MOBILE6
Day 3 Examples

MOBILE6
On-Road Motor Vehicle
Emissions Model

Training Course

Sierra Research, Inc.
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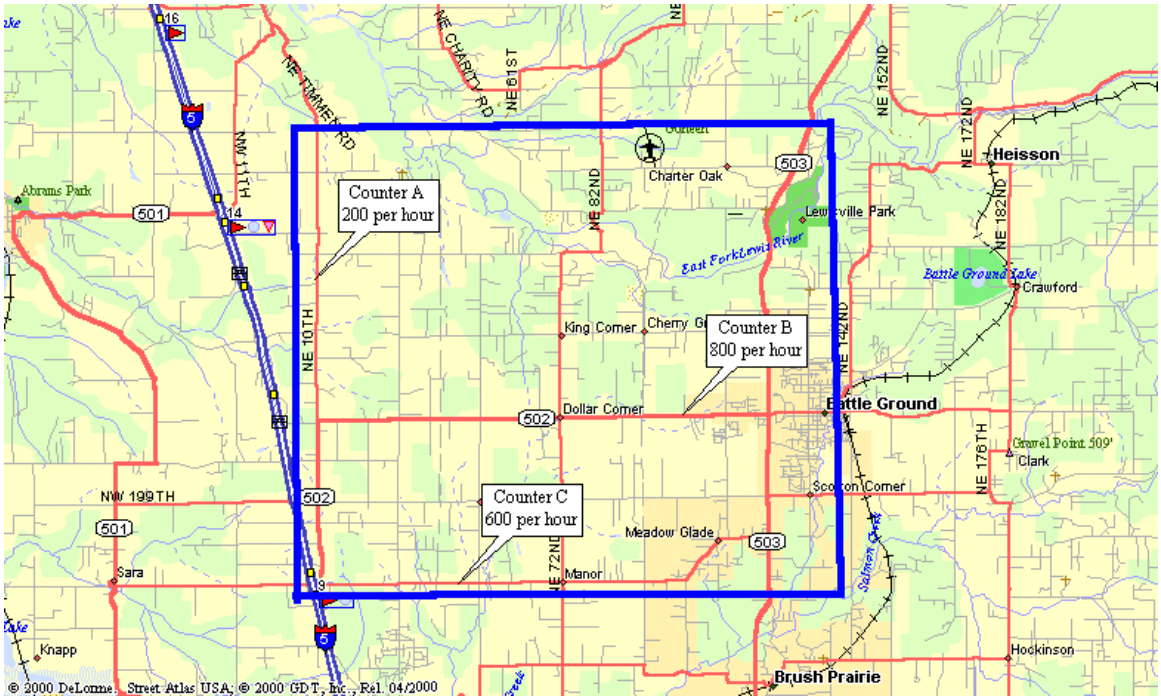
Example 12

Traffic Counts to VMT



Assuming that the square above is 6 miles on a side, generate an estimate of daily VMT for the major arterials within the square based on the given traffic counts.

Example 12 Solution

The following steps are used to convert the traffic count data to VMT:

1. Calculate the sum of counts (AADT) in each functional class

   Counter A = 200/hr * 24 hrs = 4,800 counts/day
   Counter B = 800/hr * 24 hrs = 19,200 counts/day
   Counter C = 600/hr * 24 hrs = 14,400 counts/day

   Total Counts = 38,400 counts/day

2. Determine sample size for each functional class (number of counters)

   Total Counters = 3

3. Determine average volume (by functional class) by dividing total counts by sample size

   Average Daily Volume = 38,400/3 = 12,800

4. Obtain number of miles for each functional class (from DOT or GIS software)

   Approximate roadway miles for Example 12 = 36 miles

5. Calculate VMT by functional class as average volume X number of miles of facility

   Daily VMT = 36 miles × 12,800 = 460,800 miles

Example 13

Development of a Rural Inventory VMT and Speed Estimates

Fremont County in Wyoming had a 1995 population of 35,000, and the statewide population was 475,000.

Use these data to estimate daily VMT in Fremont County in 1995; forecast to 2005 based on a 1.5% annual growth rate. Assign appropriate facility types and speeds to the overall VMT estimates.

Example 13 Solution

Determine 2005 VMT

1. Freemont County 1995 population fraction:

Freemont = 35,000/475,000 = 7.4%

2. Freemont County 1995 VMT (millions):

Total WY Rural Annual VMT = 5,365 (See Hwy Stats table, Day 3, pg. 109)
Total WY Urban Annual VMT = 1,679 (See Hwy Stats table, Day 3, pg. 109)

Total WY Annual VMT = 7,044

Freemont County VMT = 7,044 × 0.074 = 521 million annual miles
= 1,430,000 daily VMT

(The 521 million annual VMT for Freemont County in 1995 estimated above compares with 644 million annual VMT used in the 1996 National Toxics Inventory)

3. Freemont County 2005 VMT (millions) – recall that need to grow at an annual rate of 1.5%.

2005 Annual VMT = $521 \times (1.015)^{10}$ = 605 million

4. Use the rural VMT distribution in the Highway Statistics table (pg. Day 3 - 109) to generate a distribution of VMT across facility types for Freemont County. Obtain national average speeds from Volume IV (reproduced on pg. Day 3 - 114):

Parameter	Interstate	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Total
WY Rural VMT (x10^6)	1976	1135	685	508	361	700	5365
VMT Fraction	0.368	0.212	0.128	0.095	0.067	0.130	1.000
Freemont VMT (x10^6)	222.8	128.0	77.2	57.3	40.7	78.9	605
(Daily VMT)	0.61	0.35	0.21	0.16	0.11	0.22	1.66
LDV/T Speed (mph)	57.3	45.4	39.9	35.1	30.5	---	
HDV Speed (mph)	43.6	36	33.3	29.8	24.4	---	

Note: For this example, assume that all vehicles travel at the LDV/T speed.

Example 14

Development of a Rural Inventory Emissions Estimates

Using the VMT and speed estimates from Example 13, generate a summertime VOC and NOx emissions inventory for Fremont County in 2005

Temperature: 68 to 88°F
RVP: 8.7 psi
Sulfur: Western conventional
Evaluation month: July

Example 14 Solution

Generate a summertime VOC and NOx emissions inventory.

1. Configure a MOBILE6 run (or set of runs) to generate emission factors consistent with the facility types and speeds in Example 13. There are two basic approaches:

a. Set up the speed by VMT matrix to reflect the above speeds, mapping interstate to the M6 freeway class, and the arterials/collectors to the M6 arterial class. Also modify the VMT by facility file to refect the mix of freeway, arterial, and local travel above. Assume ramps account for the default 8% of total freeway VMT.

b. Use the AVERAGE SPEED command to generate the emission factors for the freeway and arterial classes. For local roads, the VMT by facility file must be modified to reflect 100% travel on local roadways.

For this problem, it is probably be easier to follow option b, and that is recommended for this simple problem.

The input file prepared for this example and the resulting output file are presented below. A summary table that combines the emission factors with the estimated VMT follows the output file.

Example 14 Input File

```
* Filename: Exam_14.in
* This input file generates emission factors at the speed points and
* for the facilities needed for the inventory developed in Example 14
*********************   Header Section   ************************
MOBILE6 INPUT FILE :

RUN DATA            :
*********************   Run Section   ***************************
MIN/MAX TEMP        : 68. 88.
FUEL RVP            : 8.7

* Specify conventional gasoline - West
FUEL PROGRAM        : 3


*********************   Scenario Section   **********************
SCENARIO RECORD     : Freeway - 57.3 mph
CALENDAR YEAR       : 2005
EVALUATION MONTH    : 7
AVERAGE SPEED       : 57.3 Freeway

SCENARIO RECORD     : Arterial - 45.4 mph
CALENDAR YEAR       : 2005
EVALUATION MONTH    : 7
AVERAGE SPEED       : 45.4 Arterial

SCENARIO RECORD     : Arterial - 39.9 mph
CALENDAR YEAR       : 2005
EVALUATION MONTH    : 7
AVERAGE SPEED       : 39.9 Arterial

SCENARIO RECORD     : Arterial - 35.1 mph
CALENDAR YEAR       : 2005
EVALUATION MONTH    : 7
AVERAGE SPEED       : 35.1 Arterial

SCENARIO RECORD     : Arterial - 30.5 mph
CALENDAR YEAR       : 2005
EVALUATION MONTH    : 7
AVERAGE SPEED       : 30.5 Arterial

SCENARIO RECORD     : Locals
CALENDAR YEAR       : 2005
EVALUATION MONTH    : 7
VMT BY FACILITY     : EX14FVMT.DAT

*********************   End of this Run   ***********************
END OF RUN
```

Example 14 Output File

```
*****************************************************************************
* MOBILE6 Draft (31-Aug-2001)                                               *
* Input file: EXAM_14.IN (file 1, run 1).                                   *
*****************************************************************************
  M616 Comment:
               User has supplied post-1999 sulfur levels.

* # # # # # # # # # # # # # # # # # # # # # # # #
* Freeway - 57.3 mph

* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # #

* A user supplied freeway average speed of 57.3 will
* be used for all hours of the day.  100% of VMT has been
* assigned to a fixed combination of freeways and freeway
* ramps for all hours of the day and all vehicle types.

  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
               Minimum Temperature:  68.0 (F)
               Maximum Temperature:  88.0 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   8.7 psi
                     Weathered RVP:   8.4 psi
               Fuel Sulfur Content:  160. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  No
                  Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                <6000     >6000     (All)
                      ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :      1.087     1.175     1.820     1.340     1.396    0.470     0.647     0.361      1.95     1.156
    Composite CO  :     16.17     18.01     21.46     18.90     13.09     1.360     1.186     2.115     10.09    16.037
    Composite NOX :      0.996     1.215     1.526     1.295     4.893    1.467     1.526    13.676      1.40     2.351
 -------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial - 45.4 mph

* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # #

* A user supplied arterial average speed of 45.4 will
* be used for all hours of the day.  100% of VMT has been
* assigned to the arterial/collector roadway type for all
* hours of the day and all vehicle types.

  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
               Minimum Temperature:  68.0 (F)
               Maximum Temperature:  88.0 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   8.7 psi
                     Weathered RVP:   8.4 psi
               Fuel Sulfur Content:  160. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  No
                  Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                <6000     >6000     (All)
                      ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :      1.137     1.221     1.897     1.394     1.492    0.487     0.672     0.390      1.93     1.207
    Composite CO  :     14.29     16.28     19.70     17.16     11.50     1.332     1.161     2.013      9.56    14.393
    Composite NOX :      0.954     1.160     1.468     1.239     4.616    1.197     1.244    10.059      1.21     1.990
 -------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial - 39.9 mph

* File 1, Run 1, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # #

* A user supplied arterial average speed of 39.9 will
* be used for all hours of the day.  100% of VMT has been
* assigned to the arterial/collector roadway type for all
* hours of the day and all vehicle types.
```

```
 M 48 Warning:
             there are no sales for vehicle class HDGV8b

                  Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  88.0 (F)
               Absolute Humidity:   75. grains/lb
                Nominal Fuel RVP:   8.7 psi
                   Weathered RVP:   8.4 psi
             Fuel Sulfur Content:  160. ppm

             Exhaust I/M Program:  No
                Evap I/M Program:  No
                     ATP Program:  No
                Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                <6000     >6000     (All)
                      ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 -----------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
    Composite VOC :      1.190     1.261     1.959     1.440     1.598    0.511     0.705     0.429      1.98     1.257
    Composite CO  :     13.46     15.46     18.87     16.33     11.74    1.364     1.189     2.128     10.32     13.697
    Composite NOX :      0.938     1.137     1.447     1.216     4.433    1.120     1.163     9.415      1.18     1.911
 -----------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial - 35.1 mph

* File 1, Run 1, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # #

* A user supplied arterial average speed of 35.1 will
* be used for all hours of the day.  100% of VMT has been
* assigned to the arterial/collector roadway type for all
* hours of the day and all vehicle types.

 M 48 Warning:
             there are no sales for vehicle class HDGV8b

                  Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  88.0 (F)
               Absolute Humidity:   75. grains/lb
                Nominal Fuel RVP:   8.7 psi
                   Weathered RVP:   8.4 psi
             Fuel Sulfur Content:  160. ppm

             Exhaust I/M Program:  No
                Evap I/M Program:  No
                     ATP Program:  No
                Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                <6000     >6000     (All)
                      ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 -----------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
    Composite VOC :      1.243     1.302     2.021     1.486     1.725    0.540     0.746     0.477      2.06     1.309
    Composite CO  :     12.74     14.75     18.15     15.62     12.65    1.422     1.240     2.340     11.40     13.130
    Composite NOX :      0.929     1.123     1.435     1.203     4.273    1.094     1.136     9.198      1.15     1.877
 -----------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial - 30.5 mph

* File 1, Run 1, Scenario 5.
* # # # # # # # # # # # # # # # # # # # # # # # #

* A user supplied arterial average speed of 30.5 will
* be used for all hours of the day.  100% of VMT has been
* assigned to the arterial/collector roadway type for all
* hours of the day and all vehicle types.

 M 48 Warning:
             there are no sales for vehicle class HDGV8b

                  Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  88.0 (F)
               Absolute Humidity:   75. grains/lb
                Nominal Fuel RVP:   8.7 psi
                   Weathered RVP:   8.4 psi
             Fuel Sulfur Content:  160. ppm

             Exhaust I/M Program:  No
                Evap I/M Program:  No
                     ATP Program:  No
                Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                <6000     >6000     (All)
                      ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
```

```
 ---------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      1.317     1.365     2.120     1.558     1.890    0.577     0.799     0.538      2.18     1.385
     Composite CO  :      12.55     14.52     17.99     15.41     14.26    1.513     1.318     2.667     12.88    13.048
     Composite NOX :      0.953     1.141     1.455     1.221     4.123    1.102     1.144     9.263      1.11     1.896
 ---------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # #
* Locals

* File 1, Run 1, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # #

* Reading Hourly Roadway VMT distribution from the following external
* data file: EX14FVMT.DAT

  Reading User Supplied ROADWAY VMT Factors
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  68.0 (F)
              Maximum Temperature:  88.0 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   8.7 psi
                    Weathered RVP:   8.4 psi
              Fuel Sulfur Content:  160. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  No
                 Reformulated Gas:  No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
              GVWR:                 <6000     >6000     (All)
                      ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 ---------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      2.089     2.073     3.131     2.343     3.682    0.863     1.207     1.012      3.13     2.174
     Composite CO  :      11.09     14.00     18.24     15.09     34.50    2.504     2.176     6.257     26.65    13.409
     Composite NOX :      0.955     1.109     1.421     1.189     3.536    1.463     1.522    11.213      0.92     2.026
 ---------------------------------------------------------------------------------------------------------------------------
```

Example 14 – Results

Freemont County CY2005 VOC and NOx Inventory (tons/day)

Parameter	Interstate	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Total
Daily VMT (x10^6)	0.61	0.35	0.21	0.16	0.11	0.22	1.66
LDV/T Speed (mph)	57.3	45.4	39.9	35.1	30.5	---	
Emission Rate (g/mi)							
VOC	1.16	1.21	1.26	1.31	1.39	2.17	
NOx	2.35	2.00	1.91	1.88	1.90	2.03	
Emissions (ton/day)							
VOC	0.78	0.47	0.29	0.23	0.17	0.52	2.45
NOx	1.58	0.77	0.45	0.32	0.23	0.48	3.84

Issues:

a. May want to change the default freeway ramp fraction (8% of total freeway + ramp VMT) to better reflect rural areas. This can be done with the AVERAGE SPEED command.