Appendix B - MOVES Inputs

Table of Contents

Emission Inventory Documentation
Tacoma-Pierce County $PM_{2.5}$ Maintenance Plan
MOVES Inputs

MOVES input parameters were similar, though not identical, for both the annual Inventory mode runs and the winter day Rates mode runs. All of the parameters are used directly in Inventory mode; however, in Rates mode, several are treated as placeholders and essentially ignored. The actual values of these parameters are input during post-processing of the MOVES output. Using the model in rates mode allowed for easier combination with PSRC's travel demand model VMT data when calculating the daily inventory.

Parameters for modeling the inventories are presented below. The attainment year 2011 inputs are described, and changes to the inputs for the projection years are noted. The MOVES input tables are in parentheses after the parameter name. Parameters that were treated as placeholders in the daily inventory are noted in the appropriate sections.

1 Average Speed Distribution (avgSpeedDistribution)

The MOVES speed distribution default was used. The defaults were used in the annual inventory. For the daily rates, the default speeds were used as a placeholder. The rates were matched to the PSRC VMT by road type and speed to calculate the daily inventory.

Projection Years: Same as attainment year.

2 Vehicle Miles Traveled Statistics

2.1 County VMT (HPMSVtypeYear)

The VMT file must contain VMT by vehicle type. Because the PSRC VMT was not available by vehicle type, Washington State Dept. of Transportation (WSDOT) data was used to develop the model input data. The WSDOT data was used in the annual inventory. For the daily rates, it was placeholder with respect to the actual number of VMT by road type. PSRC's VMT data was used for the actual VMT amount by road type during post-processing.

While not identical to the PSRC VMT amounts, the WSDOT data met the criteria of reflecting realistic values in the area. Realistic values are necessary because MOVES uses the relationship between the vehicle counts and VMT to determine the relative amount of time vehicles spend parked vs. running. The WSDOT data is described below.

To allocate the VMT by HPMS vehicle type, WSDOT's travel activity by vehicle type and road class was used (Table 2).[1] There is some uncertainty when assigning similar vehicle types (e.g., cars vs. light trucks, light trucks vs. smaller single-unit trucks). The uncertainty appeared high for the split between cars and light trucks. The state car population was 45% of the sum of cars and light duty trucks in 2010, but the reported 2011 travel activity percentage was 70%. As this did not seem reasonable, an adjustment was made. First, the car and light truck activity was summed. Then the VMT was calculated for the sum. Finally, the VMT was split between cars and light trucks using the vehicle population split. This was done on a county basis. County car percentages ranged from 32% to 51%.

For the 2011 inventory, the WSDOT data were used to construct the HPMSVtypeYear table of Pierce County VMT estimates by HPMS vehicle class (b).

(1) a = VMT x TF, for each combination of county, HPMS road type (Table 3) and HPMS vehicle class (Table 5). VMT is from Table 3. TF is the travel fraction from Table 2.
(2) b = ∑(a), by county and HPMS vehicle class.

Table 1: MOVES Pierce County 2011 Estimated Annual VMT

MOVES Vehicle Class	Annual VMT
Motorcycle	22,207,996
Passenger Car	2,600,693,113
Light Duty Trucks	3,219,329,321
Buses	15,639,428
Single Unit Trucks	311,193,128
Combination Trucks	209,233,174
TOTAL	6,378,296,160

Projection Years: VMT was projected using PSRC's Pierce County VMT growth rates.

2.2 Road and Vehicle Type Travel Distribution (roadTypeDistribution)

The MOVES roadTypeDistribution file contains VMT fractions by MOVES vehicle and road type. WSDOT data was used to develop the distribution. The distribution was used in the annual inventory. For the daily rates, the distribution was used both as actual input data and as a placeholder. As actual data, it allots vehicle types to road types by hour. The road type distribution is a placeholder with respect to the fraction of VMT assigned to each road type. The PSRC VMT was used as the actual amount of VMT by road type during post-processing for the daily inventory. The WSDOT distribution is described below.

Though the vehicle breakout uses the MOVES vehicle classes, it is achieved by assuming all MOVES vehicle types included in a single HPMS class have the same road distribution (inherent assumption in the national travel fractions). The distribution fractions (d) were calculated for each MOVES vehicle type and MOVES road type as follows:

(1) a = VMT x TF, for each combination of HPMS road type (Table 3), MOVES road type (Table 4), and MOVES vehicle class (Table 5). VMT is from Table 3. TF is the travel fraction from Table 2.
(2) b = ∑(a), by MOVES road type and vehicle class.
(3) c = ∑(a), by vehicle class.
(4) d = b/c

Projection Years: Same as attainment year.

2.3 Restricted Road Ramp Fraction (roadType)

To model restricted-access roads (e.g. freeways), vehicle hours traveled are split between the ramps and the roadway. The MOVES ramp fraction default is 8%. The default was used for the annual and daily calculations.

Projection Years: Same as attainment year.

2.4 WSDOT VMT Information and MOVES-HPMS Classifications

Table 2: Washington State Travel Activity Percentages, 2011

HPMS Class	Rural			Urban			All
	Interstate	Arterial	Other	Interstate	Arterial	Other	
Motorcycles	0.221	0.505	1.28	0.264	0.323	0.398	0.35
Passenger Cars	58.097	58.532	53.748	66.63	66.535	62.446	63.756
Other 2 Axle-4 Tire Vehicles	23.44	28.103	31.454	23.982	25.474	29.765	25.577
Buses	0.319	0.282	0.259	0.248	0.248	0.214	0.262
Single Unit Trucks	5.412	6.84	7.951	4.066	4.925	4.761	4.729
Combination Trucks	12.511	5.738	5.308	4.81	2.495	2.416	5.326

Table 3: Average Daily Vehicle Miles Traveled in Thousands by HPMS Road Type, 2011

Area	Interstate	Princ Art	Minor Art	Collector	Local
Urban					
Pierce	3232	6668	3332	1134	1776
State Total	29788	38539	20738	8378	12049
Rural					
Pierce	339	0	649	251	93
State Total	12530	11043	5867	13874	3257

Table 4: WSDOT and EPA (MOVES) Road Classifications

WSDOT			EPA	
VMT	**Travel Fractions**	**Temporal**	**MOVES Road**	**SCC Road**
Rural				
Interstate	Interstate	Interstate	Restricted	Interstate
Principle Arterial	Arterial	Arterial	Unrestricted	Principal Arterial
Minor Arterial	Arterial	Arterial	Unrestricted	Minor Arterial
Collector	Other	Other	Unrestricted	Major Collector
Local	Other	Other	Unrestricted	Local
Urban				
Interstate	Interstate	Interstate	Restricted	Interstate
Principle Arterial	Arterial	Arterial	Unrestricted	Principal Arterial
Minor Arterial	Arterial	Arterial	Unrestricted	Minor Arterial
Collector	Other	Arterial	Unrestricted	Collector
Local	Other	Arterial	Unrestricted	Local

Table 5: HPMS and MOVES Vehicle Classifications

MOVES Vehicle Type	HPMS & MOVES Vehicle Class
Motorcycle	Motorcycles
Passenger Car	Passenger Cars
Passenger Truck	Other 2 axle-4 tire vehicles
Light Commercial Truck	Other 2 axle-4 tire vehicles
Intercity Bus	Buses
Transit Bus	Buses
School Bus	Buses
Refuse Truck	Single Unit Trucks
Single Unit Short-haul Truck	Single Unit Trucks
Single Unit Long-haul Truck	Single Unit Trucks
Motor Home	Single Unit Trucks
Combination Short-haul Truck	Combination Trucks
Combination Long-haul Truck	Combination Trucks

3 VMT Temporal Adjustments (monthVMTFraction, dayVMTFraction, hourVMTFraction)

Month and day-of-week adjustments were actual data for the annual inventory and placeholders for the daily rates. Hourly adjustments were actual data for the annual inventory and served as both placeholders and actual data for the daily rates. They were used as placeholders with respect to the amount of VMT allocated to each hour. The actual amount of VMT allocated to each of PSRC's 5 time periods was used to calculate daily emissions.

WSDOT adjustment factors for month, day of week, and hour (weekday and weekend) were used in the MOVES runs.[2] The adjustment factors were based on traffic counter data, and were calculated for 5 road classes (Table 4). MOVES temporal files were developed using the WSDOT temporal adjustments with WSDOT VMT and road/vehicle travel estimates described above.

In the MOVES default database, all vehicle types are assumed to have the same temporal distributions. The same assumption was made for Pierce County.

The Other Rural Arterial category was used to represent MOVES class Rural Unrestricted. Off-network fractions were calculated as the average of the fractions for Urban Restricted and Urban Unrestricted.

The monthly adjustments (d) were calculated for each county and month:

(1) a = ∑VMT, by county and MOVES road type (Table 4). VMT is from Table 3.
(2) b = ∑(a), by county
(3) c = a/b, which are VMT fractions by county and MOVES vehicle class.
(4) m = WSDOT VMT fractions by month and MOVES road type. The fractions were calculated from the data in Table 6 such that the fractions sum to 1 for the year.
(5) d = ∑(c x m), by county and month

Table 6: WSDOT VMT Monthly Adjustment Factors

WSDOT Road Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rural Interstate	0.77	0.85	0.93	1	1.03	1.12	1.22	1.24	1.1	1.03	0.89	0.83
Other Rural Arterial	0.77	0.86	0.9	0.95	1.04	1.12	1.25	1.26	1.11	1.03	0.84	0.79
Other Rural	0.72	0.77	0.82	0.87	1.05	1.23	1.42	1.36	1.2	1.01	0.84	0.71
Urban Interstate	0.92	0.97	0.99	1.01	1.06	0.99	0.98	0.98	0.99	0.95	0.91	0.91
Other Urban Arterial	0.92	0.95	0.98	1.01	1.06	1.07	1.06	1.07	1.03	1	0.93	0.93

The day-of-week adjustments (d) were calculated for each day type (weekday, weekend) and MOVES road type:

(1) a = ∑ Mon to Fri adjust. factors (Table 7) for each MOVES road type (Table 4).
(2) b = ∑ Sat and Sun adjust. factors (Table 7) for each MOVES road type (Table 4).
(3) c = a+b, by MOVES road type.
(4) dweekday = a/c, dweekend = b/c

Table 7: WSDOT VMT Day of Week Adjustment Factors (x 100)

Road Type	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Rural Interstate	107.38	93.76	88.1	89.95	98.22	122.86	99.66
Other Rural Arterial	96.32	95.22	94.32	95.17	100.48	117.73	100.13
Other Rural	100.33	93.64	92.97	94.06	98.66	110.45	110.8
Urban Interstate	79.69	101.01	103.03	104.91	106.65	112.69	92.02
Other Urban Interstate	75.33	102.5	104.86	106.51	107.92	113.47	89.25

The hourly adjustments (b) were calculated for each day type (weekday, weekend), hour, and MOVES road type:

(1) a = ∑ Hourly factors (Table 8) for each MOVES road type (Table 4) and day type (weekday/weekend)
(2) bweekday = Hour j/a, where j = 1 through 24, and daytype = weekday
(3) bweekend = Hour j/a, where j = 1 through 24, and daytype = weekend

Table 8: WSDOT VMT Hourly Fractions (x 100)

Hour	Rural						Urban			
	Interstate		Arterial		Other		Interstate		Other	
	Wkday	Wkend	Wkday	Wkend	Wkday	Wkend	Wkday	Wkend	Wkday	Wkend
1	1	1.2	0.6	1	0.6	1	0.8	1.6	0.6	1.6
2	0.8	0.8	0.4	0.6	0.4	0.8	0.6	1	0.4	1
3	0.6	0.6	0.4	0.4	0.4	0.6	0.4	0.8	0.4	0.8
4	0.8	0.6	0.6	0.4	0.6	0.4	0.6	0.6	0.4	0.6
5	1.2	0.6	1	0.6	1.4	0.6	1.2	0.6	1.2	0.6
6	2.4	1	2.2	1	2.6	1	3.2	1	2.8	1.2
7	3.6	1.6	3.8	1.6	4.2	1.4	5.2	1.8	5.2	1.8
8	4.6	2.6	5.2	2.6	5.6	2.4	6.6	2.6	6.6	2.6
9	4.8	3.8	5.2	4	5.2	3.8	6	3.8	5.8	3.8
10	5.4	5.2	5.8	5.6	5	5.2	5.2	5	5.4	5
11	6	6.4	6.2	7	5.4	6.6	5.2	6	5.2	6.2
12	6.4	7.2	6.6	7.8	5.8	7.6	5.2	6.8	5.4	7
13	6.6	7.6	7	8.4	6.2	8.4	5.6	7.2	5.8	7.6
14	6.8	7.8	7	8.4	6.6	8.6	5.8	7.4	6	7.6
15	7.2	8	7.6	8.4	7	8.6	6.4	7.4	6.6	7.6
16	7.6	8	8.2	8.4	8	8.6	7	7.4	7.4	7.4
17	7.6	7.8	8.2	8	8.4	8.2	7.4	7.4	7.8	7.4
18	7.2	7.2	7.4	7	8.2	7.2	7.4	7	7.4	7
19	5.6	6.2	5.4	5.8	6.2	5.8	5.8	6.2	5.8	6.2
20	4.4	5	3.8	4.6	4.4	4.6	4.2	5.2	4.2	5
21	3.6	4	3	3.4	3.4	3.4	3.4	4.4	3.4	4.2
22	2.8	3	2.2	2.6	2.6	2.6	3	3.8	2.8	3.6
23	2	2.2	1.6	1.8	1.6	1.8	2.2	3	2	2.8
24	1.4	1.4	1	1.2	1	1.2	1.4	2	1.4	1.8

Projection Years: Same as attainment year.

4 Fleet Characteristics

Fleet characteristics are important inputs to MOVES. Washington has a substantially older fleet than the national average, and this has a significant effect on emissions. Another difference occurs in Pierce County where nearly the entire fleet of transit buses is powered by CNG.

Local data sources were supplemented with some national default information to calculate the number of vehicles by type and age, and the age distributions. The data sources and calculations are described below.

The Washington State Department of Licensing (DOL) registers non-governmental vehicles annually. Registrations for calendar year 2010 and 2012 were obtained from DOL.[3]

Because DOL does not register public transit and school buses each year, alternate sources of information were obtained. Transit and Intercity bus data came from Federal Transit Administration (FTA) Annual Report data for 2010 (most recent available).[4] EPA classified all FTA buses as Transit when they developed the default database. They used FHWA bus information to develop the Intercity estimates. EPA believed this estimate should be improved. The overall split was 62%/38% Intercity/Transit. For WA, the FTA data appears to include both Intercity and Transit (though couldn't find definition of these terms). For the WA fleet, the FTA counts were supplemented with private bus counts from DOL (identified as Stages). Though the end use (school or other transit) of the DOL buses cannot be determined by any easy means, they are only a small portion of the buses. The default 62%/38% Intercity/Transit split was applied to the total.

Washington State Office of the Superintendent of Public Instruction (OSPI) tracks public school buses. Data current to March 2012 was used for the 2011 distribution.[5] There are duplicate VINs in the OSPI database. They were removed prior to tallying counts. OSPI does not identify fuel type for the buses. All buses were assumed to be diesel-powered. Private school buses were counted in the DOL data. Total school buses were the sum of the DOL and OSPI data.

4.1 Age Distribution (sourceTypeAgeDistribution)

The DOL, FTA, and OSPI registration data was used with VMT data to calculate the number of vehicles in each county by model year for several vehicle classes. The statewide distribution was also calculated. The model year fractions were calculated from the vehicle counts. The resulting distribution was used for both the annual and daily calculations. The registration classes matched to the MOVES vehicle types as shown in Table 9.

Distributions were a combination of the county-specific and state distributions. Distributions for light duty vehicles, motor homes, and school buses were calculated using the vehicles' registered county. Distributions for single and combination trucks were assigned to the statewide distribution for all counties since registered county may not be a good indicator of where the vehicles travel. The distribution for refuse trucks was also assigned to the statewide distribution for all counties since methods for extracting refuse trucks from the DOL data may not capture all refuse trucks. Distributions for transit and intercity buses were conditionally assigned. If a given county had bus registrations, they were used to calculate the distribution. If not, the statewide distribution was used.

Four of the registration classes had to be split in order to match the MOVES vehicle types: light duty trucks, non-refuse single unit trucks, combination trucks, and transit/intercity buses. To make the splits, the fractions in Table A.1 of the MOVES Technical Guidance were used.[6] The fractions were multiplied by the number of WA registrations in the registration class to estimate the number of WA registrations in the MOVES vehicle type.

Because the datasets were predominantly 2010 registrations, the age distributions were calculated for 2010. They were projected to 2011 by vehicle type and county with the following equations/assumptions where age variables are fractions:
Ages 0 -1: It was assumed fractions were the same as in 2010.

$$\text{Ages 2 - 29: } \text{ageN2011} = \text{age}(N-1)2010 \times \sum_{2}^{30}\text{ageN} / \sum_{1}^{30}\text{ageN}$$

$$\text{Age 30: } \text{age302011} = (\text{age292010} + \text{age 302010}) \times \sum_{2}^{30}\text{ageN} / \sum_{1}^{30}\text{ageN}$$

Projection Years: Same as attainment year.

Table 9: DOL and MOVES Vehicle Classifications

MOVES Vehicle Type	WA Registration Vehicle Class
Motorcycle	Motorcycle
Passenger Car	Passenger Car
Passenger Truck	Trucks up to 19,500 lbs gvwt
Light Commercial Truck	Trucks up to 19,500 lbs gvwt
Intercity Bus	Transit/Intercity Bus
Transit Bus	Transit/Intercity Bus
School Bus	School Bus
Refuse Truck	Refuse Truck
Single Unit Short-haul Truck	Single Unit Trucks > 19,500 lbs gvwt
Single Unit Long-haul Truck	Single Unit Trucks > 19,500 lbs gvwt
Motor Home	Motor Home
Combination Short-haul Truck	Combination Trucks
Combination Long-haul Truck	Combination Trucks

4.2 Vehicle Counts (sourceTypeYear)

Vehicle counts were used as actual data for the annual and daily calculations. Vehicle counts by county and MOVES vehicle type for 2010 were calculated according to the MOVES Technical Guidance. County vehicle counts were calculated as described above. The counts are used to calculate off-network emissions: starts, evaporative permeation and fuel vapor venting, extended idling, and refueling.

An adjustment was made for refuse trucks, and short and long haul single and combination trucks. County registrations may not be a good indicator of trucking activity in an individual county. State registrations were apportioned to counties using a spatial surrogate. Two different surrogates were tested: human population and truck VMT. Either surrogate is reasonable for counties where the population and VMT are comparable, such as Pierce County. To be consistent with the statewide 2011 inventories, population was used as the surrogate.

The 2010 vehicle counts were projected to 2011 by vehicle type and county based on human population:[7] VehicleTypeCount x (2011 population / 2010 population).

Table 10: Pierce County Population

Year	Population
2010	795,225
2011	802,150

Table 11: Estimated 2011 Vehicle Counts

MOVES Vehicle Type	Vehicles
Motorcycle	24,434
Passenger Car	269,735
Passenger Truck	251,671
Light Commercial Truck	81,988
Intercity Bus	264
Transit Bus	162
School Bus	1,234
Refuse Truck	155
Single Unit Short-haul Truck	4,293
Single Unit Long-haul Truck	306
Motor Home	7,219
Combination Short-haul Truck	2,247
Combination Long-haul Truck	1,931

Projection Years: Vehicle counts were projected using PSRC's Pierce County vehicle population growth factors. The growth factors incorporated projections in households, vehicle trips per household, and vehicle miles traveled.

4.3 Alternative Vehicle Fuels and Technology (AVFT)

In Pierce County, nearly the entire fleet of transit buses is powered by CNG. The MOVES default AVFT file was exported from the County Data Manager. Transit bus (veh 42) fuels were updated to 100% CNG.

Projection Years: Same as attainment year.

5 Vehicle Inspection and Maintenance Program (IMCoverage)

There is a Vehicle Inspection and Maintenance (I/M) programs in the Puget Sound area covering most of King, Pierce, and Snohomish Counties.[8] Both gasoline and diesel vehicles are tested, but MOVES only models I/M benefits for gasoline vehicles. The remainder of this section addresses the I/M program for gasoline vehicles.

In MOVES, the I/M program is defined for each county and evaluation year. The required parameters are test frequency, pollutant, test type, first and last model year tested, fuel type, vehicle type, emissions process, and compliance factor. They are described in more detail below.

The test frequency is biennial. The pollutant and emissions processes tested are exhaust hydrocarbons and carbon monoxide, and evaporative hydrocarbons.

The program includes multiple test types. From 2008 to June 30, 2012, vehicles required to test are given a gas cap check, and either a 2500/idle test, acceleration simulation mode (ASM) test, or on-board diagnostic (OBD) test. The vehicle type and model year determine the test type given. Beginning July 1, 2012, the Dept. of Ecology is proposing to simplify the I/M tests by eliminating the gas cap check and ASM tests. The I/M program will be ended no later than Dec. 31, 2019, and may be ended in 2017.

A summary of the test types, model years tested, and vehicle (duty) types are shown in the table below. To simplify data requirements, the current I/M program is defined from calendar year 2008 to 2012. The future program is defined as covering calendar year 2013 to 2019.

Table 12: I/M Program Test Types and Applicable Model Years and Vehicle Duty Class

ID	Test Type	Veh Duty	2008-2012			2013-2019	
			First MY	Last MY		First MY	Last MY
1	ASM 2525 Phase-in Cutpoints	Light	First MY	1995			
2	Two-mode, 2500 RPM/Idle Test	Light				First MY	1995
3	Exhaust OBD Check	Light	1996	Last MY		1996	2008
4	Two-mode, 2500 RPM/Idle Test	Heavy	First MY	Last MY		First MY	2008
5	Evaporative Gas Cap Check	Heavy	First MY	1999			
6	Evaporative System OBD Check	Light	1996	Last MY		1996	2008
7	Evaporative Gas Cap Check	Light	First MY	1995			

First and last model year (MY) for each year of evaluation are defined in WACs 173-422 and 173-422A

The final parameter is the compliance factor. The compliance factor is the product of the compliance rate and (100 - waiver rate)/100. The compliance rate is the percentage of vehicles required to test that either pass the test or receive a waiver. A compliance factor was calculated based on 2007 testing and licensing data.[9] The waiver rate is the percentage of vehicles that fail an initial test and do not pass a retest, but do receive waiver. Waiver rates were calculated for each test type based on 2007-2008 testing data.[10] The compliance rates, waiver rates, and compliance factors are shown in Table 13.

Table 13: Compliance Rate, Waiver Rate, and Compliance Factor

ID	Test Type	Veh Duty	Waiver Rate	Compliance Rate	Compliance Factor
1	ASM 2525 Phase-in Cutpoints	Light	20.5	94.5	75.1
2	Two-mode, 2500 RPM/Idle Test	Light	19.7	94.5	75.9
3	Exhaust OBD Check	Light	27.9	94.5	68.1
4	Two-mode, 2500 RPM/Idle Test	Heavy	13.6	94.5	81.6
5	Evaporative Gas Cap Check	Heavy	0	94.5	94.5
6	Evaporative System OBD Check	Light	27.9	94.5	68.1
7	Evaporative Gas Cap Check	Light	0	94.5	94.5

Projection Years: The 2017 program was defined using the tests shown in Table 12. The waiver and compliance rates, and compliance factor were the same as the attainment year. For 2026, I/M was discontinued.

6 California Low-Emission Vehicle II Program (mylevs.emissionRateByAge)

The MOVES model uses federal emissions standards by default. Because several states adopted California Low-Emission Vehicle (LEV) standards in place of the federal standards, EPA provided files and instructions for modeling LEV standards.[11]

LEV standards affect cars and light duty trucks, SUVs and vans. The California LEV input database provides a set of alternate HC, CO, and NOx start and running emission rates based on EPA and CA Air Resources Board (CARB) analysis of the LEV programs. The input database provides rates from model year 1994 until model year 2050, including both the LEV I and LEV II California standards. These rates replace the rates in the default database for these particular pollutants and model years. EPA provided tools to modify the files to reflect the model years affected by the LEV standards in the area of interest.

WA adopted California LEV II standards beginning with 2009 model year vehicles. The EPA tools were used to create a supplementary emissionRateByAge table where the first model year subject to LEV II standards is 2009. The LEV standards are given by fuel type, engine type, vehicle type, model year, pollutant, emission mode, age group, and vehicle operating mode. The vehicle operating mode describes what the vehicle is doing (accelerating, braking, cruising, idling), vehicle specific power (VSP – an energy measure in kw/tonne), and speed. There are individual 31 operating modes in the LEV table.

There are over 65,000 standards records in the supplementary file, but the LEV standards as fractions of the federal standards are fairly constant for the three major classes of operating modes shown in Table 14.

Table 14: LEV Standards as Fractions of Federal Standards, Approximate

Pollutant	Running Emissions speed < 25 or speed ≥ 25 and VSP < 18		Running Emissions speed ≥ 25 and VSP ≥ 18		Start Emissions	
	Car	Light Truck	Car	Light Truck	Car	Light Truck
HC	0.78	0.76	1.01	0.99	0.75	0.77
CO	0.67	0.64	1.00	0.99	0.76	0.76
NOx	1.02	0.79	1.01	0.99	1.01	0.92

EPA also included files and a procedure to model the effects of California's Zero-Emission Vehicle requirements on evaporative emissions. WA did not adopt the ZEV standards, so these should not be used.

Projection Years: Same as attainment year.

7 Meteorological Parameters (zoneMonthHour)

Emissions are affected by temperature and humidity. These parameters are required by month and hour to estimate emission rates. Temperatures and humidity used in the base year 2008 inventory were used for the budget. The temperature profile is representative of days on which exceedances of the 24-hour PM2.5 standard primarily occur. Using meteorological data from the Tacoma L Street monitoring site, seventy-four (74) days were identified between Jan. 1, 2006, and December 31, 2010, on which the daily PM2.5 concentration exceeded 25 µg/m3. Each hour's temperatures for the 74 days were pooled. The 50th (median) percentile for each hour was calculated to produce the design day temperature profile.

Table 15: Tacoma PM2.5 NAA Winter Temperature Profile

Hour	Temperature	Hour	Temperature	Hour	Temperature	Hour	Temperature
0	28	6	29	12	43	18	34
1	27	7	29	13	45	19	34
2	27	8	30	14	46	20	34
3	28	9	33	15	45	21	32
4	28	10	36	16	41	22	32
5	28	11	41	17	37	23	32

Projection Years: Same as attainment year.

8 Fuel Parameters (fuelFormulation and fuelSupply)

The gasoline fuel parameters are Reid vapor pressure (RVP); sulfur content; oxygenate types, volume, and market share; aromatic, olefin, and benzene content; the volume percentage of gasoline evaporated at 200 and 300 degrees Fahrenheit, and the temperatures where 50% and 90% of gasoline is vaporized.

The MOVES Technical Guidance recommended using model defaults for all fuel properties except legal RVP limits and oxygenated fuel market share, unless survey data was available and included volumetric data to weigh the sample results. Survey data was available from Northrop-Grumman,[12] but it did not include volumetric data, so defaults were used for most of the parameters. The survey was useful for comparison to the default.

The MOVES defaults allocated counties to one of four groups: (1) King, Pierce, and Snohomish, (2) Spokane, (3) Other Western WA, (4) Other Eastern WA. The default data county groupings separating King/Pierce/Snohomish from the rest of western WA were likely based on an old voluntary low RVP agreement that no longer exists. A comparison of the MOVES defaults with the Northrup-Grumman data showed the Seattle survey data (representing King/Pierce/Snohomish) matched with either the King/Pierce/Snohomish or the WWA group. For consistency with statewide 2011 inventories, the WWA group default was used.

RVP and the ethanol market share were the only fuel parameters changed from the default. The default MOVES winter RVPs were simplified by using a single representative value for WWA. The representative values were chosen by using the most predominant MOVES assignment for counties in WWA. Since 2009, nearly all gasoline in Washington contains 10% ethanol, so the budget was modeled assuming 100% market share for 10% ethanol fuel.[13]

Projection Years: The MOVES defaults were used.

Table 16: Winter Western Washington Gasoline Parameters

Year	Mkt Share	Ethanol	RVP	Sulfur	Aromatic	Olefin	Benzene	E200	E300	T50	T90
	%	%	Psi	ppm	%	%	%	%	%	°F	°F
2011	100	10	14.7	30.0	26.0	8.2	0.64	52	90	196	296
2017 2026	100	10	14.8	28.0	25.0	8.2	0.64	53	91	194	291

References

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