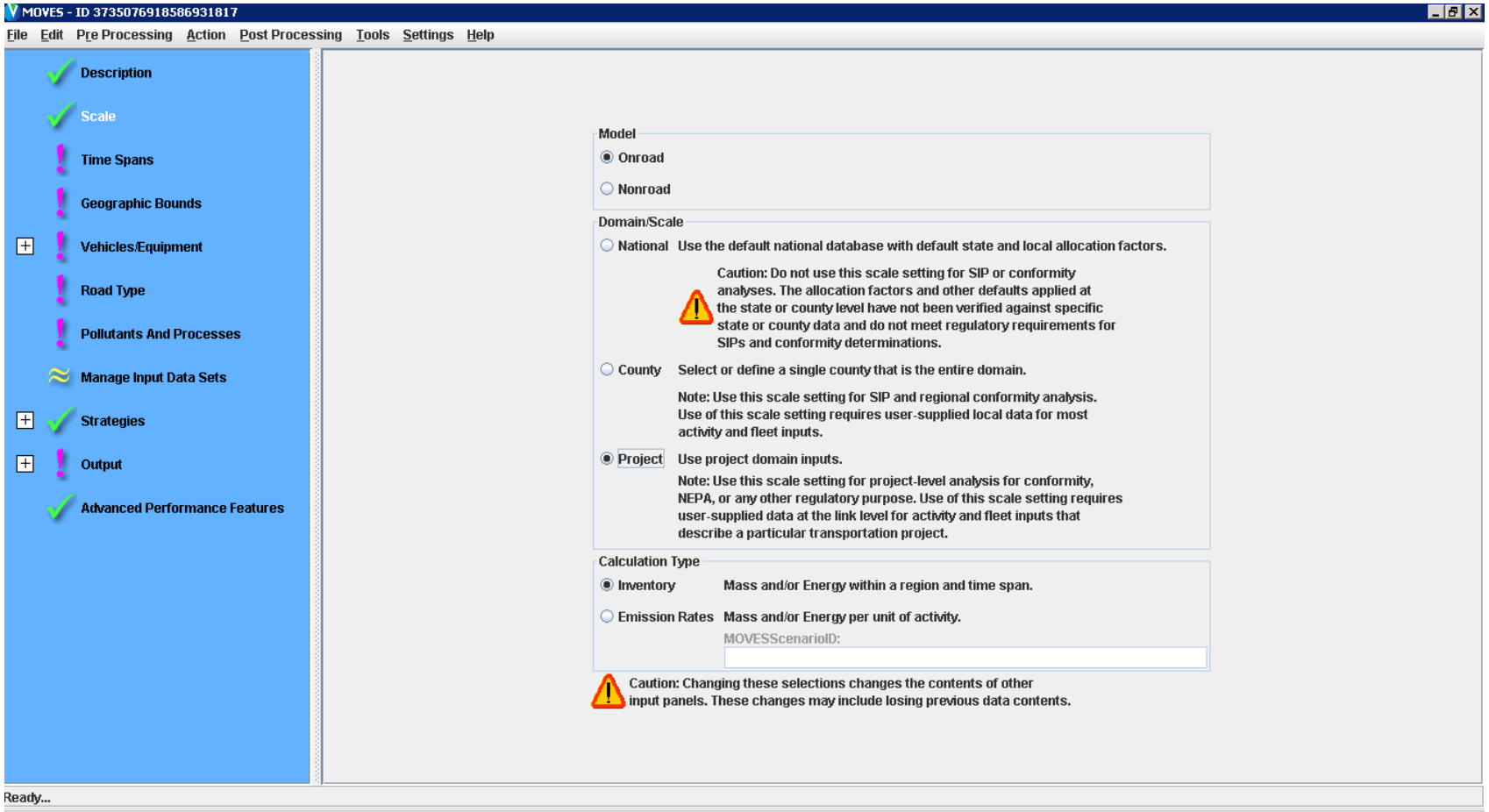
Code	Name	Months
Q1	First Quarter	January - March
Q2	Second Quarter	April – June
Q3	Third Quarter	July - September
Q4	Fourth Quarter	October - December

Table 2. Traffic volume times of day for MOVES runs

Code	Name	Time of Day
AM	Morning Peak	0600 – 0900 (3 hours)
MD	Midday	0900 – 1600 (7 hours)
PM	Evening Peak	1600 – 1900 (3 hours)
ON	Overnight	1900 – 0600 (11 hours)

Methodology – MOVES

- Scale



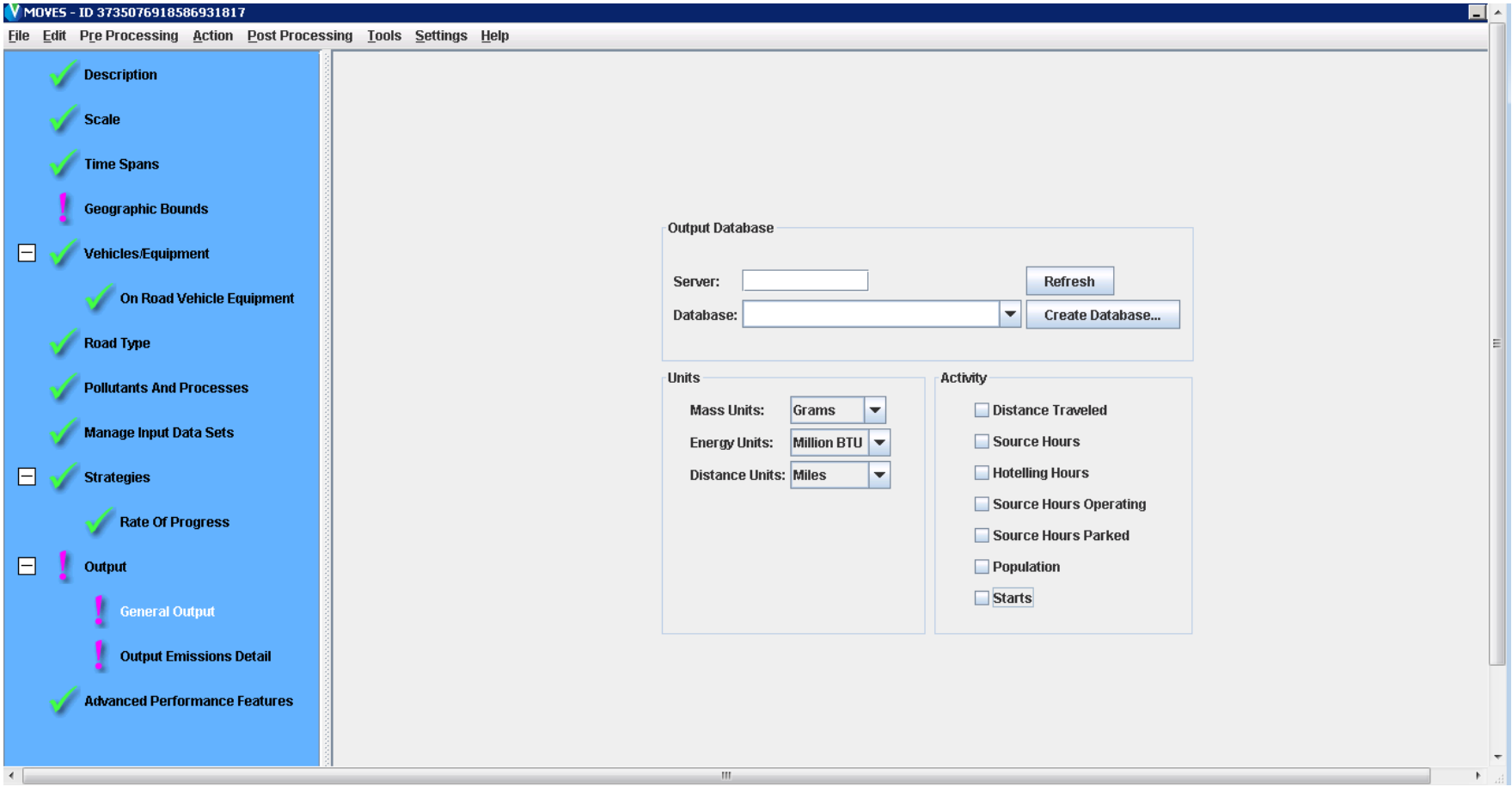
Methodology – MOVES

- Pollutants and Processes for Roadway Links
  - These Pollutants and processes must be selected so results appropriately map to AEDT

Pollutant	Emissions Process
Total Gaseous Hydrocarbons	Running Exhaust and Crankcase Running Exhaust
Non-Methane Hydrocarbons	
Non-Methane Organic Gases	
Volatile Organic Compounds	
Total Organic Gases	
Carbon Monoxide (CO)	
Oxides of Nitrogen (NOX)	
Sulfur Dioxide (SO2)	
Total Energy Consumption	
Atmospheric CO2	
Primary Exhaust PM10 - Total	
Primary Exhaust PM2.5 - Total	
Primary PM10 - Organic Carbon	
Primary PM2.5- Organic Carbon	
Primary PM10 - Elemental Carbon	
Primary PM2.5 - Elemental Carbon	
Primary PM10 - Sulfate Particulate	
Primary PM2.5 - Sulfate Particulate	
Primary PM10 - Brakewear Particulate	Running Exhaust, Crankcase Running Exhaust, and Brakewear
Primary PM2.5 - Brakewear Particulate	
Primary PM10 - Tirewear Particulate	Running Exhaust, Crankcase Running Exhaust, and Tirewear
Primary PM2.5 - Tirewear Particulate	

Methodology – MOVES

- Output – General Output



Methodology – MOVES

- Links
  - Roadway Links
    - Unique Link for each Roadway Segment
      - Road Type
      - Average Speed (mph)
      - Length (miles)
      - Grade (%)
  - Parking Facility Links
    - Three Links for each Parking Facility/Level
      - Parking Facility Movement Link
      - Idle Link
      - Off-Network Link (starts and soak)
        - » Only a single off-network link can modeled with each MOVES run

Methodology – MOVES Output

- After all MOVES runs have been completed, the analyst will have generated output by each link represented in total grams of each pollutant for the hour modeled.
- The MOVES output for all links is located in the "movesoutput" table within the output database.
- The analyst must conduct post processing on the MOVES output so that pollutants match those generated by the other sources modeled with AEDT

Pollutant	MOVES Pollutant ID
THC	1
CO	2
VOC	87
NMHC	79
TOG	86
NOx	3
SOx	31
PM10	100 (100 + 106 + 107)
PM2.5	110 (110 + 116 + 117)
CO2 Atmospheric	90
H2O	119

Methodology – MOVES Output

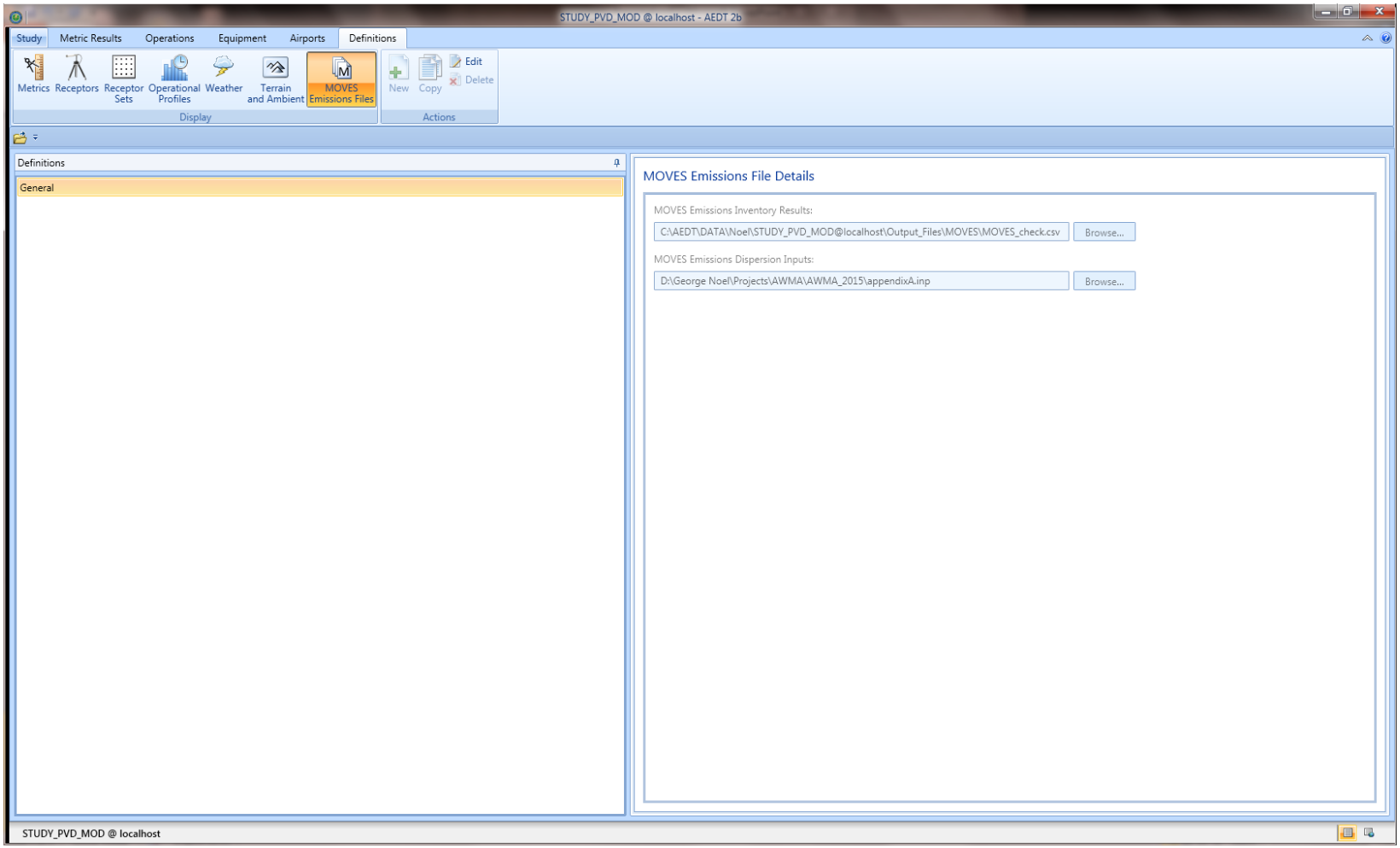
- AEDT accepts a comma separated file (.csv) for importing an emission inventory
- A single emission inventory for each analysis year can be imported in AEDT
- Four columns of information are to be included in the .csv import file
  - YearID – Analysis Year
  - Source – Roadway, Parking Facilities, and Construction
  - PollutantID – MOVES Pollutant ID
  - emissionQuant – total mass in grams

Example of Emissions Inventory Input File

```
yearID,Source,pollutantID,emissionQuant
2015,Roadways,1,130500300.8
2015,Parking Facilities,1,5200900.5
2015,Construction,1,100000.5
2015,Roadways,2,2357991820
2015,Parking Facilities,2,58200458.5
2015,Construction,2,526878.2
2015,Roadways,3,142300852.3
2015,Parking Facilities,3,4400800.9
```

Methodology – AEDT Import

- Emission Inventory and AERMOD input files Import



Methodology – AERMOD Input Files

- AEDT does not manage or utilize geospatial data associated with roadway links or parking facility links
  - The analyst can import a GIS shape file (.shp) to display roadways on the AEDT map viewer.
    - Shape file data is not used for any other purpose (e.g., AERMOD)
- Analyst is responsible for managing geospatial coordinates of roadway and parking facility sources
  - All AERMOD source coordinates are based on a local coordinate system with the origin based on the airport reference point
  - UTM Coordinates are not utilized

Methodology – AERMOD .inp File

- Roadway Sources
  - Modeled using AREA sources
- Parking Sources
  - Modeled using AERAPOLY sources
  - Each level of a parking garage is to be modeled as an individual source
- Construction Sources
  - Can be modeled as AREA, AREAPOLY, POINT, or VOLUME sources

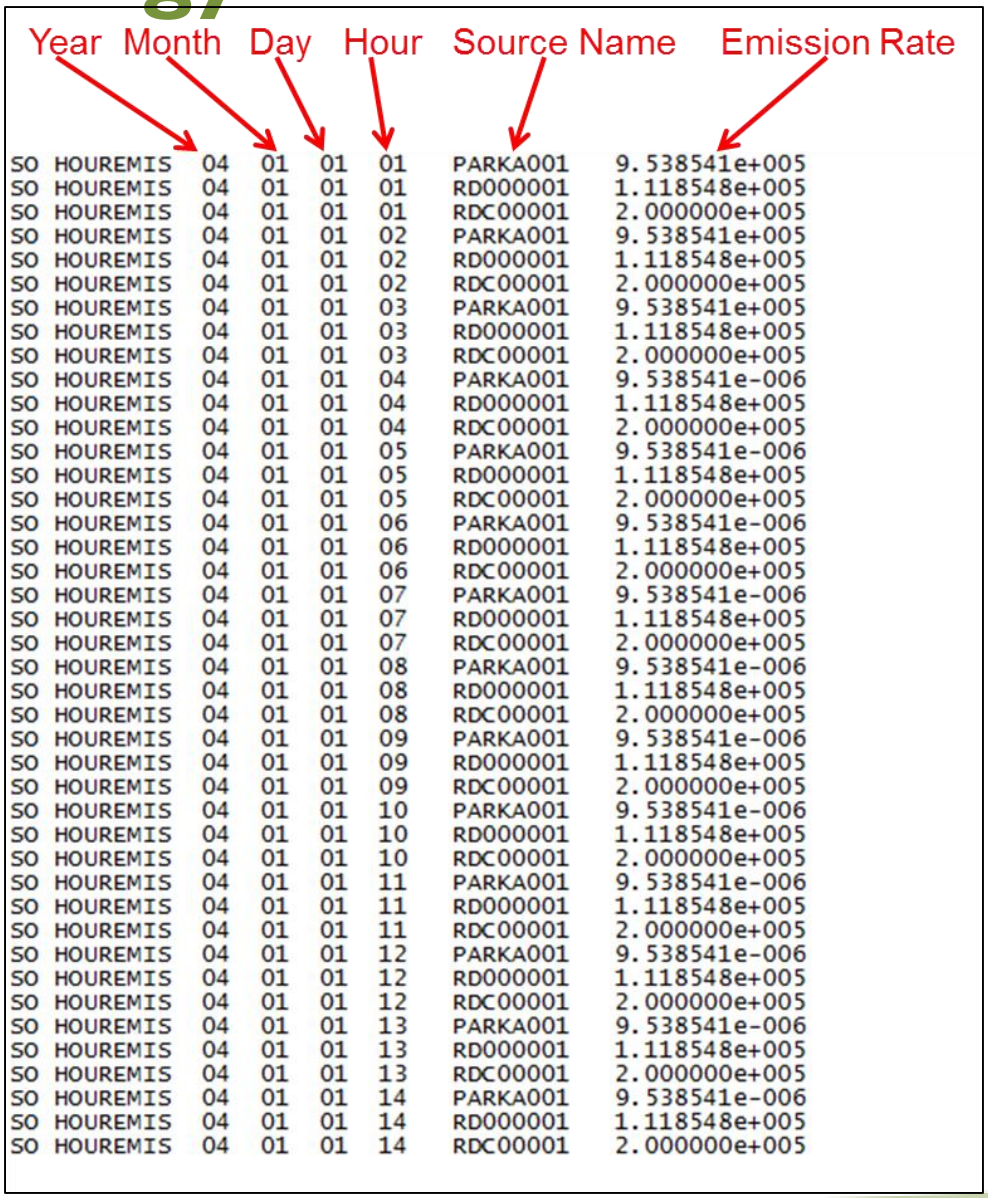
Methodology – AERMOD .inp File

- The analyst needs to only specify the CO and SO Pathways

```
CO STARTING
   TITLEONE Example CO 1 HOUR INP FILE
   TITLETWO Example
   MODELOPT CONC DFAULT
   AVERTIME 1
   POLLUTID CO
   FLAGPOLE 1.8
   RUNORNOT RUN
   SAVEFILE
CO FINISHED

SO STARTING
SO ELEVUNIT METERS
** ----------------------------------------------------------
**              SOURCE  TYPE    X(m)     Y(m)    Z(m)
** ----------------------------------------------------------
   LOCATION PARKA001 AREAPOLY 1213.10 2565.50 16.76
   LOCATION RD000001 AREA 719.51 1742.71 16.76
   LOCATION RDC00001 VOLUME 1345.69 2147.62 16.76
** ------------------------------------------------------------------------------
** AREA AND VOLUME SOURCE PARAMETERS:       HEIGHT      WIDTH     LENGTH      ANGLE   SIGMA-Z0
** ------------------------------------------------------------------------------
   SRCPARAM RD000001  1.00 0.00 14.63 100.0 91.39 3.00
   SRCPARAM RDC00001  1.00 13.00 3.00 3.00
** ------------------------------------------------------------------
** AREAPOLY PARAMETERS:     HEIGHT   POINTS   SIGMA-Z0
** ------------------------------------------------------------------
   SRCPARAM PARKA001  1.00 1.00 4 3.00
   AREAVERT PARKA001  1213.10 2565.50 1358.80 2519.78 1346.30 2453.03 1193.29 2499.97
** ---------------------------------------
** HOURLY EMISSION FILE:
** ---------------------------------------
   HOUREMIS  appendixA.HRE  RD000000-RD999999
   HOUREMIS  appendixA.HRE  RDC00001-RDC99999
   HOUREMIS  appendixA.HRE  PARKA001-PARKA999
** ---------------------------------------
**  SOURCE GROUP DEFINITIONS:
** ---------------------------------------
   SRCGROUP ALL
   SRCGROUP ROADWAYS RD000000-RD999999
   SRCGROUP CONSTRUCTION RDC00000-RDC99999
   SRCGROUP PARKING PARKA001-PARKA999
SO Finished
```

Methodology – AERMOD .hre File



SO	HOUREMIS	04	01	01	01	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	01	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	01	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	02	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	02	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	02	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	03	PARKA001	9.538541e+005
SO	HOUREMIS	04	01	01	03	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	03	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	04	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	04	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	04	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	05	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	05	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	05	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	06	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	06	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	06	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	07	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	07	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	07	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	08	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	08	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	08	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	09	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	09	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	09	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	10	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	10	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	10	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	11	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	11	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	11	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	12	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	12	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	12	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	13	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	13	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	13	RDC00001	2.000000e+005
SO	HOUREMIS	04	01	01	14	PARKA001	9.538541e-006
SO	HOUREMIS	04	01	01	14	RD000001	1.118548e+005
SO	HOUREMIS	04	01	01	14	RDC00001	2.000000e+005

Methodology – AERMOD .inp and .hre Requirements

- A minimum of one parking facility must be included in the .inp and corresponding .hre file. If the analyst does not want to model a parking facility then the emission rates can be set to zero in the .hre file.
- The following naming conventions must be used in order for the AERMOD .inp to import correctly into AEDT.
  - Parking Facilities: naming range of PARKA001 through PARKZ999
  - Roadways: naming range of RD000001 through RD999999
  - Construction: naming range of RDC00001 through RDC99999
- The order of the sources listed under the SRCPARAM keyword in the .inp must be ordered in the following manner:
  - All roadway sources are to be defined first.
  - All construction sources are to be defined following the roadway sources.
  - All parking facility sources are to be defined after the construction sources. If there are no construction sources to be modeled then the parking facility sources will follow the roadway sources. Construction Sources

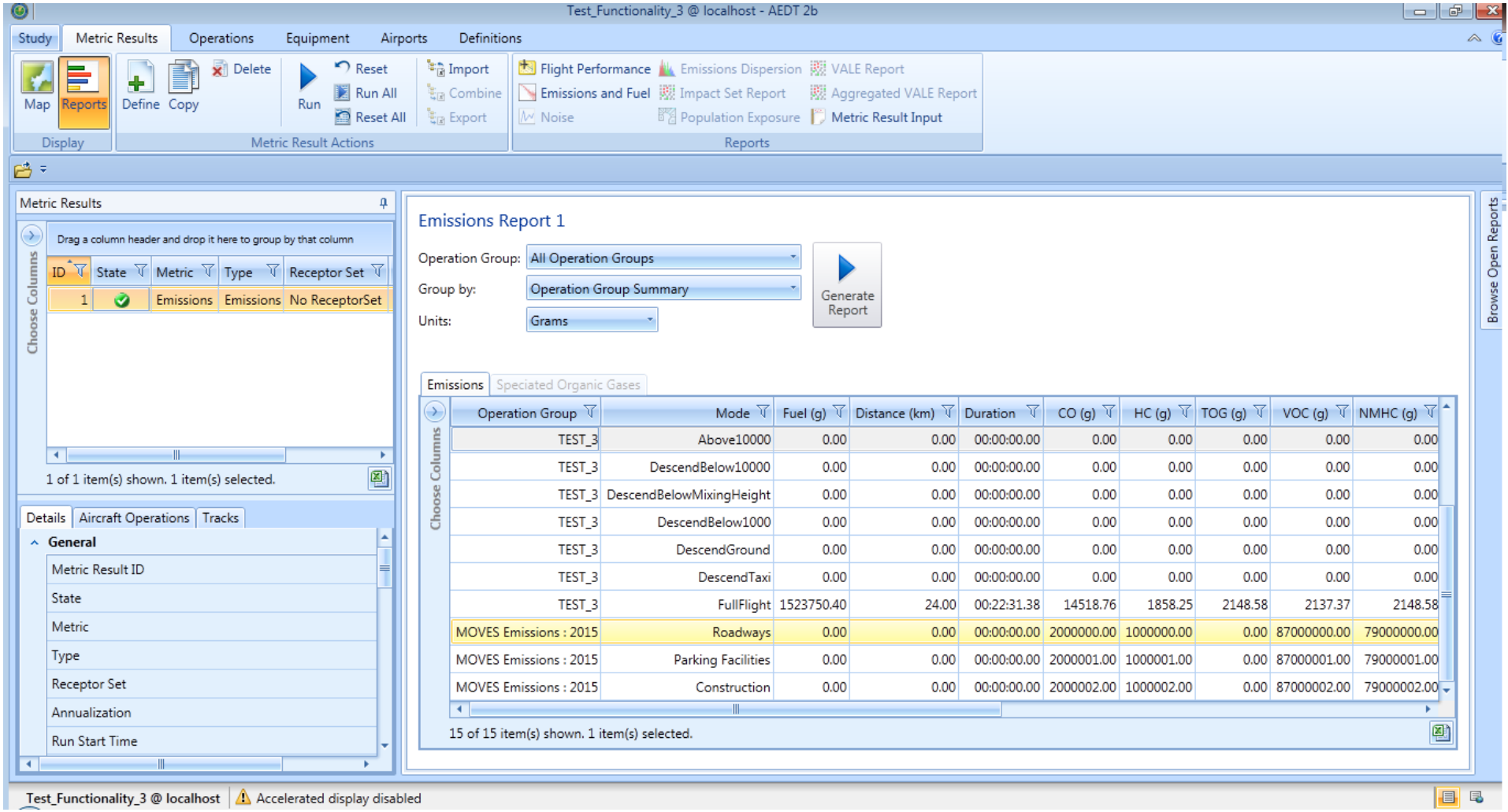
Methodology – AERMOD .inp and .hre Requirements

- The POLLUTID in the CO (control) Pathway in the AERMOD input file must match the AEDT Metric Result being modeled. For example, if the CO (carbon monoxide) Metric is chosen to be modeled in AEDT then CO (carbon monoxide) must be listed with the POLLUTID keyword within the CO (control) Pathway section of the AERMOD input fileThe following naming conventions must be used in order for the AERMOD .inp to import correctly into AEDT.

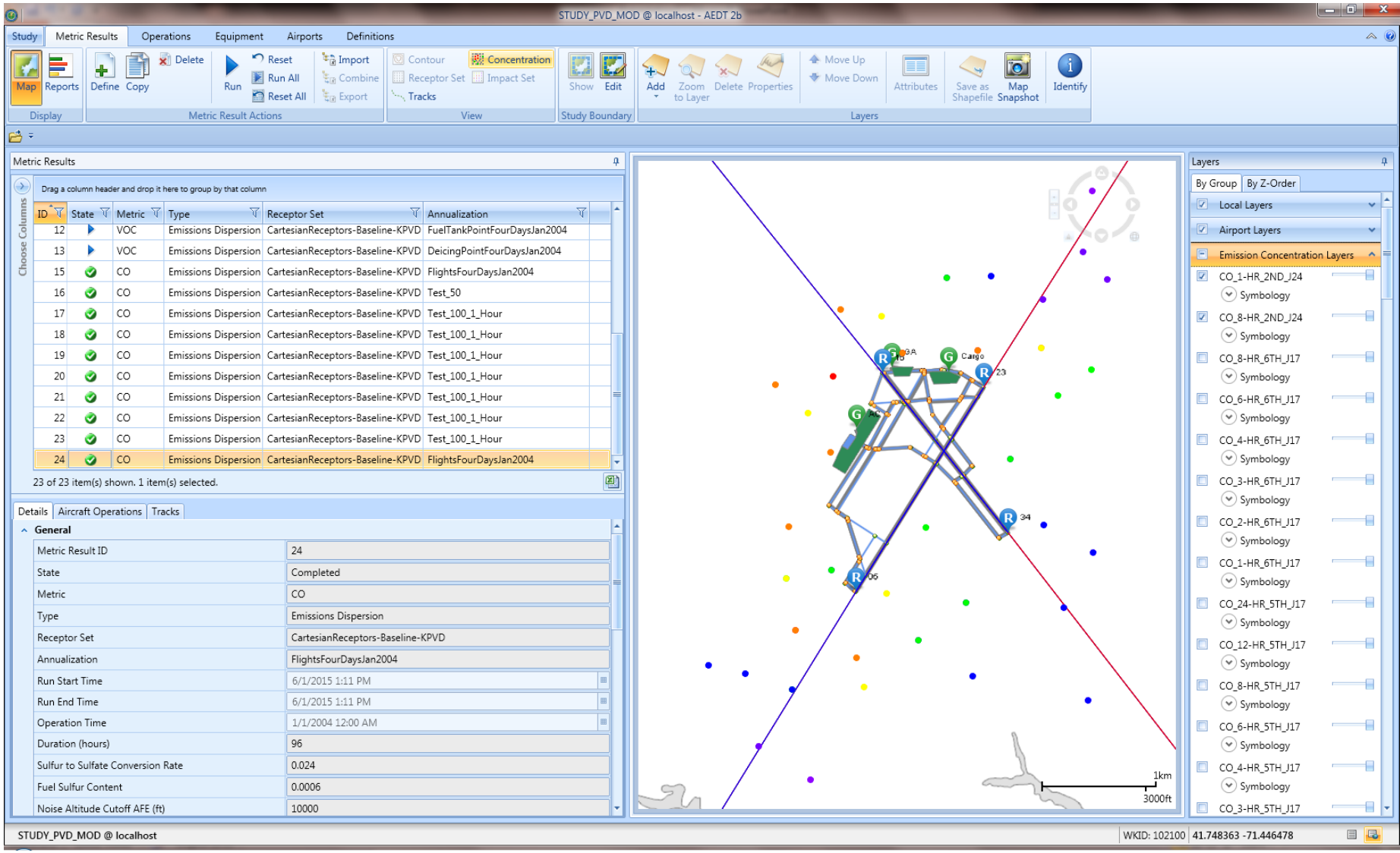
- The AERMOD input file (.inp) and the hourly emission rate file (.hre) must have the same naming convention. For example, if the AERMOD input file name is CO_airportXYZ.inp then the hourly emission rate file is to be named CO_airportXYZ.hre.

- The order of sources in the hourly emission rate file (.hre) must be ordered in the following manner:
  - All parking facility sources are to be listed first.
  - All roadway sources are to be listed following the parking facility sources.
  - All construction sources are to be listed following the roadway sources.

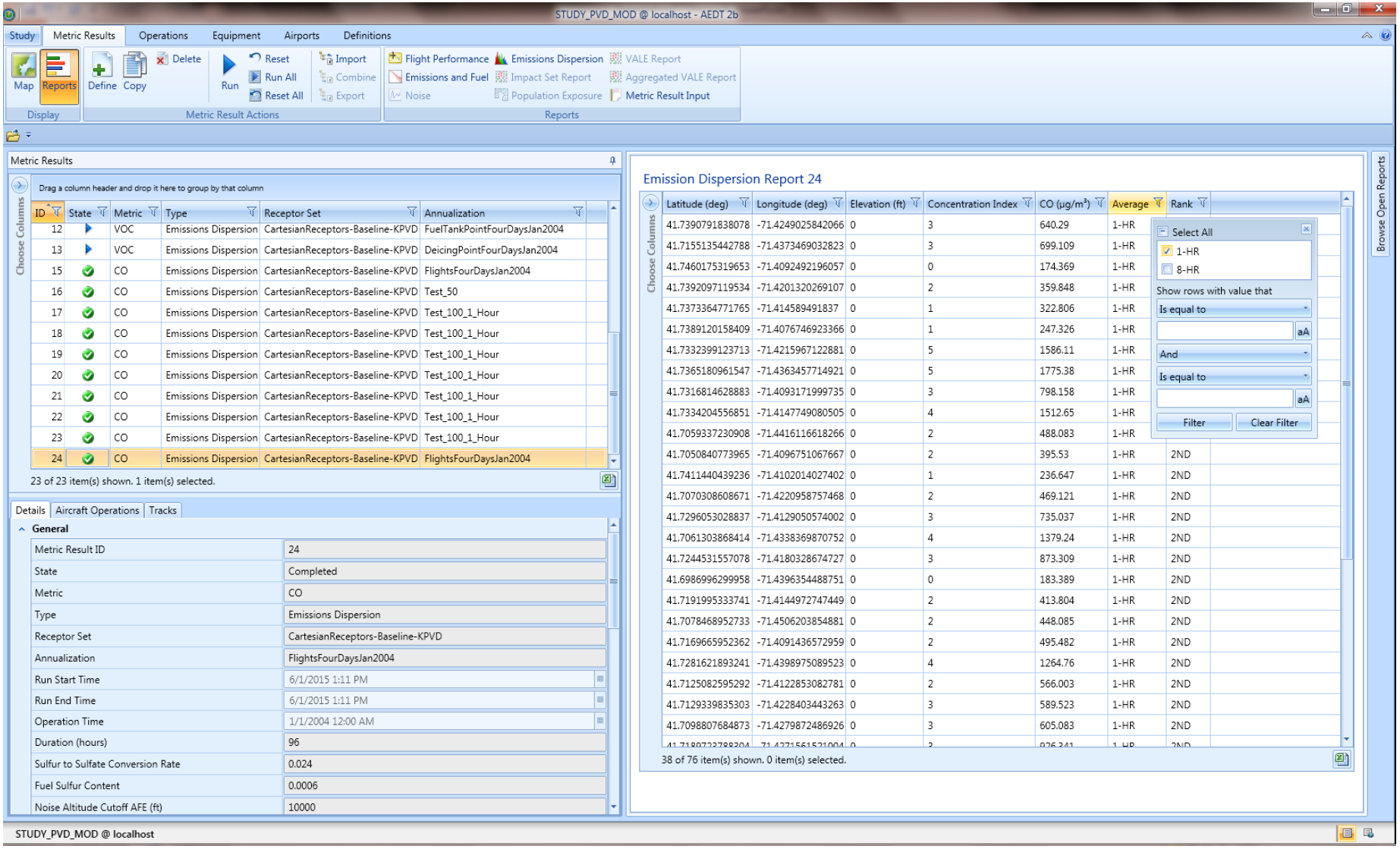
AEDT Emissions Inventory Results



AEDT Dispersion Analysis Results



AEDT Dispersion Analysis Results



Questions?

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AEDT Website

https://aedt.faa.gov/