

TECHNICAL SUPPORT DOCUMENT
FOR NON-ROAD MOBILE SOURCES:
PM2.5 EMISSIONS INVENTORIES
FOR SERIOUS PM2.5 SIP EPISODE DAYS

Three Episodes:
January 1-12, 2011
February 1-17, 2016
December 7-19, 2013

(PEAK WINTER EPISODE WEEKDAYS AND WEEKEND DAYS)

June 2017
Utah Division of Air Quality
Planning Branch/Inventory Section\Mobile

ABSTRACT

This document describes the non-road mobile source emissions inventory modeling procedure and results for the Serious PM2.5 SIP episodes.

Non-road mobile sources include 1) non-road engines and motorized equipment from MOVES2014a (formerly the EPA NONROAD Model), 2) aircraft, 3) airport ground support equipment and 4) diesel locomotives. The majority of emissions come from non-road engines and equipment. However, about 40% of non-road NOx comes from diesel locomotives. except for SO2, for which the majority of emissions come from aircraft.

The modeling domain for this SIP includes the entire state of Utah and portions of surrounding states. (UDAQ did not create inventories for out-of-state areas in the domain. Instead, the NEI 2011 was used to obtain inventories for these areas.)

Emissions for the non-road sector in the state of Utah were modeled by UDAQ inventory staff.

Three PM2.5 episodes were modeled for this SIP. Overall, the coldest episode took place from Saturday, December 7 through Thursday, December 19, 2013 inclusive. The January 2011 episode was the second coldest, and the February 2016 episode was the warmest.

This document includes inventory results for each of the three episodes. Units were converted to tons per year for easy comparison to other source groups—point, area, and on-road mobile.

If one reviews the daily inventories of non-road engines and equipment from MOVES within a single episode, NOx is highest on the coldest day, while CO and VOC are highest on the warmest day. PM, SO2 and NH3 are insensitive to small changes in daily temperature.

1. TABLE OF CONTENTS

i. Abstract.....	2
ii. Introduction.....	5
iii. Overview.....	7
iv. Emission Inventories.....	10
A. Episode Inventories.....	10
B. Annual Ton-per-Year Summaries.....	11
C. Comparison of Coldest and Warmest Episode Days—Ton-per-Year Changes in Inventory.....	11
v. Non-road Emissions Sources and Models.....	12
vi. Miscellaneous Non-road Engines and Equipment (MOVES2014a Model).....	13
A. Input Data.....	14
B. Hourly Temperatures by Episode Day and County.....	14
C. Snowmobile Adjustments.....	15
a. Reallocation of Snowmobile Counts by County in MOVES2014 Database.....	16
b. Utah Snowmobile Population Changed in MOVES2014a Database.....	16
c. Utah Snowmobile Counts in Future Years Changed in MOVES2014a Database...	17
d. Snowmobile Seasonality Changed in MOVES2014a Database.....	17
e. Additional MOVES2014a Files Related to Snowmobiles.....	17
f. No Additional Changes to MOVES2014 Database.....	18
vii. Aircraft.....	18
A. Four Main Operation Types for Aircraft.....	18
B. Aircraft Activity (Landings and Takeoffs, or LTOs).....	18
C. Aircraft Types.....	19
1. Commercial.....	19
2. Air Taxi and General Aviation.....	20
3. Military.....	20
D. Emissions and Dispersion Modeling System (EDMS) Software.....	21
E. Airport Ground Support Equipment (GSE).....	21

viii. Diesel Locomotives.....	21
ix. Output.....	22
A. MOVES2014a.....	22
B. Aircraft and Airport Ground Support Equipment (EDMS 5.1.4.1).....	23
C. Locomotives.....	23
x. Appendix Items.....	24
A. Annual Ton-per-Year Summaries.....	24
1. January 2011 Non-road Mobile Source Inventory Summaries (Tons per Year)....	24
a. Miscellaneous Non-road Engines and Equipment (MOVES2014a).....	24
b. Aircraft.....	25
c. Aircraft Ground Support Equipment.....	26
d. Diesel Locomotives.....	27
e. Totals.....	28
2. February 2016 Non-road Mobile Source Inventory Summaries (Tons per Year)....	29
a. Miscellaneous Non-road Engines and Equipment (MOVES2014a).....	29
b. Aircraft.....	30
c. Aircraft Ground Support Equipment.....	31
d. Diesel Locomotives.....	32
e. Totals.....	33
3. December 2013 Non-road Mobile Source Inventory Summaries (Tons per Year)...	34
a. Miscellaneous Non-road Engines and Equipment (MOVES2014a).....	34
b. Aircraft.....	35
c. Aircraft Ground Support Equipment.....	36
d. Diesel Locomotives.....	37
e. Totals.....	38
B. MOVES2014a Model: Changes to Underlying Database for Snowmobiles.....	39
1. File Name: “nrstatesurrogate”.....	39
2. File Name: “nrbaseyearequippopulation”.....	39
3. File Name: nrgrowthindex.....	40
4. File Name: nrmonthallocation.....	41
xii. Footnotes.....	41
xiii. References.....	43

ii. Introduction

This inventory includes emissions of carbon monoxide (CO), nitrogen oxides (NO_x), PM₁₀ and PM_{2.5} exhaust, sulfur dioxide (SO₂), volatile organic compounds (VOC) and ammonia (NH₃) from miscellaneous non-road engines, locomotives and aircraft.

Inventories were computed for three PM_{2.5} episodes:

Episode #1: Saturday, January 1 through Wednesday, January 12, 2011 inclusive (12 days);

Episode #2: Monday, February 1 through Wednesday, February 17, 2016 inclusive (17 days);

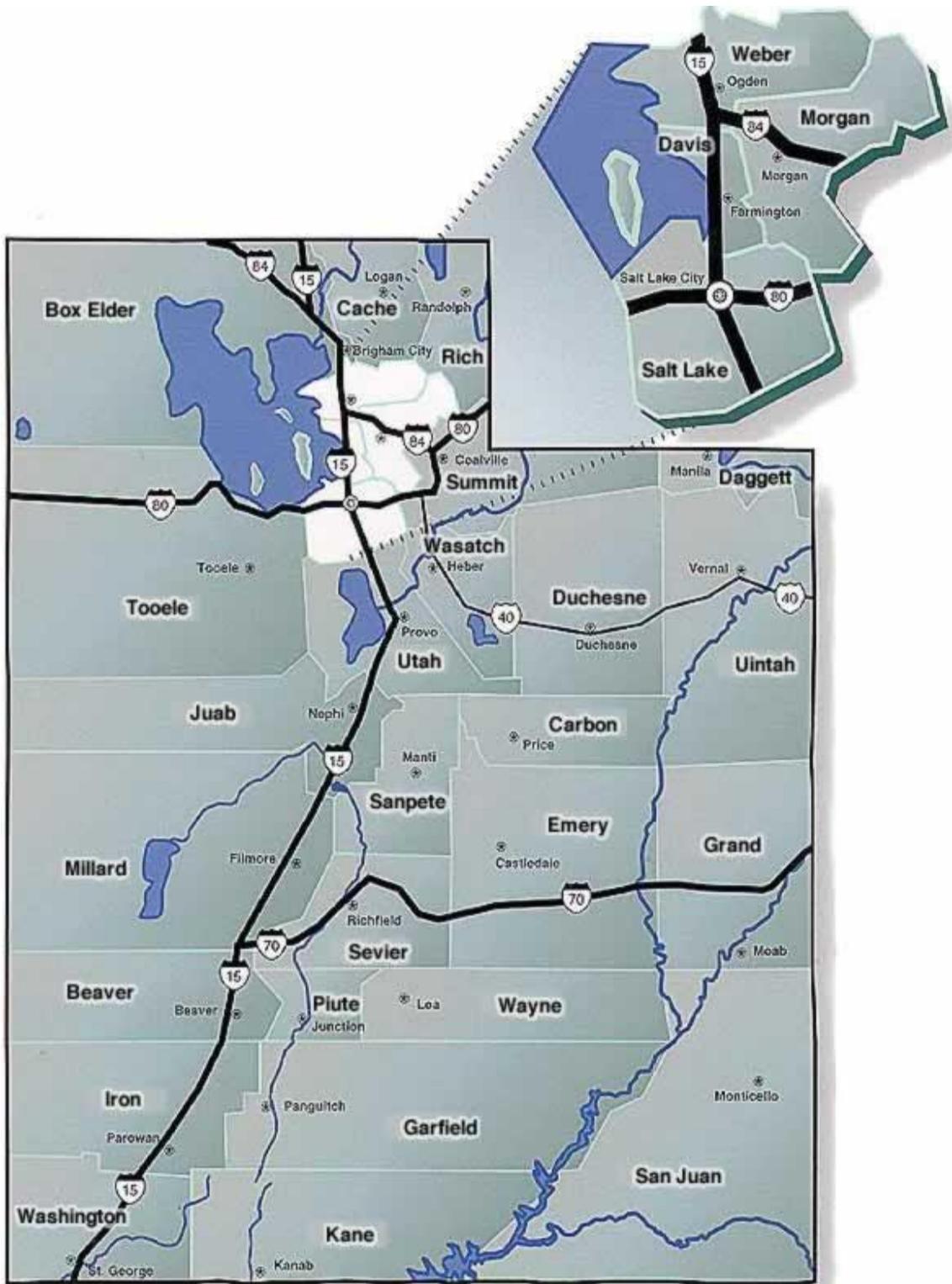
Episode #3: Saturday, December 7 through Thursday, December 19, 2013 inclusive (13 days).

The PM_{2.5} domain consists of all 29 counties in Utah and portions of Colorado and Wyoming.

UT County Names, FIPs Codes, Abbreviations and Human Population (2010, 2016 and 2020)

No.	County Name	FIPs	Abbrev	Human Populations and Projections		
				(2010)	(2016)	(2020)
1	Beaver	49001	BE	6,629	7,311	7,766
2	Box Elder	49003	BX	49,975	52,732	54,571
3	Cache	49005	CA	112,656	128,599	139,228
4	Carbon	49007	CR	21,403	21,522	21,602
5	Daggett	49009	DG	1,059	1,290	1,444
6	Davis	49011	DA	306,479	336,772	356,968
7	Duchesne	49013	DU	18,607	21,121	22,797
8	Emery	49015	EM	10,976	11,128	11,230
9	Garfield	49017	GA	5,172	5,707	6,063
10	Grand	49019	GR	9,225	9,870	10,300
11	Iron	49021	IR	46,163	52,698	57,055
12	Juab	49023	JU	10,246	12,348	13,750
13	Kane	49025	KA	7,125	7,864	8,357
14	Millard	49027	MI	12,503	12,673	12,787
15	Morgan	49029	MO	9,469	10,955	11,945
16	Piute	49031	PI	1,556	1,603	1,635
17	Rich	49033	RI	2,264	2,425	2,532
18	Salt Lake	49035	SL	1,029,655	1,120,377	1,180,859
19	San Juan	49037	SJ	14,746	15,285	15,644
20	Sanpete	49039	SP	27,822	30,111	31,637
21	Sevier	49041	SE	20,802	21,749	22,380
22	Summit	49043	SU	36,324	41,824	45,491
23	Tooele	49045	TO	58,218	68,213	74,877
24	Uintah	49047	UI	32,588	36,424	38,982
25	Utah	49049	UT	516,564	607,764	668,564
26	Wasatch	49051	WA	23,530	29,057	32,741
27	Washington	49053	WS	138,115	173,303	196,762
28	Wayne	49055	WY	2,778	2,818	2,845
29	Weber	49057	WE	231,236	247,548	258,423
SUM			ALL	2,763,885	3,091,095	3,309,234

UT Governor's Office of Planning and Budget\Demographics\Population Estimates\
<http://governor.utah.gov/dea/popestimates.html>. Go to Demographics\Population Projections\; page
down to "2012 Baseline Projections, Population and Households by Area" to see the population data.



For most pollutants, the majority of non-road mobile source emissions come from miscellaneous non-

road engines. However, emissions of SO_x are higher from aircraft and from diesel locomotives than from miscellaneous non-road engines. In addition, about 54% and 40% of non-road NO_x comes from (MOVES) miscellaneous non-road vehicles and equipment and locomotives, respectively.

iii. Overview

The purpose of this document is to explain how the non-road mobile source emission inventories were created for the “Serious” PM_{2.5} SIP episode days:

- Episode #1: Saturday, January 1 through Wednesday, January 12, 2011 inclusive (12 days);
- Episode #2: Monday, February 1 through Wednesday, February 17, 2016 inclusive (17 days);
- Episode #3: Saturday, December 7 through Thursday, December 19, 2013 inclusive (13 days).

Non-road mobile sources include a) non-road vehicles, equipment and engines from the EPA NONROAD Model (now obsolete, replaced by MOVES/NR); b) aircraft; c) airport ground support equipment (GSE) and d) diesel locomotives.

The non-road mobile source inventories for this SIP were modeled by Utah Division of Air Quality (UDAQ), Inventory Section (formerly Mobile Sources and Transportation Section).

The episode day inventories cover the entire state—all 29 counties. In addition, counties outside Utah were included in the PM_{2.5} SIP domain. The NEI 2011 was used for these counties.

Emissions units for the episode day inventories were the following:

<u>Non-road Sector</u>	<u>Units</u>
Miscellaneous Non-road Vehicles & Equipment (MOVES/NR)	January 2011, February 2016 and December 2013 weekday or weekend days, according to the calendar
Aircraft and Airport Ground Support Equipment	(January emissions) * (365.25/31) = Tons per Year
Diesel Locomotives	2014 Annual Emissions (TPY)

If emissions are not reported in TPY, as was the case for emissions from MOVES, they are converted to TPY before processing in the CAMx air dispersion model. For weekday and weekend days, emissions were converted to TPY as follows:

$$\text{TPY} = (5/7) * \text{Winter Weekday} * 365.25$$

$$\text{TPY} = (2/7) * \text{Winter Wknd Day} * 365.25$$

This is equivalent to the conversion of daily emissions to TPY:

$$\text{TPY} = [(5 * \text{Wkdy} + 2 * \text{Wknd}) / 7] * 365.25$$

The CAMX model then converts the ton-per-year inventories into moles per hour for solids and grams per hour for gases.

EPA guidance requires that states create inventories that use the most recent available data for fleet or equipment characterization, fuel parameters and meteorological data.

Agencies involved in discussions or supplying data include:

Bureau of Transportation Statistics/Transtats/Aviation Databases—commercial aircraft
EPA Office of Transportation and Air Quality: Mobile Team (OTAQ)—general questions
Federal Aviation Administration (FAA)—Emissions and Dispersion Modeling System
FAA Airport Master Records—Airport IQ 5010—aircraft activity for small airports-air taxi and general aviation
Railroad companies operating in Utah—annual reports of locomotive fuel consumption by county
Utah Division of Motor Vehicles (UDMV)—snowmobile inventory for Utah
Utah Transit Authority—commuter rail “Front Runner” activity

Emissions from MOVES/NONROAD (Non-road Vehicles, Equipment and Engines)

Features of MOVES versus EPA NONROAD Model

MOVES2014a was used to obtain emission inventories for non-road mobile vehicles and equipment that operate on unpaved roads or other areas but not on paved roads.

MOVES/NR was run for weekdays and weekend days according to the calendar. Emissions were converted to tons per year as shown above.

MOVES models the same non-road categories as the EPA NONROAD model. For exactly identical inputs, MOVES gives the same results as NONROAD.

However, MOVES models additional compounds that NONROAD does not, including:

CH₄, CO₂, NH₃, major mobile HAPs (1,3-butadiene, acetaldehyde, acrolein, benzene, formaldehyde), polycyclic aromatic hydrocarbons (PAH), various toxic metals, dioxins and furans.

MOVES Inputs for Non-road Mobile Sources

Using MOVES, inputs of fuel (diesel, gasoline, CNG and LPG) and their properties such as ethanol (E-10) volume percent, E-10 market share, E-10 oxygen weight percent, gasoline RVP and fuel sulfur content are supplied from the main MOVES database, movesdb20161117.

Other inputs include temperature and relative humidity data.

The user must use caution to insure that the MOVES default values for such inputs as fuels and temperatures are appropriate. For example, MOVES default temperatures are generally too low for Utah compared to actual temperatures recorded during the past 20 years (1997 – 2016).

Utah obtains meteorological data from one of several reputable websites generally run by colleges and universities in Utah, or from national meteorological websites such as National Climatic Data Center (NCDC) or Western Regional Climate Center (WRCC).

Meteorological data for this inventory came from MESOWEST operated by the University of Utah Department of Atmospheric Sciences (<http://mesowest.utah.edu>). (1)

Aircraft Emissions

Commercial aircraft activity (mostly at Salt Lake City International Airport, but also at other major airports in Utah, including Ogden, Provo, St. George, Cedar City and Wendover), was obtained from Transtats/Bureau of Transportation Statistics (<https://www.transtats.bts.gov/>). Activity data is available for any given historical month, but not for specific days. (2)

The aircraft portion of the inventory includes aircraft and helicopter emissions from all the major and minor airports operating in Utah. The Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System software (EDMS 5.1.4.1) was used to obtain emission factors for aircraft.

In addition to commercial aircraft, the aircraft inventory includes air taxi (mostly privately owned or operated small aircraft), general aviation (small aircraft based at small municipal airports in Utah) and military aircraft. Activity for these aircraft categories comes from the FAA Airport Master Records, found at <http://www.grc1.com/5010web>.

Only three airports are considered major point sources: Salt Lake City International and the military installations Hill Air Force Base in Davis County and Dugway Proving Ground in Tooele County. The vast majority of aircraft emissions in Utah comes from Salt Lake City International.

Aircraft produce significant amounts of CO and SO_x. In fact, the majority of SO_x in the non-road inventory comes from aircraft.

Airport Ground Support Equipment

Airport Ground Support Equipment (GSE) emissions are included in output from EDMS. UDAQ believes the emission factors from EDMS are more accurate than those from the MOVES/NR model. Therefore, MOVES emissions for GSE were removed from the MOVES output to avoid double-counting with EDMS.

Locomotive Emissions

There are six railroad companies operating in Utah. The vast majority of emissions come from Union Pacific Railroad, which operates in seventeen of the 29 counties in Utah.

Locomotives produce significant amounts of NO_x and minor amounts of other pollutants.

Diesel locomotive fuel consumption was reported by the railroads operating in Utah. These reports show annual fuel consumption. Some railroads also report ton-miles by county (Union Pacific Railroad) or miles of track for a round trip, such as reported by AMTRAK and the Utah Transit Authority “Front Runner” commuter rail. Emissions are calculated based on annual diesel fuel consumption.

Federal regulations (Tier IV Non-road Final Rule) require that diesel locomotives operate on ULSD (15 ppm) by 2012. All railroads operating in Utah during 2014 used 15-ppm sulfur diesel except that Salt Lake, Garfield & Western Railway did not return our calls (the latter is an extremely small railroad). For SL, Garfield & Western, diesel sulfur was set to the maximum value of 500 ppm.

See Federal Register and rule text at <https://www.gpo.gov/fdsys/pkg/FR-2004-06-29/pdf/04-11293.pdf>.

Final Comments

PM₁₀ and PM_{2.5} shown above do not include fugitive dust from unpaved roads, which is an Area Source category.

Aircraft emissions from Salt Lake City International Airport are included in the non-road inventory because the point source inventory for SLC Int’l does not include these.

Airport ground support equipment (GSE) emissions from two military bases—Dugway Proving Ground and Hill Air Force Base—are reported in the Point Source inventory. GSE emissions from all other sources are included in this non-road inventory.

A. Episode Inventories

Three episodes were modeled in this inventory:

Saturday, Jan 1 – Wednesday, Jan 12, 2011 inclusive
Monday, Feb 1 – Wednesday, Feb 17, 2016 inclusive
Saturday, Dec 7 – Thursday, Dec 19, 2013 inclusive

MOVES2014 was run for each separate episode day for each of the 29 counties in Utah. Each episode day was modeled as either a weekday or weekend day according to the calendar.

Commercial aircraft were modeled on a monthly scale (Jan 2011, Feb 2016 and Dec 2013) because landing and takeoff (LTO) data is only available by month or year from the U.S. Department of Transportation “Transtats” website. The monthly inventory was converted to tons per year. Air taxi, general aviation and military aircraft inventories were modeled on an annual scale because LTO data is only available for whole calendar years (from FAA).

Airport ground support equipment was modeled alongside each aircraft make and model using the Emissions and Dispersion Modeling System (EDMS) Software (v. 5.1.4.1).

Diesel locomotives were modeled on an annual scale because reports from railroads show diesel fuel consumption for whole years only.

B. Annual Ton-per-Year Summaries

To easily compare emissions from the various sectors and sources, ton-per-year inventories were modeled and summarized.

For the summary tables in the Appendix, MOVES was run for a “peak winter day” by modeling the coldest day in each county during each episode and creating daily inventories. Daily inventories were multiplied by 365.25 to obtain units of tons per year.

Aircraft and locomotive inventories are reported in tons per year as well.

The summary tables include emissions for the following:

Miscellaneous Non-road Engines and Equipment (MOVES2014)
Aircraft
Aircraft Ground Support Equipment
Locomotives
Total Non-road Mobile Source Emissions

C. Comparison of Coldest and Warmest Episode Days—Ton-per-Year Changes in Inventory

In addition, the *warmest* episode day in each of the 29 counties was modeled to observe the effect of temperature on the inventory of miscellaneous non-road equipment and engines (aircraft and locomotive

emissions were modeled on monthly and annual scales, respectively, so these inventories were constant during each day of a given episode).

CO and VOC emissions from nonroad vehicles and equipment in MOVES increase with temperature, while NOx decreases as temperature increases.

For example, the inventories for Salt Lake County on January 1, 2011 (the coldest day) and on January 8, 2011 (the warmest day) are shown below:

Coldest Episode Day

Date: Saturday, Jan 1, 2011

Min, Max and 24-Hour Average Temperatures (F) 6.7 19.9 13.3

County	CO TONS	NOx PER YEAR	PM10	PM2.5	SO2	VOC	NH3
Salt Lake	25,319	3,023	270.3	258.7	7.420	2,149	3.484

Warmest Episode Day

Date: Saturday, Jan 8, 2011

Min, Max and 24-Hour Average Temperatures (F) 19.0 25.0 22.0

County	CO TONS	NOx PER YEAR	PM10	PM2.5	SO2	VOC	NH3
Salt Lake	25,561	2,995	270.3	258.7	7.420	2,151	3.484

v. Non-road Emissions Sources and Models

- A. Miscellaneous Engines & Equipment EPA MOVES2014a Model (October 2015)
- B. Aircraft (emissions per landing/
cycle or LTO) Federal Aviation Administration “Emissions and takeoff
Dispersion Modeling System” (EDMS), version
5.1.4.1
- 1. Air Carriers (Commercial) Bureau of Transportation Statistics (BTS)
Transtats” website (2):
<http://www.transtats.bts.gov/>
Number of commercial landings and takeoffs
- 2. Air Taxi, General Aviation FAA “Airport Master Records” by Airport (3)
<http://www.grc1.com/5010web>
and consultation with UT Div. of Aeronautics:
number of air taxi and general aviation takeoffs and
landings (LTOs)

3. Military Aircraft

U.S. Dugway Proving Ground (annual report)
U.S. Hill Air Force Base (annual report)
FAA “Airport Master Records” and consultation
with UT Div. of Aeronautics: number of military aircraft

takeoffs and landings (LTOs)

C. Diesel Locomotives

Railroad Companies (reports from):
AMTRAK
Salt Lake, Garfield and Western Railway
Union Pacific Railroad (includes activity from
Burlington Northern Santa Fe)
Utah Railway Company
Utah Transit Authority (commuter rail): diesel fuel
consumption by county and locomotive type: line-
haul, yard and commuter

vi Non-road Miscellaneous Engines and Equipment (MOVES2014a)

The EPA MOVES2014a Model (October 2015) was used to compute non-road emissions.

The current version of MOVES produces identical non-road emissions to those from the EPA NONROAD Model if inputs are the same.

“MOVES” calculates emissions for twelve non-road categories:

- Agricultural Equipment
- Airport Ground Support Equipment
- Commercial Equipment
- Construction Equipment
- Industrial Equipment
- Lawn & Garden Equipment
- Logging Equipment
- Oil Field Miscellaneous Equipment
- Pleasure Craft
- Railroad Miscellaneous Equipment
- Recreational Equipment
- Underground Mining Equipment

Commercial marine equipment, locomotives, and aircraft are not modeled by MOVES2014a (small personal watercraft are included).

MOVES output includes the usual pollutants carbon monoxide (CO), nitrogen oxides (NO_x), PM10 and PM2.5 exhaust, sulfur dioxide (SO₂), volatile organic compounds (VOC) and ammonia (NH₃).

In addition, a large number of Hazardous Air Pollutants (HAPs) can be modeled.

For this SIP, the Air Modeling Section requested that Total Organic Gases (TOG), benzene, toluene and xylene also be modeled for analysis by the CAMx air dispersion model. Emissions for these pollutants and compounds are not reported in this document.

The model can output emissions by category and equipment type, fuel and engine type (e.g., 2-stroke and 4-stroke gasoline, diesel, CNG and LPG, including horsepower rating and SCC code).

For each episode, emissions were computed for each separate episode day as either a winter weekday or a winter weekend day. Output units were grams per winter weekday or grams per winter weekend day. Output was organized into “SMOKE” format and transferred to the CAMx air dispersion model for analysis of pollutant concentrations.

In addition, the coldest episode day in each county was modeled, and output was converted to units of tons per year so comparisons of the inventory between counties and calendar years could easily be made. NO_x emissions increase as temperature decreases, while CO and VOC increase with temperature. In the non-road module of MOVES, emissions of PM₁₀ and PM_{2.5} exhaust, NH₃ and SO₂ are generally insensitive to small temperature changes. For the PM problem along the Wasatch Front, it is believed that PM, NO_x and VOC are the most important pollutants.

However, NONROAD emissions are sensitive to the choice of weekday versus weekend day. Annual average emissions were calculated by the following equation:

$$\text{Annual avg emissions (TPY)} = [(\text{average weekday} * 5 + \text{average weekend days} * 2) / 7] * 365.25$$

A. Input Data

Unlike the EPA NONROAD Model, it is not necessary to manually input fuel parameters such as RVP, ethanol content, sulfur content, etc. Instead, the GUI selections automatically choose the correct fuel parameters from the default database based on the county, years, months and days modeled.

The user must use caution to insure that the MOVES default values for such inputs as fuels and temperatures are appropriate. UDAQ reviewed all data used from the MOVES default database to insure that inputs were correct.

For example, MOVES default temperatures are generally too low for Utah compared to actual temperatures recorded during the past 20 years (1997 – 2016).

Therefore, hourly temperature data by episode day and county were gathered from the University of Utah Department of Atmospheric Sciences “MESOWEST” meteorological website and were input into the model instead of using default meteorological data in the “zonemonthhour” table (<http://mesowest.utah.edu>). (1)

B. Hourly Temperatures by Episode Day and County

January 1 - 12, 2011 Episode

FIPs	County Name	Coldest Day	24-Hr Min T (F)	24-Hr Max T (F)	Warmest Day	24-Hr Min T (F)	24-Hr Max T (F)
49003	Box Elder	010411	-4.60	12.70	010811	6.50	21.70
49005	Cache	010401	-4.60	12.70	010811	6.50	21.70
49011	Davis	011211	11.90	17.10	010811	20.00	26.50
49035	Salt Lake	010111	6.70	19.90	010811	19.00	25.00
49045	Tooele	010111	1.40	19.40	010311	15.80	24.80
49049	Utah	010111	1.40	17.60	010911	14.60	24.80
49057	Weber	010111	6.80	19.30	010811	18.30	25.00

For the 22 PM2.5 attainment counties, temperatures from Salt Lake County were modeled.

Data for Box Elder County was not available, so Cache County data was used.

February 1 - 17, 2016 Episode

FIPs	County Name	Coldest Day	24-Hr Min T (F)	24-Hr Max T (F)	Warmest Day	24-Hr Min T (F)	24-Hr Max T (F)
49003	Box Elder	020216	-4.80	17.80	021616	33.40	48.40
49005	Cache	020216	-4.80	17.80	021616	33.40	48.40
49011	Davis	020216	15.10	29.80	021716	35.10	58.20
49035	Salt Lake	020216	15.30	27.90	021716	37.40	59.90
49045	Tooele	020316	8.40	25.70	021716	33.60	55.90
49049	Utah	020316	11.30	27.10	021716	29.30	58.70
49057	Weber	020216	9.00	24.70	021716	36.60	52.90

December 7 - 19, 2013 Episode

FIPs	County Name	Coldest Day	24-Hr Min T (F)	24-Hr Max T (F)	Warmest Day	24-Hr Min T (F)	24-Hr Max T (F)
49003	Box Elder	120913	-10.4	8.1	121913	19.0	30.4
49005	Cache	120913	-10.4	8.1	121913	19.0	30.4
49011	Davis	120913	-0.8	17.1	121913	26.8	33.0
49035	Salt Lake	120913	3.9	18.4	121913	28.0	33.7
49045	Tooele	120913	-0.4	18.4	121913	26.6	30.2
49049	Utah	121013	-2.2	12.2	121913	29.6	39.2
49057	Weber	120913	3.9	18.4	121913	26.1	33.1

C. Snowmobile Adjustments (MOVES2014a)

As previously mentioned, MOVES2014a computes identical emissions to those from the EPA NONROAD Model if inputs are the same.

The discussion below sometimes refers to the EPA NONROAD Model because this model was in use when the underlying database for snowmobiles was adjusted to match local survey data.

In MOVES2014a, a folder named “nrsnowmobilefiles” was added to the MySQL data folder to store changes made to the default snowmobile tables.

The following tables were created to store local data for snowmobiles, which replaces default data:

Nrstatesurrogate

Nrbaseyearequippopulation

Nrgrowthindex

Nrmonthallocation

UDAQ reviewed the PM2.5 SIP inventories from the EPA NONROAD model for the 2008 base year and projection years 2014, 2017 and 2019. This showed that, in several counties, a large majority of VOC emissions from equipment in the NONROAD model were emitted by snowmobiles, as shown below:

Calendar Year	County	FIPs	VOC from Snowmobiles (Tons per Win Wkdy)	VOC from NR Model (Tons per Win Wkdy)	Percent from Snowmobiles (%)
2008	Cache	49005	0.262	0.617	42.5
2008	Duchesne	49013	1.085	1.243	87.3
2008	Morgan	49029	2.186	2.206	99.1
2008	Rich	49033	8.290	8.437	98.3
2008	Summit	49043	0.502	0.788	63.7
2008	Wasatch	49051	0.955	1.026	90.2

At the same time, other counties in the domain showed zero VOC emissions from snowmobiles in the EPA NONROAD model.

1. Reallocation of Snowmobile Counts in NONROAD Database (File “nrstatesurrogate”)

Questioning the accuracy of the output, UDAQ obtained recent survey data on snowmobile activity from two agencies. The survey data showed that the true number of snowmobiles by county were very different from the allocation in the NONROAD database. (4, 5)

Therefore, snowmobile counts were reallocated among the counties based on survey data. This was done by modifying the file “nrstatesurrogate” found in the database “movesdb20151028”. For details of changes to the file “nrstatesurrogate”, see the Appendix.

2. Utah Snowmobile Population Changed in MOVES2014a Database (File “nrbaseyearequippopulation”)

The NONROAD file “nrbaseyearequippopulation” shows the default number of snowmobiles in Utah as of calendar year 1999.

UDAQ obtained counts of registered snowmobiles by county from the Utah Tax Commission for calendar years 2008 through 2014. (6)

From the above data, the Utah snowmobile population for calendar year 1999 was estimated. From Tax Commission data, it was found that Utah had about 36,100 snowmobiles in 1999. The default value in the NR file “nrbaseyearequippopulation” showed only 25,729 snowmobiles in Utah.

Therefore, the counts of snowmobiles in the “nrbaseyearequippopulation” file were changed. Details of changes to this file are shown in the Appendix.

3. Utah Snowmobile Counts in Future Years Changed in MOVES2014a Database (File “nrgrowthindex”)

The NR file “nrgrowthindex” determines counts of equipment in future years.

Because the snowmobile count in the base year (1999) was changed in the NR model, it was necessary to adjust snowmobile counts in future years. This was done by changing the growth numbers in the “nrgrowthindex” file.

Details of changes to the “nrgrowthindex” file are shown in the appendix.

4. Snowmobile Seasonality Changed in MOVES2014a Database (File “nrmonthallocation”)

The NR default file “nrmonthallocation” shows that snowmobile occurs evenly over the months of January, February and December, as denoted by the values (0.333, 0.333, 0.333).

Snowmobile surveys showed that actual activity in Utah is spread evenly over the months from December through April.

Therefore, the “nrmonthallocation” values were changed to (0.200, 0.200, 0.200, 0.200 and 0.200) for the respective months of December through April.

In summary, default values in the following files must be changed for snowmobiles:

File Name	Description
nrstatesurrogate	Relative number of snowmobiles by county in calendar year 2002

nrbaseyearequippopulation	Snowmobile counts by county and source type ID: source type IDs for snowmobiles include: 1002 – 1010
nrgrowthindex	Snowmobiles have growth pattern ID = 98.
nrmonthallocation	Relative snowmobile activity by month

5. Additional MOVES2014a Files Related to Snowmobiles

In addition to changing the default values in the above tables affecting snowmobiles, the following files contain information relevant to snowmobiles, but default values need not be changed. These files help identify source type, growth pattern, and surrogate IDs for snowmobiles.

File Name	Description
nrsourceusetype	Source type IDs by SCC and HP range: snowmobiles are identified as source type IDs 1002 – 1010.
nrgrowthpattern	Growth pattern ID = 98 identifies snowmobiles
nrsurrogate	Surrogate ID = 14 identifies residential snowmobiles

6. No Additional Changes to the MOVES2014a Database

No other changes were made to the MOVES2014a default database.

vii Aircraft

The aircraft source category includes all aircraft types used for public, private, and military purposes. Aircraft emissions inventories are grouped by type of operation rather than aircraft type. Four types of aircraft activity are included: commercial, air taxi, general aviation and military aircraft.

A. Four Main Operation Types for Aircraft

<u>Operation Type</u>	<u>Description</u>	<u>Source of Emission Factors</u>	<u>SCC Code Groups</u>
Commercial Flights/Air Carriers	Operations at Salt Lake City International Airport and smaller municipal airports.	EDMS and EPA guidance documents for PM from commercial aircraft	2275000000

Air Taxi	Small privately-owned commuter planes	EDMS and EPA guidance documents for air taxi	2275000000
General Aviation Based Aircraft	Small municipal airport operations (aircraft are "based" in small cities and towns)	EDMS and EPA guidance documents for general aviation	2275000000
Military Aircraft	Military operations	Military installations and EPA guidance	2275000000

B. Aircraft Activity (Landings and Takeoffs, or LTOs)

For each type of aircraft operation shown above, the first step is to gather the numbers of landings and takeoffs during the relevant time period.

One common error is to count each landing or takeoff as a complete LTO. This is *incorrect*. Instead, one LTO cycle consists of one landing and one takeoff, so care must be taken to observe how aircraft activity is reported. In short, activity from the U.S. DOT BTS "Transtats" website reports commercial activity as separate landings and takeoffs, so the total number of these must be divided by two to obtain LTOs. FAA also reports activity as separate landings and takeoffs. The EDMS emission model assumes that the input is in LTO units.

For air taxis, general aviation, and military aircraft, only annual activity data are available. Annual activity is reported by the FAA on its "Airport Master Records". These records are updated periodically. Some of the airport records have not been updated since 2010, while others are current to December 31, 2015. For those records that are not up-to-date, FAA scaling factors were used to adjust the number of LTOs to the calendar years being modeled (2011, 2016 and 2013). (7)

C. Aircraft Types

1. Commercial

Commercial activity from the U.S. DOT "Transtats" website reports landings and takeoffs by aircraft type using a unique 3-digit code for each aircraft type.

Commercial aircraft landings and takeoffs can be downloaded from the Bureau of Transportation Statistics (BTS) "Transtats" website at <http://www.transtats.bts.gov/> as follows:

Under "Aviation", one chooses "Air Carrier Statistics - Form 41 Traffic - All Carriers", and then "T-100 Domestic Segment—All Carriers". Next, choose "T-100 Domestic Segment (U.S. Carriers)". In

the lower right-hand corner of the box, click on “Download”. At the top of the screen, under “Download Instructions”, choose the state, calendar year and month. For this SIP, calendar years and months were January 2011, December 2013, and February 2016. In addition to the boxes already checked, put a check mark in front of the following parameters:

Aircraft Type
Origin City Name
Destination City Name
Departures Performed

Each “departure performed” is either an arrival or a departure. One landing-takeoff cycle (LTO) consists of one departure and one arrival pair. There were 9,614 LTO cycles that took place in January 2011 where the origin or destination was in Utah.

The vast majority of commercial aircraft activity in Utah takes place at Salt Lake City International Airport. There are about 50 additional smaller municipal airports in the state, but only about ten municipal airports handle commercial aircraft. Based on January 2011 activity, there were about 113,000 commercial LTOs in Utah during the entire 2011 calendar year.

2. Air Taxi and General Aviation

The Utah Department of Transportation, Division of Aeronautics, no longer reports aircraft activity for air taxi and general aviation operations. Instead, activity is reported on FAA “Airport Master Records” for each separate airport in Utah at <http://www.gcr1.com/5010web/>.

As with commercial aircraft, these records report separate landings and takeoffs, so the total must be divided by two to obtain the number of LTOs.

For General Aviation, the Airport Master Record shows, for each airport, the number of based aircraft of each general type: single-engine, multi-engine, and jets. Single- and multi-engine aircraft operate on aviation fuel, which is similar to gasoline, while jets operate on jet fuel. Aircraft refueling emissions are reported in the Area Source inventory.

The Utah Division of Aeronautics was consulted to determine the specific aircraft types used under each general aircraft type—single- and multi-engine and jets.

For Air Taxi, the Airport Master Record for each airport shows the number of landings and takeoffs. The Utah Division of Aeronautics was consulted to determine the specific aircraft types used for air taxis.

3. Military

There are only two major military airports in Utah, each of which sends annual reports of aircraft activity and the inventory to UDAQ:

Hill Air Force Base (Davis County)
Dugway Proving Ground (Tooele County)

However, the Airport Master Records show that about seven small municipal airports have military aircraft activity.

Statewide Aircraft LTOs by Calendar Year, Month and Operational Type (Annualized to LTOs per Year)

<u>Calendar Year and Month</u>	<u>Commercial Monthly LTOs</u>	<u>Commercial Annual LTOs*</u>	<u>Air Taxi</u>	<u>General Aviation</u>	<u>Military</u>	<u>SUM</u>
Jan 2011	9,614	113,275	61,752	252,108	22,353	449,488
Feb 2016	9,698	114,264	49,013	390,463	25,195	578,935
Dec 2013	9,750	114,877	73,637	328,892	29,859	547,265

*Annual commercial LTOs were obtained by multiplying monthly LTOs by (365.25/31).

D. Emissions and Dispersion Modeling System (EDMS) Software

The EDMS model (v. 5.1.4.1) was used to obtain emissions from the numerous aircraft types in the inventory.

The user enters the calendar year and name of airport. A list of all the aircraft and engine types opens, and the user selects the specific aircraft type (and engine type if known—otherwise, the default engine type for the aircraft type is chosen). Then, the number of LTOs (separate landings and takeoffs divided by two) is entered. The entire list of aircraft and engine types operating at a particular airport is entered. The user then merely chooses “Update”, and the inventory is generated in the units chosen by the user.

Sensitivity tests showed that the location of the airport has almost no effect on emissions, so Salt Lake City International Airport was selected as the default location.

Emissions reported include CO, NOX, PM10 and PM2.5 exhaust, SO2 and VOC, but not NH3.

NEI 2014 Aircraft Inventory and Activity Scaling Factors to Calendar Years 2011, 2013 and 2016

EDMS 5.1.4.1 was run for the NEI 2014 for all 29 counties. Sensitivity tests showed that the emission factors did not change for a given aircraft and engine type when the calendar year was changed. Therefore, to obtain emissions for 2011, 2013 and 2016, FAA scaling factors were used to adjust the aircraft activity to the calendar year needed. Scaling factors are shown in the FAA Appendix item “Total Combined Aircraft Operations at Airports”, Table 32 (shows activity for historical years 2007 – 2015, and projected activity for calendar years 2015 – 2035). (7)

E. Airport Ground Support Equipment (GSE)

Aircraft ground support emissions (GSE) are generated from the EDMS 5.1.41 model at the same time that aircraft tailpipe emissions are generated.

For example, when a particular aircraft type is modeled in EDMS, the number of landing and takeoff (LTO) cycles is input. The model automatically generates, in addition to aircraft emissions, ground support equipment emissions from this activity.

GSE emissions from two point sources—Hill Air Force Base and Dugway Proving Ground—are reported in the Point Source inventories from these sources. GSE emissions from these sources will not be modeled by UDAQ using EDMS. Care will be taken that these emissions are not double-counted.

viii. Diesel Locomotives

The locomotive source category includes railroad locomotives powered by diesel-electric engines and does not include locomotives powered by electricity or steam.

All of the criteria pollutants, VOC, CO, NO_x, SO_x, PM10, PM2.5 and NH₃ are included in the locomotive inventory. Emissions were estimated by applying emission factors to the total amount of diesel fuel used by locomotives. Emission factors for the criteria pollutants were obtained from the EPA guidance document “Emission Factors for Locomotives” (April 2009). (8)

For NH₃, the EPA document “Documentation for Locomotive Component of the National Emissions Inventory Methodology” (May 2011) was used. (9)

About 90% of locomotive emissions come from Union Pacific Railroad. The second-highest source of locomotive emissions is the Utah Transit Authority commuter rail, the “Front Runner”. Commuter rail currently runs from Ogden in the north (Weber County to Provo in the south (Utah County).

The sulfur content of locomotive diesel fuel affects emissions. UDAQ requested railroad companies to report the sulfur content of diesel fuel along with the volume of fuel used.

Diesel locomotives are grouped by two operations: line haul and yard, or switch.

Emissions from diesel locomotives were reported to UDAQ by the individual railroad companies that operate in Utah. For 2011 and 2014, these companies include Amtrak, Burlington Northern Santa Fe Railway (BNSF), Salt Lake, Garfield & Western Railway, Union Pacific Railroad Company (UPRR), Utah Railway and Utah Transit Authority (UTA)--commuter rail operations.

To estimate diesel fuel consumption for the 2013 and 2016 episodes, scaling factors were applied.

For projections of commuter/passenger diesel fuel consumption, scaling factors were obtained from an AMTRAK report, "AMTRAK Fleet Strategy, v. 3.1". Passenger growth was projected at 2% per year. Thus diesel fuel consumption was projected to increase 2% per year as well. (10)

For projections of freight diesel fuel consumption, scaling factors were obtained from the report by U.S. DOE, Energy Efficiency & Renewable Energy, "Freight Transportation Demand: Energy-Efficient Scenarios for a Low-Carbon Future", 2012. Line-haul diesel fuel consumption was projected by using projections of ton-miles of freight through 2030. (11)

ix Output

A. MOVES2014a

In order to capture the day-to-day emissions profile of the non-road inventory, MOVES was run for each of the 29 counties in Utah for each separate episode day. For example, the first episode ran from Saturday, January 1 through Wednesday, January 12, 2011. Saturdays and Sundays were modeled separately as January weekend days, and Monday through Fridays were modeled separately as January weekdays. Hourly temperature and relative humidity data were input into the model to reflect actual meteorology.

The resulting output in units of grams per January weekday or weekend day were compatible for input into the CAMX air dispersion model.

B. Aircraft (EDMS v. 5.1.4.1)

Commercial aircraft activity (landings and takeoffs, or LTOs) were downloaded for the month and calendar year of each episode. Daily LTO activity for commercial aircraft is not available on the U.S. DOT Bureau of Transportation Statistics (BTS) "Transtats" website, so monthly activity was captured.

For air taxi, general aviation and military aircraft LTOs, only annual data is available from FAA.

Thus the aircraft portion of the inventory is reported in units of tons per year, where the January inventory for commercial aircraft use the conversion factor of (365.25/31) to obtain TPY from January tons.

The final aircraft inventory is reported in tons per year.

Aircraft GSE emissions were also reported in tons per year.

C. Diesel Locomotives

Reports submitted by railroads included diesel fuel consumed by locomotives by county. Emissions were computed by applying EPA emission factors in units of grams per gallon consumed.

Locomotive diesel fuel consumption was reported on an annual scale only, so the units of locomotive emissions are tons per year.

Union Pacific Railroad is by far the largest railroad operating in Utah.

x. APPENDIX ITEMS

1. January 2011 Non-road Mobile Source Inventory Summaries

a. Miscellaneous Non-road Engines and Equipment from MOVES2014a (formerly EPA NONROAD Model)

2011 Tons per Year Based on January 2011 Episode
05/09/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	111.0	22.47	2.162	2.079	0.0538	10.47	0.0243
Box Elder	49003	2,361	331.4	25.05	23.78	1.005	496.6	0.3510
Cache	49005	3,117	418.4	47.30	44.95	1.126	711.8	0.5589
Carbon	49007	979.4	131.8	19.01	18.13	0.3360	254.7	0.1764
Daggett	49009	339.2	9.916	4.183	3.866	0.0651	141.6	0.0434
Davis	49011	4,912	869.4	77.76	74.63	2.259	542.9	0.9892
Duchesne	49013	595.4	59.05	7.506	7.097	0.1669	125.0	0.0863
Emery	49015	428.0	96.08	13.31	12.74	0.2343	142.2	0.1155

Garfield	49017	687.1	53.95	11.04	10.33	0.1836	241.6	0.1019
Grand	49019	951.4	50.27	12.15	11.31	0.1698	290.8	0.1047
Iron	49021	963.9	142.9	16.06	15.29	0.3872	213.0	0.1912
Juab	49023	393.2	42.33	5.604	5.297	0.1250	99.70	0.0647
Kane	49025	619.9	41.57	7.806	7.273	0.1576	198.5	0.0758
Millard	49027	557.8	82.49	7.302	6.948	0.2585	127.7	0.0967
Morgan	49029	154.8	25.82	2.106	2.032	0.0627	10.39	0.0287
Piute	49031	103.4	6.399	1.480	1.382	0.0282	42.17	0.0168
Rich	49033	1,392	43.43	17.69	16.37	0.2703	572.0	0.1862
Salt Lake	49035	25,319	3,023	270.3	258.7	7.420	2,149	3.484
San Juan	49037	519.6	41.22	6.097	5.705	0.1441	142.9	0.0648
Sanpete	49039	814.2	60.95	11.23	10.53	0.2134	269.9	0.1244
Sevier	49041	783.4	153.4	20.10	19.22	0.3589	181.0	0.1717
Summit	49043	2,553	206.6	37.76	35.47	0.7402	841.9	0.4301
Tooele	49045	901.0	153.3	13.19	12.59	0.4695	184.9	0.1795
Uintah	49047	1,241	137.9	13.06	12.41	0.3846	192.0	0.1932
Utah	49049	7,377	1,286	120.5	115.6	3.252	862.8	1.469
Wasatch	49051	1,890	114.8	28.05	26.21	0.5130	774.8	0.3214
Washington	49053	3,244	557.2	59.98	57.30	1.463	492.1	0.6844
Wayne	49055	213.8	15.33	3.241	3.031	0.0481	67.00	0.0274
Weber	49057	5,215	585.0	64.76	61.51	1.591	925.4	0.7842
TOTAL		68,738	8,762	925.8	881.7	23.49	11,305	11.15

b. Aircraft Emissions

2011 Tons per Year Based on January 2011 Episode
04/27/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	40.67	0.0337	0.1117	0.1117	0.0502	0.5332	N/A
Box Elder	49003	228.5	0.2467	0.6300	0.6300	0.2984	4.562	N/A
Cache	49005	529.0	1.213	1.690	1.690	0.8984	27.16	N/A
Carbon	49007	49.35	0.2032	0.1449	0.1449	0.1098	1.891	N/A
Daggett	49009	20.17	0.0175	0.0554	0.0554	0.0252	0.2706	N/A
Davis	49011	570.7	67.73	17.42	15.75	4.043	39.13	N/A
Duchesne	49013	79.65	0.0520	0.2124	0.2124	0.0922	1.014	N/A
Emery	49015	63.16	0.1223	0.1775	0.1775	0.0991	1.364	N/A
Garfield	49017	80.34	0.1142	0.2250	0.2250	0.1138	1.905	N/A
Grand	49019	60.22	0.1604	0.1733	0.1733	0.1087	1.739	N/A
Iron	49021	147.4	1.879	0.5181	0.5181	0.5760	11.02	N/A
Juab	49023	38.65	0.1021	0.1192	0.1192	0.0712	1.918	N/A

Kane	49025	37.63	0.0321	0.1002	0.1002	0.0456	0.5459	N/A
Millard	49027	44.78	0.0417	0.1232	0.1232	0.0567	0.6223	N/A
Morgan	49029	49.68	0.0369	0.1351	0.1351	0.0596	0.7655	N/A
Piute	49031	9.926	0.0050	0.0271	0.0271	0.0113	0.1051	N/A
Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Salt Lake	49035	3,567	808.7	22.29	22.29	101.9	392.5	N/A
San Juan	49037	108.4	0.0828	0.2735	0.2735	0.1235	1.685	N/A
Sanpete	49039	28.54	0.0660	0.0995	0.0995	0.0495	1.637	N/A
Sevier	49041	112.8	0.0832	0.3092	0.3092	0.1362	1.400	N/A
Summit	49043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Tooele	49045	170.8	6.374	0.9542	0.9542	0.8932	19.35	N/A
Uintah	49047	122.4	0.1780	0.3192	0.3192	0.1676	2.681	N/A
Utah	49049	1,458	5.675	4.310	4.310	2.575	74.81	N/A
Wasatch	49051	224.1	0.9174	0.8683	0.8683	0.5113	20.42	N/A
Washington	49053	377.1	4.135	1.182	1.182	1.147	13.41	N/A
Wayne	49055	31.80	0.0263	0.0873	0.0873	0.0393	0.4165	N/A
Weber	49057	834.0	2.900	2.603	2.603	1.457	39.86	N/A
TOTAL		9,085	901.2	55.15	53.48	115.7	662.7	N/A

c. Airport Ground Support Equipment Emissions
2011 Tons per Year Based on January 2011 Episode

County Number	County Name	County FIPs	EMISSIONS (TPY)					
			CO	NOX	PM10	PM2.5	SOX	VOC
1	Beaver	49001	0.092017	0.022407	0.000293	0.000259	0.000236	0.006426
2	Box Elder	49003	0.355435	0.105491	0.001105	0.000978	0.000893	0.029486
3	Cache	49005	3.437718	0.445540	0.007875	0.006732	0.009517	0.149792
4	Carbon	49007	1.159697	0.119574	0.003900	0.003450	0.003150	0.040881
5	Daggett	49009	0.050790	0.011568	0.000163	0.000144	0.000131	0.003350
6	Davis	49011	0.196813	0.153215	0.000488	0.000431	0.000394	0.039677
7	Duchesne	49013	0.106237	0.035552	0.000325	0.000288	0.000263	0.009804
8	Emery	49015	0.594703	0.074626	0.001983	0.001754	0.001601	0.024242
9	Garfield	49017	0.240708	0.047299	0.000780	0.000690	0.000630	0.014022

10	Grand	49019	1.031093	0.107086	0.002977	0.002677	0.002807	0.037513
11	Iron	49021	4.822183	0.497184	0.016662	0.015203	0.013728	0.167397
12	Juab	49023	0.033189	0.014180	0.000098	0.000086	0.000079	0.003820
13	Kane	49025	0.100798	0.021048	0.000325	0.000288	0.000263	0.006178
14	Millard	49027	0.131010	0.027290	0.000423	0.000374	0.000341	0.008013
15	Morgan	49029	0.025578	0.018660	0.000065	0.000058	0.000053	0.004848
16	Piute	49031	0.001353	0.003608	0.000000	0.000000	0.000000	0.000902
17	Rich	49033	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
18	Salt Lake	49035	610.765419	61.245073	2.114193	2.007810	1.947858	20.375831
19	San Juan	49037	0.252579	0.054940	0.000977	0.000884	0.000656	0.015629
20	Sanpete	49039	0.284639	0.033300	0.000606	0.000513	0.000796	0.011607
21	Sevier	49041	0.188325	0.056258	0.000585	0.000518	0.000473	0.015713
22	Summit	49043	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
23	Tooele	49045	3.789904	0.445267	0.013852	0.012784	0.010287	0.139895
24	Uintah	49047	1.115610	0.126072	0.003003	0.002722	0.003029	0.043510
25	Utah	49049	9.158310	1.140756	0.022759	0.020080	0.026081	0.380429
26	Wasatch	49051	4.224790	0.423094	0.010192	0.008752	0.011800	0.152826
27	Washington	49053	4.802768	0.593510	0.016008	0.015482	0.014936	0.189213
28	Wayne	49055	0.071592	0.017489	0.000228	0.000201	0.000184	0.005013
29	Weber	49057	5.257448	0.687777	0.011846	0.010349	0.015140	0.229546
ALL	GRAND	652.3	66.53	2.232	2.114	2.065	22.11	

d. Locomotive
Emissions
2011 Tons per Year Based on January 2011 Episode
04/27/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	46.26	258.9	7.646	7.416	2.404	13.38	0.1447
Box Elder	49003	114.4	640.2	18.90	18.34	5.943	33.08	0.3579
Cache	49005	5.847	32.72	0.9663	0.9373	0.3038	1.691	0.0183
Carbon	49007	45.72	257.2	7.563	7.336	3.820	13.25	0.1430
Daggett	49009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Davis	49011	68.35	391.0	11.35	11.01	3.150	20.07	0.2137
Duchesne	49013	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Emery	49015	16.42	93.10	2.721	2.639	0.7685	4.777	0.0514
Garfield	49017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Grand	49019	28.09	159.5	4.656	4.516	1.297	8.176	0.0879

Iron	49021	62.54	350.0	10.34	10.03	3.249	18.09	0.1957
Juab	49023	60.47	338.4	9.993	9.694	3.142	17.49	0.1892
Kane	49025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Millard	49027	99.00	554.0	16.36	15.87	5.143	28.63	0.3097
Morgan	49029	52.34	292.9	8.650	8.391	2.720	15.14	0.1638
Piute	49031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Salt Lake	49035	109.3	718.1	18.95	18.38	4.752	38.58	0.3380
San Juan	49037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sanpete	49039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sevier	49041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Summit	49043	90.05	504.0	14.88	14.44	4.679	26.04	0.2817
Tooele	49045	121.3	681.9	20.06	19.46	6.074	35.15	0.3794
Uintah	49047	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Utah	49049	64.75	371.6	10.77	10.45	3.617	19.28	0.2023
Wasatch	49051	4.336	24.27	0.7166	0.6951	0.4307	1.254	0.0136
Washington	49053	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Wayne	49055	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Weber	49057	74.82	443.1	12.57	12.19	3.753	23.30	0.2331
TOTAL		1,064	6,111	177.1	171.8	55.25	317.4	3.324

e. TOTAL Non-road Mobile Source Inventory (Misc. NONROAD Engines, Aircraft, GSE and Locomotives)

2011 Tons per Year Based on January 2011 Episode

05/09/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	198.0	281.4	9.920	9.608	2.508	24.39	0.1691
Box Elder	49003	2,704	972.0	44.59	42.75	7.248	534.3	0.7089
Cache	49005	3,656	452.7	49.96	47.58	2.337	740.8	0.5772
Carbon	49007	1,076	389.4	26.72	25.61	4.269	269.8	0.3195
Daggett	49009	359.4	9.945	4.239	3.921	0.0904	141.9	0.0434
Davis	49011	5,551	1,328	106.5	101.4	9.452	602.1	1.203
Duchesne	49013	675.2	59.14	7.719	7.310	0.2594	126.1	0.0863
Emery	49015	508.1	189.4	16.21	15.56	1.103	148.4	0.1668
Garfield	49017	767.7	54.11	11.27	10.56	0.2980	243.5	0.1019
Grand	49019	1,041	210.0	16.98	16.00	1.578	300.8	0.1926

Iron	49021	1,179	495.3	26.93	25.85	4.226	242.2	0.3869
Juab	49023	492.4	380.9	15.72	15.11	3.338	119.1	0.2539
Kane	49025	657.6	41.62	7.906	7.374	0.2035	199.1	0.0758
Millard	49027	701.7	636.6	23.79	22.94	5.459	157.0	0.4065
Morgan	49029	256.8	318.8	10.89	10.56	2.842	26.30	0.1925
Piute	49031	113.3	6.407	1.507	1.409	0.0395	42.28	0.0168
Rich	49033	1392.5	43.43	17.69	16.37	0.2703	572.0	0.1862
Salt Lake	49035	29,606	4,612	313.6	301.3	116.0	2,601	3.822
San Juan	49037	628.3	41.36	6.371	5.980	0.2683	144.6	0.0648
Sanpete	49039	843.1	61.05	11.33	10.63	0.2637	271.5	0.1244
Sevier	49041	896.4	153.5	20.41	19.53	0.4956	182.4	0.1717
Summit	49043	2,643	710.5	52.64	49.91	5.419	867.9	0.7118
Tooele	49045	1,197	842.0	34.22	33.02	7.447	239.6	0.5590
Uintah	49047	1,364	138.2	13.38	12.74	0.5552	194.7	0.1932
Utah	49049	8,910	1,664	135.7	130.3	9.471	957.3	1.672
Wasatch	49051	2,123	140.4	29.65	27.78	1.467	796.6	0.3350
Washington	49053	3,626	562.0	61.17	58.49	2.624	505.6	0.6844
Wayne	49055	245.7	15.38	3.329	3.119	0.0876	67.43	0.0274
Weber	49057	6,129	1,032	79.94	76.32	6.816	988.8	1.017
TOTAL		79,539	15,841	1,160	1,109	196.5	12,307	14.47

2. February 2016 Non-road Mobile Source Inventory Summaries

a. Miscellaneous Non-road Engines and Equipment from MOVES2014a (formerly EPA NONROAD Model)

2016 Tons per Year Based on February 2016 Episode
05/10/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	113.9	18.52	1.779	1.705	0.0258	10.00	0.0295
Box Elder	49003	2,064	278.8	18.78	17.83	0.5519	360.6	0.4091
Cache	49005	2,585	312.9	36.57	34.69	0.6300	532.6	0.6303
Carbon	49007	849.8	124.6	15.86	15.14	0.1948	186.7	0.1933
Daggett	49009	277.8	10.51	3.211	2.967	0.0516	103.5	0.0419
Davis	49011	4,787	663.8	62.81	60.09	1.119	478.1	1.204

Duchesne	49013	601.7	49.15	6.082	5.739	0.1024	103.3	0.1004
Emery	49015	346.3	92.15	11.02	10.56	0.1190	103.5	0.1278
Garfield	49017	707.8	45.45	8.878	8.297	0.1236	201.3	0.1189
Grand	49019	1,040	43.03	10.13	9.412	0.1390	253.3	0.1255
Iron	49021	847.2	111.0	12.50	11.89	0.2070	161.7	0.2186
Juab	49023	367.2	34.82	4.438	4.189	0.0738	77.51	0.0727
Kane	49025	655.5	37.90	6.329	5.892	0.1088	166.2	0.0899
Millard	49027	541.4	74.84	5.602	5.332	0.1378	96.77	0.1139
Morgan	49029	156.2	20.40	1.685	1.622	0.0325	8.758	0.0350
Piute	49031	76.85	6.049	1.110	1.036	0.0184	29.46	0.0164
Rich	49033	1,087	44.44	13.71	12.69	0.2103	409.4	0.1763
Salt Lake	49035	25,242	2,263	230.0	219.1	4.256	1,982	4.266
San Juan	49037	543.1	37.79	4.968	4.643	0.0927	119.5	0.0764
Sanpete	49039	666.6	51.14	8.675	8.131	0.1383	197.5	0.1294
Sevier	49041	784.6	139.1	17.08	16.32	0.1890	154.0	0.2041
Summit	49043	2,108	169.2	29.43	27.62	0.4545	613.3	0.4524
Tooele	49045	851.4	128.8	10.16	9.690	0.2353	141.8	0.2133
Uintah	49047	1,215	109.1	10.27	9.743	0.2196	150.1	0.2187
Utah	49049	7,201	967.6	98.09	93.70	1.630	776.3	1.786
Wasatch	49051	1,380	99.14	21.10	19.70	0.3328	540.7	0.3155
Washington	49053	3,345	425.6	49.45	47.06	0.7268	458.2	0.8362
Wayne	49055	232.5	13.27	2.699	2.519	0.0348	58.43	0.0330
Weber	49057	4,723	444.4	52.34	49.59	0.9226	730.4	0.9046
TOTAL		65,397	6,817	754.7	716.9	13.08	9,205	13.14

b. Aircraft Emissions

2016 Tons per Year Based on February 2016 Episode
05/10/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	40.52	0.0317	0.1112	0.1112	0.0495	0.5171	N/A
Box Elder	49003	227.9	0.2393	0.6281	0.6281	0.2956	4.501	N/A
Cache	49005	529.6	1.221	1.692	1.692	0.9014	27.23	N/A
Carbon	49007	47.77	0.1820	0.1394	0.1394	0.1019	1.717	N/A
Daggett	49009	20.88	0.0168	0.0573	0.0573	0.0256	0.2700	N/A
Davis	49011	499.8	33.59	8.328	6.778	2.822	18.59	N/A
Duchesne	49013	81.67	0.0497	0.2154	0.2154	0.0928	1.044	N/A

Emery	49015	55.74	0.2125	0.1817	0.1817	0.1246	3.024	N/A
Garfield	49017	79.95	0.1090	0.2236	0.2236	0.1118	1.862	N/A
Grand	49019	98.09	0.8160	0.2997	0.2997	0.3281	5.154	N/A
Iron	49021	556.0	5.275	2.450	2.450	2.145	76.22	N/A
Juab	49023	38.30	0.0974	0.1180	0.1180	0.0695	1.880	N/A
Kane	49025	37.46	0.0299	0.0996	0.0996	0.0448	0.5280	N/A
Millard	49027	44.59	0.0390	0.1225	0.1225	0.0557	0.6003	N/A
Morgan	49029	49.67	0.0365	0.1350	0.1350	0.0595	0.7622	N/A
Piute	49031	9.926	0.0050	0.0271	0.0271	0.0113	0.1051	N/A
Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Salt Lake	49035	3,494	891.2	23.06	23.06	108.4	373.9	N/A
San Juan	49037	108.0	0.0741	0.2719	0.2719	0.1205	1.637	N/A
Sanpete	49039	28.29	0.0578	0.0965	0.0965	0.0466	1.479	N/A
Sevier	49041	112.9	0.0801	0.3092	0.3092	0.1354	1.377	N/A
Summit	49043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Tooele	49045	938.2	6.680	3.246	3.246	1.902	43.79	N/A
Uintah	49047	119.0	0.4571	0.3146	0.3146	0.2339	2.948	N/A
Utah	49049	3,131	9.434	9.045	9.045	4.973	153.0	N/A
Wasatch	49051	221.6	0.8835	0.8595	0.8595	0.4986	20.14	N/A
Washington	49053	738.8	5.089	2.285	2.285	1.791	29.21	N/A
Wayne	49055	30.31	0.0240	0.0831	0.0831	0.0371	0.3890	N/A
Weber	49057	1,128	3.631	3.521	3.521	2.026	55.41	N/A
TOTAL		12,468	959.6	57.92	56.37	127.4	827.3	N/A

c. Aircraft Ground Support Equipment Emissions
2016 Tons per Year Based on February 2016 Episode
5/10/2016, 5/27/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	0.0798	0.0213	0.0003	0.0002	0.0002	0.0060	N/A
Box Elder	49003	0.3091	0.1012	0.0009	0.0008	0.0008	0.0280	N/A
Cache	49005	3.487	0.4501	0.0080	0.0069	0.0097	0.1514	N/A
Carbon	49007	1.028	0.1074	0.0035	0.0031	0.0028	0.0366	N/A
Daggett	49009	0.0441	0.0112	0.0001	0.0001	0.0001	0.0032	N/A
Davis	49011	0.1764	0.1513	0.0004	0.0004	0.0003	0.0390	N/A

Duchesne	49013	0.0926	0.0343	0.0003	0.0002	0.0002	0.0094	N/A
Emery	49015	0.5262	0.0654	0.0018	0.0016	0.0014	0.0213	N/A
Garfield	49017	0.2080	0.0443	0.0007	0.0006	0.0005	0.0130	N/A
Grand	49019	4.492	0.4476	0.0164	0.0147	0.0128	0.1522	N/A
Iron	49021	7.799	0.8570	0.0231	0.0207	0.0220	0.2912	N/A
Juab	49023	0.0043	0.0115	0.0000	0.0000	0.0000	0.0029	N/A
Kane	49025	0.0872	0.0198	0.0003	0.0002	0.0002	0.0057	N/A
Millard	49027	0.1141	0.0257	0.0004	0.0003	0.0003	0.0075	N/A
Morgan	49029	0.0229	0.0184	0.0001	0.0000	0.0000	0.0048	N/A
Piute	49031	0.0014	0.0036	0.0000	0.0000	0.0000	0.0009	N/A
Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Salt Lake	49035	614.7	62.27	2.133	2.034	1.977	20.57	N/A
San Juan	49037	0.2179	0.0493	0.0007	0.0006	0.0006	0.0143	N/A
Sanpete	49039	0.2380	0.0293	0.0005	0.0004	0.0007	0.0101	N/A
Sevier	49041	0.1683	0.0545	0.0005	0.0005	0.0004	0.0151	N/A
Summit	49043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Tooele	49045	6.741	0.9291	0.0198	0.0179	0.0184	0.2942	N/A
Uintah	49047	2.201	0.2449	0.0086	0.0078	0.0065	0.0799	N/A
Utah	49049	16.24	2.084	0.0358	0.0311	0.0465	0.6986	N/A
Wasatch	49051	4.014	0.4036	0.0095	0.0081	0.0112	0.1459	N/A
Washington	49053	8.641	1.039	0.0274	0.0255	0.0254	0.3391	N/A
Wayne	49055	0.0615	0.0161	0.0002	0.0002	0.0002	0.0046	N/A
Weber	49057	8.968	1.1054	0.0235	0.0206	0.0248	0.3700	N/A
TOTAL		680.6	70.59	2.316	2.197	2.163	23.32	N/A

d. Locomotive Emissions
2016 Tons per Year Based on Feb 2016 Episode

2016 Annual Locomotives
6/13/2017, checked 6-14-2017

County	FIPs	TONS PER YEAR							
		CO	NOx	PM10	PM2.5	SO2	VOC	CO2	NH3
Beaver	49001	52.34	237.9	6.095	5.912	0.1107	10.03	20,086	0.1638
Box Elder	49003	133.0	604.4	15.48	15.02	0.2814	25.47	51,033	0.4161
Cache	49005	6.154	27.97	0.7166	0.6951	0.0130	1.179	2,362	0.0193

Carbon	49007	49.33	224.01	5.744	5.571	2.450	9.458	18,930	0.1543
Daggett	49009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Davis	49011	95.45	434.3	11.16	10.82	0.3322	18.58	36,614	0.2985
Duchesne	49013	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Emery	49015	23.62	107.2	2.750	2.667	0.0528	4.531	9,062	0.0739
Garfield	49017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Grand	49019	35.32	160.2	4.112	3.989	0.0801	6.780	13,554	0.1105
Iron	49021	77.60	352.7	9.035	8.764	0.1642	14.86	29,779	0.2428
Juab	49023	67.66	307.5	7.878	7.642	0.1432	12.96	25,964	0.2117
Kane	49025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Millard	49027	111.7	507.5	13.00	12.61	0.2363	21.39	42,849	0.3494
Morgan	49029	64.97	295.3	7.565	7.338	0.1375	12.45	24,932	0.2033
Piute	49031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Salt Lake	49035	133.5	727.6	17.60	17.07	1.252	35.72	50,540	0.4121
San Juan	49037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sanpete	49039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sevier	49041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Summit	49043	111.4	506.2	12.97	12.58	0.2357	21.34	42,742	0.3485
Tooele	49045	150.8	684.8	17.55	17.03	0.3265	28.90	57,855	0.4717
Uintah	49047	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Utah	49049	93.04	428.3	10.96	10.63	0.9800	18.52	35,661	0.2907
Wasatch	49051	4.267	19.39	0.4968	0.4819	0.3208	0.8174	1,637	0.0134
Washington	49053	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Wayne	49055	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Weber	49057	91.49	442.6	11.11	10.78	0.4152	19.80	34,957	0.2850
TOTAL		1,301	6,068	154.2	149.6	7.532	262.8	498,559	4.065

e. TOTAL Non-road Mobile Source Inventory (Misc. NONROAD Engines, Aircraft, GSE and Locomotives)
2016 Tons per Year Based on February 2016 Episode

County	FIPs	TONS PER YEAR						NH3
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	
Beaver	49001	206.8	256.5	7.985	7.728	0.186	20.55	0.1933
Box Elder	49003	2,426	883.5	34.89	33.48	1.130	390.6	0.8252
Cache	49005	3,124	342.6	38.98	37.09	1.554	561.1	0.6496

Carbon	49007	947.9	348.9	21.75	20.85	2.750	198.0	0.3476
Daggett	49009	298.7	10.54	3.269	3.025	0.0774	103.8	0.0419
Davis	49011	5,382	1,132	82.30	77.69	4.273	515.4	1.5020
Duchesne	49013	683.5	49.23	6.297	5.954	0.1954	104.4	0.1004
Emery	49015	426.2	199.6	13.95	13.41	0.298	111.1	0.2016
Garfield	49017	788.0	45.60	9.102	8.521	0.2360	203.2	0.1189
Grand	49019	1,178	204.5	14.56	13.72	0.560	265.4	0.2360
Iron	49021	1,489	469.8	24.01	23.13	2.538	253.1	0.4613
Juab	49023	473.1	342.4	12.43	11.95	0.286	92.36	0.2844
Kane	49025	693.1	37.95	6.429	5.992	0.1538	166.8	0.0899
Millard	49027	697.8	582.4	18.73	18.07	0.430	118.8	0.4633
Morgan	49029	270.9	315.7	9.385	9.095	0.230	21.97	0.2383
Piute	49031	86.78	6.057	1.137	1.063	0.0297	29.56	0.0164
Rich	49033	1,087	44.44	13.71	12.69	0.2103	409.4	0.1763
Salt Lake	49035	29,484	3,945	272.8	261.3	115.9	2,412	4.6776
San Juan	49037	651.3	37.91	5.241	4.916	0.2137	121.1	0.0764
Sanpete	49039	695.1	51.22	8.772	8.228	0.1856	199.0	0.1294
Sevier	49041	897.6	139.3	17.39	16.63	0.3248	155.4	0.2041
Summit	49043	2,219	675.4	42.40	40.20	0.690	634.6	0.8009
Tooele	49045	1,947	821.2	30.98	29.98	2.482	214.7	0.6850
Uintah	49047	1,336	109.8	10.59	10.07	0.4600	153.1	0.2187
Utah	49049	10,441	1,407	118.1	113.4	7.6	948.6	2.0771
Wasatch	49051	1,610	119.8	22.46	21.05	1.163	561.8	0.3289
Washington	49053	4,092	431.7	51.76	49.37	2.544	487.8	0.8362
Wayne	49055	262.9	13.31	2.782	2.603	0.0721	58.83	0.0330
Weber	49057	5,952	891.7	66.99	63.91	3.389	806.0	1.1896
TOTAL		79,848	13,915	969.2	925.1	150.2	10,318	17.20

3. December 2013 Non-road Mobile Source Inventory Summaries

a. Miscellaneous Non-road Engines and Equipment from MOVES2014a--Coldest Days
2013 Tons per Year Based on December 2013 Episode
07/19/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	102.5	20.42	1.934	1.858	0.0532	9.595	0.0253
Box Elder	49003	2,059	303.5	21.83	20.73	0.7047	417.1	0.3582
Cache	49005	2,669	363.7	41.87	39.77	1.106	614.6	0.5633
Carbon	49007	854.0	124.4	17.12	16.33	0.3353	218.1	0.1757

Daggett	49009	292.4	10.23	3.686	3.406	0.0555	111.5	0.0413
Davis	49011	4,429	769.4	69.88	67.00	2.154	482.5	1.028
Duchesne	49013	550.8	54.08	6.742	6.369	0.1619	112.7	0.0882
Emery	49015	367.1	91.27	11.94	11.44	0.2325	122.0	0.1154
Garfield	49017	649.2	50.30	10.01	9.365	0.1748	221.5	0.1047
Grand	49019	919.5	47.21	11.21	10.42	0.1705	272.2	0.1090
Iron	49021	843.4	126.7	14.22	13.53	0.3817	184.8	0.1938
Juab	49023	353.3	38.51	4.987	4.711	0.1195	87.83	0.0652
Kane	49025	590.3	40.21	7.103	6.616	0.1253	181.4	0.0784
Millard	49027	507.5	78.52	6.372	6.063	0.1887	109.0	0.0992
Morgan	49029	141.5	23.05	1.877	1.810	0.0624	8.874	0.0299
Piute	49031	85.92	6.188	1.282	1.197	0.0248	35.74	0.0160
Rich	49033	1,177	43.67	15.57	14.41	0.2415	490.4	0.1756
Salt Lake	49035	23,027	2,633	247.1	236.2	7.431	1,932	3.631
San Juan	49037	490.2	39.68	5.516	5.158	0.1122	129.6	0.0667
Sanpete	49039	697.7	55.68	9.890	9.275	0.2038	232.7	0.1215
Sevier	49041	725.4	143.1	18.30	17.50	0.3623	165.1	0.1770
Summit	49043	2,193	188.4	33.39	31.36	0.7170	724.1	0.4217
Tooele	49045	811.4	141.2	11.63	11.10	0.3668	158.6	0.1847
Uintah	49047	1,129	123.5	11.55	10.97	0.3724	167.6	0.1950
Utah	49049	6,671	1,128	108.7	104.1	3.200	781.8	1.527
Wasatch	49051	1,562	107.1	24.45	22.84	0.4827	657.5	0.3069
Washington	49053	3,018	494.2	54.40	51.90	1.460	460.4	0.7135
Wayne	49055	206.2	14.41	2.974	2.778	0.0474	62.64	0.0286
Weber	49057	4,575	514.8	58.19	55.23	1.553	807.9	0.7975
TOTAL		61,699	7,774	833.7	793.4	22.60	9,960	11.44

b. Aircraft Emissions

2013 Tons per Year Based on December 2013 Episode
07/19/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	40.56	0.0330	0.1113	0.1113	0.0499	0.5267	N/A
Box Elder	49003	227.9	0.2437	0.6284	0.6284	0.2970	4.534	N/A
Cache	49005	526.8	1.230	1.683	1.683	0.9013	27.17	N/A
Carbon	49007	48.78	0.1991	0.1432	0.1432	0.1081	1.855	N/A
Daggett	49009	20.91	0.0175	0.0574	0.0574	0.0259	0.2754	N/A

Davis	49011	534.2	41.41	14.54	13.09	3.092	30.56	N/A
Duchesne	49013	81.65	0.0511	0.2155	0.2155	0.0931	1.054	N/A
Emery	49015	56.22	0.2210	0.1835	0.1835	0.1277	3.091	N/A
Garfield	49017	80.08	0.1122	0.2242	0.2242	0.1129	1.887	N/A
Grand	49019	103.8	1.084	0.3195	0.3195	0.4012	5.638	N/A
Iron	49021	553.3	4.131	1.782	1.782	1.643	37.01	N/A
Juab	49023	37.68	0.0994	0.1162	0.1162	0.0694	1.869	N/A
Kane	49025	37.51	0.0313	0.0998	0.0998	0.0453	0.5388	N/A
Millard	49027	44.55	0.0407	0.1225	0.1225	0.0562	0.6133	N/A
Morgan	49029	49.62	0.0367	0.1349	0.1349	0.0595	0.7634	N/A
Piute	49031	9.911	0.0050	0.0270	0.0270	0.0113	0.1049	N/A
Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Salt Lake	49035	4,040	811.5	26.39	23.91	103.3	406.9	N/A
San Juan	49037	108.1	0.0775	0.2724	0.2724	0.1216	1.663	N/A
Sanpete	49039	28.28	0.0582	0.0964	0.0964	0.0467	1.480	N/A
Sevier	49041	112.3	0.0823	0.3077	0.3077	0.1355	1.389	N/A
Summit	49043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	N/A
Tooele	49045	321.9	6.218	1.504	1.504	1.212	42.11	N/A
Uintah	49047	120.5	0.5805	0.3203	0.3203	0.2661	3.111	N/A
Utah	49049	3,128	9.082	9.027	9.027	4.946	152.5	N/A
Wasatch	49051	222.9	0.9041	0.8639	0.8639	0.5060	20.29	N/A
Washington	49053	698.7	4.454	2.145	2.145	1.590	25.49	N/A
Wayne	49055	30.10	0.0249	0.0826	0.0826	0.0372	0.3940	N/A
Weber	49057	1,030	7.204	5.021	5.021	3.021	173.6	N/A
TOTAL		12,294	889.1	66.42	62.48	122.3	946.5	N/A

c. Aircraft Ground Support Equipment Emissions
2013 Tons per Year Based on Dec 2013 Episode

6/24/2016, updated 8/23/16

County Number	County	FIPs	TONS PER YEAR					
			CO	NOX	PM10	PM2.5	SOX	VOC
1	Beaver	49001	0.0876	0.0220	0.0003	0.0002	0.0002	0.0063
2	Box Elder	49003	0.3386	0.1038	0.0010	0.0009	0.0008	0.0289
3	Cache	49005	3.577	0.4574	0.0084	0.0072	0.0099	0.1540
4	Carbon	49007	1.135	0.1172	0.0038	0.0034	0.0031	0.0401

5	Daggett	49009	0.0484	0.0116	0.0002	0.0001	0.0001	0.0033
6	Davis	49011	0.1893	0.1523	0.0005	0.0004	0.0004	0.0394
7	Duchesne	49013	0.1013	0.0351	0.0003	0.0003	0.0002	0.0096
8	Emery	49015	0.5808	0.0704	0.0019	0.0017	0.0016	0.0231
9	Garfield	49017	0.2289	0.0462	0.0007	0.0007	0.0006	0.0136
10	Grand	49019	7.258	0.6113	0.0180	0.0165	0.0200	0.2351
11	Iron	49021	18.04	1.778	0.0597	0.0531	0.0498	0.6157
12	Juab	49023	0.0312	0.0137	0.0001	0.0001	0.0001	0.0037
13	Kane	49025	0.0959	0.0206	0.0003	0.0003	0.0002	0.0060
14	Millard	49027	0.1254	0.0267	0.0004	0.0004	0.0003	0.0078
15	Morgan	49029	0.0246	0.0186	0.0001	0.0001	0.0000	0.0048
16	Piute	49031	0.0014	0.0036	0.0000	0.0000	0.0000	0.0009
17	Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	Salt Lake	49035	623.3	62.24	2.486	2.042	1.994	20.74
19	San Juan	49037	0.2396	0.0512	0.0008	0.0007	0.0006	0.0150
20	Sanpete	49039	0.2403	0.0295	0.0005	0.0004	0.0007	0.0102
21	Sevier	49041	0.184	0.0557	0.0006	0.0005	0.0005	0.0155
22	Summit	49043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	Tooele	49045	5.810	0.648	0.0168	0.0151	0.0161	0.2165
24	Uintah	49047	3.87	0.3286	0.0083	0.0078	0.0106	0.129
25	Utah	49049	15.91	2.045	0.0347	0.0301	0.0454	0.687
26	Wasatch	49051	4.14	0.4156	0.0099	0.0085	0.0116	0.150
27	Washington	49053	5.89	0.7868	0.0186	0.0177	0.0178	0.249
28	Wayne	49055	0.0675	0.0165	0.0002	0.0002	0.0002	0.0047
29	Weber	49057	30.42	2.708	0.0617	0.0521	0.0867	1.036
ALL		GRAND	721.9	72.82	2.733	2.261	2.271	24.44
		TOTAL						

d. Locomotive
Emissions
2013 Tons per Year Based on December 2013 Episode
07/26/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	48.99	255.8	6.993	6.783	0.0691	11.96	0.1533
Box Elder	49003	123.4	644.4	17.62	17.09	0.1741	30.13	0.3862
Cache	49005	5.896	30.78	0.8415	0.8163	0.0083	1.439	0.0184
Carbon	49007	46.88	245.4	6.699	6.498	2.493	11.48	0.1467
Daggett	49009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Davis	49011	83.99	446.7	12.09	11.73	0.2491	20.99	0.2627

Duchesne	49013	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Emery	49015	20.62	108.2	2.950	2.862	0.0330	5.062	0.0645
Garfield	49017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Grand	49019	32.02	168.2	4.583	4.445	0.0527	7.870	0.1002
Iron	49021	70.62	368.7	10.08	9.777	0.0996	17.24	0.2210
Juab	49023	63.55	331.8	9.071	8.799	0.0896	15.52	0.1988
Kane	49025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Millard	49027	104.6	546.2	14.93	14.48	0.1476	25.54	0.3273
Morgan	49029	59.12	308.7	8.438	8.185	0.0834	14.43	0.1850
Piute	49031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Rich	49033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Salt Lake	49035	122.0	752.0	18.90	18.34	1.114	38.88	0.3769
San Juan	49037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sanpete	49039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sevier	49041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Summit	49043	101.5	529.7	14.48	14.05	0.1431	24.77	0.3174
Tooele	49045	137.1	717.4	19.59	19.00	0.2039	33.55	0.4290
Uintah	49047	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Utah	49049	81.24	436.2	11.75	11.40	0.9013	20.65	0.2539
Wasatch	49051	4.182	21.83	0.5969	0.5790	0.3284	1.021	0.0131
Washington	49053	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Wayne	49055	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Weber	49057	83.62	462.8	12.27	11.90	0.3322	22.49	0.2605
TOTAL		1,189	6,375	171.9	166.7	6.522	303.0	3.715

e. TOTAL Non-road Mobile Source Inventory (Misc. NONROAD Engines, Aircraft, GSE and Locomotives)

2013 Tons per Year Based on December 2013 Episode

07/26/16

County	FIPs	TONS PER YEAR						
		CO	NOX	PM10 Exh	PM2.5 Exh	SO2	VOC	NH3
Beaver	49001	192.1	276.3	9.038	8.752	0.1724	22.09	0.1785
Box Elder	49003	2,411	948.2	40.07	38.45	1.177	451.8	0.7443
Cache	49005	3,205	396.2	44.40	42.28	2.026	643.4	0.5817
Carbon	49007	950.8	370.1	23.96	22.97	2.939	231.5	0.3223
Daggett	49009	313.4	10.26	3.744	3.464	0.0815	111.7	0.0413
Davis	49011	5,048	1,258	96.50	91.82	5.495	534.1	1.291
Duchesne	49013	632.6	54.17	6.958	6.585	0.2553	113.7	0.0882

Emery	49015	444.6	199.8	15.08	14.48	0.3947	130.2	0.1799
Garfield	49017	729.5	50.46	10.24	9.589	0.2883	223.4	0.1047
Grand	49019	1,063	217.1	16.13	15.20	0.6443	285.9	0.2092
Iron	49021	1,485	501.3	26.14	25.15	2.174	239.7	0.4147
Juab	49023	454.5	370.4	14.17	13.63	0.2786	105.2	0.2640
Kane	49025	627.9	40.26	7.203	6.716	0.1708	181.9	0.0784
Millard	49027	656.7	624.8	21.43	20.67	0.3928	135.2	0.4265
Morgan	49029	250.2	331.8	10.45	10.13	0.2054	24.08	0.2149
Piute	49031	95.83	6.197	1.309	1.224	0.0360	35.85	0.0160
Rich	49033	1,177	43.67	15.57	14.41	0.2415	490.4	0.1756
Salt Lake	49035	27,812	4,258	294.9	280.5	113.8	2,399	4.008
San Juan	49037	598.6	39.81	5.789	5.431	0.2344	131.3	0.0667
Sanpete	49039	726.3	55.77	9.987	9.372	0.2512	234.2	0.1215
Sevier	49041	837.8	143.2	18.61	17.80	0.4982	166.5	0.1770
Summit	49043	2,295	718.0	47.87	45.41	0.8601	748.9	0.7392
Tooele	49045	1,276	865.4	32.74	31.62	1.799	234.4	0.6137
Uintah	49047	1,253	124.4	11.87	11.30	0.6491	170.8	0.1950
Utah	49049	9,896	1,576	129.5	124.5	9.093	955.7	1.781
Wasatch	49051	1,793	130.2	25.92	24.29	1.329	678.9	0.3200
Washington	49053	3,723	499.4	56.56	54.06	3.067	486.1	0.7135
Wayne	49055	236.4	14.45	3.056	2.861	0.0847	63.04	0.0286
Weber	49057	5,719	987.5	75.54	72.21	4.992	1,005	1.058
TOTAL		75,904	15,111	1,075	1,025	153.7	11,234	15.15

B. MOVES2014a Model: Changes to Underlying Database for Snowmobiles

The following files in the MOVES2014a database were changed, as discussed in the body of the report:

1. File Name: "nrstatesurrogate"

Counts show the relative numbers of snowmobiles by county.

Surrogate ID	County ID	Surrogate Year ID	Original Count	Revised Count	
14	49000	2002	1,891	1,891	UT
14	49001	2002	0	0	Beaver

14	49003	2002	0	0	Box Elder
14	49005	2002	10	226	Cache
14	49007	2002	0	96	Carbon
14	49009	2002	0	58	Daggett
14	49011	2002	0	0	Davis
14	49013	2002	67	17	Duchesne
14	49015	2002	0	55	Emery
14	49017	2002	217	19	Garfield
14	49019	2002	0	0	Grand
14	49021	2002	0	64	Iron
14	49023	2002	0	24	Juab
14	49025	2002	0	0	Kane
14	49027	2002	0	0	Millard
14	49029	2002	135	0	Morgan
14	49031	2002	724	18	Piute
14	49033	2002	512	226	Rich
14	49035	2002	0	0	Salt Lake
14	49037	2002	0	0	San Juan
14	49039	2002	43	100	Sanpete
14	49041	2002	52	18	Sevier
14	49043	2002	31	330	Summit
14	49045	2002	0	0	Tooele
14	49047	2002	38	48	Uintah
14	49049	2002	3	29	Utah
14	49051	2002	59	349	Wasatch
14	49053	2002	0	0	Washington
14	49055	2002	0	0	Wayne
14	49057	2002	0	226	Weber

2. File Name: "nrbaseyearequippopulation"

Based on estimated snowmobile counts obtained from the Utah Tax Commission for calendar year 1999, the populations of snowmobiles were adjusted upwards as follows:

FIPS	Year	Source Type ID	Equipment Description	HP Min	HP Max	Original Population	Revised Population
49000	1999	1002	2-Str Snowm	1	3	103.4	145.1
49000	1999	1003	2-Str Snowm	3	6	61.0	85.6
49000	1999	1004	2-Str Snowm	11	16	65.6	91.9
49000	1999	1005	2-Str Snowm	16	25	5,219.0	7,322.7
49000	1999	1006	2-Str Snowm	25	40	5,268.0	7,391.5
49000	1999	1007	2-Str Snowm	40	50	2,364.8	3,318.0
49000	1999	1008	2-Str Snowm	50	75	8,331.3	11,689.6
49000	1999	1009	2-Str Snowm	75	100	3,424.1	4,804.3
49000	1999	1010	2-Str Snowm	100	175	892.0	1,251.6
SUM						25,729.1	36,100.0

3. File Name: nrgrowthindex

The 1999 base year population of snowmobiles in Utah was changed. Therefore, snowmobile growth factors in future years were also changed.

However, data from Utah Tax Commission showed snowmobile counts actually decreased over calendar years 2005 through 2014. Therefore, growth factors also decrease over calendar years as follows:

Snowmobile Indicator Code: 098

SCC: 226001020

Type: 2-Stroke Snowmobile

Calendar Year	Growth Pattern ID	Original Growth Indicator Value	Revised Growth Indicator Value	Utah Actual Snowmobile Counts
1970	98	500	500	
1990	"	1,000	353	
1996	"	1,000	309	
1997	"	1,063	302	
1998	"	1,121	294	
1999	"	1,172	287	
2000	"	1,213	280	
2001	"	1,256	272	
2002	"	1,307	265	
2003	"	1,364	258	
2004	"	1,427	250	
2005	"	1,496	243	28,248
2006	"	1,567	236	28,222
2007	"	1,635	228	29,241
2008	"	1,696	221	30,782
2009	"	1,749	214	28,768
2010	"	1,800	206	26,294
2011	"	1,852	199	26,167
2012	"	1,908	192	22,144
2013	"	1,967	184	23,184
2014	"	2,026	177	20,993
2015	"	2,083	170	
2016	"	2,135	162	
2017	"	2,184	155	
2018	"	2,229	148	
2019	"	2,271	140	
2020	"	2,310	133	
2021	"	2,345	126	
2022	"	2,377	118	
2023	"	2,406	111	
2024	"	2,431	103	
2025	"	2,454	96	
2026	"	2,473	89	
2027	"	2,490	81	
2028	"	2,505	74	
2029	"	2,517	67	
2030	"	2,526	59	

4. File Name: nrmonthallocation

In the default file, fractions of annual activity by month were changed for snowmobiles (SCC = 2260001020) as follows:

State	SCC	Equipment Description	Jan	Feb	Mar	Apr	Dec
49000	2260001020	Snowmobiles	0.200	0.200	0.200	0.200	0.200

(Fractions for all other months are zero.)

xi Footnotes

1. University of Utah “MESOWEST” website (<http://mesowest.utah.edu/>)

2. U.S. Department of Transportation “Transtats” website, <http://www.transtats.bts.gov/>

Under “Aviation”, one chooses “Air Carrier Statistics - Form 41 Traffic - All Carriers”, and then “T-100 Domestic Segment—All Carriers”. Next, choose “T-100 Domestic Segment (U.S. Carriers)”. In the lower right-hand corner of the box, click on “Download”. At the top of the screen, under “Download Instructions”, choose the state, calendar year and month. In addition to the boxes already checked, put a check mark in front of the following parameters:

Aircraft Type
Origin City Name
Destination City Name
Departures Performed

3. Federal Aviation Administration: “Airport Master Records”, <http://www.grc1.com/5010web>.

4. McCoy, N., Fujisaki, I., Keith, J., *An Economic and Social Assessment of Snowmobiling in Utah*, January 2001.

http://extension.usu.edu/iort/files/uploads/pdfs/interdisciplinary_cf7.pdf.

5. Utah Snowmobile Association, Utah State Parks OHV Program, *2012 Snowmobile User Survey Results*, February 2012.

6. Utah Tax Commission\Utah Division of Motor Vehicles: Snowmobile Counts by Year and County <http://tax.utah.gov/econstats/mv/registrations-2010#2014>

7. Aircraft Activity Scaling Factors

http://www.faa.gov/data_research/aviation/aerospace_forecasts/

The scaling factors are found in the EXCEL document under the bold heading “FY 2015-2035 Forecast Tables”, (choose General Aviation A (Tables 28 – 31, MS EXCEL). Note there are two sets of tables that use the same name, “General Aviation Tables 28 – 31”. Choose the second one, which actually contains Tables 32 – 34.

8. U.S. EPA, *Emission Factors for Locomotives* (EPA-420-F-09-025), April 2009,

<https://www3.epa.gov/nonroad/locomotv/420f09025.pdf>

9. Bergin, Michelle S., “Locomotive Emission Inventories for the United States from ERTAC Rail”,

2012, <http://www.epa.gov/ttnchie1/conference/ei20/session8/mbergin.pdf>

(emission factor for ammonia from diesel locomotives).

10. AMTRAK, “Amtrak Fleet Strategy: Building a Sustainable Fleet for the Future of America’s Intercity and High-Speed Passenger Railroad”, March 2012.

<https://www.amtrak.com/ccurl/36/921/2012-Amtrak-Fleet-Strategy-v3.1-%2003-29-12.pdf>

11. Locomotive Activity Scaling Factors: Scaling factors for calendar years 2013 and 2016 were obtained from “Freight Transportation Demand: Energy-Efficient Scenarios for a Low-Carbon Future”, pp. 32 – 33, March 2013, U.S. DOE, Energy Efficiency & Renewable Energy.

<http://www.nrel.gov/docs/fy13osti/55641.pdf>

xi. References

The following documents were used as references in creating the non-road mobile source PM_{2.5} SIP emissions inventories:

1. Federal Aviation Administration, *Emissions and Dispersion Modeling System (EDMS) User's Manual*, FAA-AEE-07-01, (Rev. 10 – 060713, June 2013),
https://www.faa.gov/about/office_org/headquarters_offices/apl/research/models/edms_model/media/EDMS_5.1.4_User_Manual.pdf
2. U.S. EPA, “MEMORANDUM: Development of Non-road, Stationary, and Area Source Emissions for Tier 2/Sulfur NPRM, March 29, 1999.
<http://www.epa.gov/otaq/models/tier2/tec2nrnsa.pdf>
3. U.S. EPA, “MOVES2014a User Guide”, EPA-420-B-15-095, November 2015,
<https://www3.epa.gov/otaq/models/moves/documents/420b15095.pdf>
4. U.S. EPA, “MOVES2014 and MOVES2014a Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity”, EPA-420-B-15-093, November 2015,
<https://www3.epa.gov/otaq/models/moves/documents/420b15093.pdf>
5. U.S. EPA, “User’s Guide for the Final NONROAD2005 Model”, EPA420-R-05-013, December 2005,
<http://www.epa.gov/otaq/models/nonrdmdl/nonrdmdl2005/420r05013.pdf>

Reports from Railroads

6. AMTRAK, 2014 fuel consumption (Utah), Jeffrey White, WhiteJef@amtrak.com.
7. Salt Lake Garfield & Western Railway, 2008 fuel consumption, Donald M. Hogle, 801-322-3429.
8. Union Pacific Railroad Company (UPRR), Jon Germer, Manager Environmental Affairs, July 11, 2012, 2011 fuel consumption (Utah), mjgermer@up.com. The report includes fuel consumption from Burlington Northern & Santa Fe Railroad.
9. Utah Railway, 2014 fuel consumption, Stephen Green, stgreene@gwrr.com.

10. Utah Transit Authority, 2011 and 2014 Front Runner (commuter rail) fuel consumption and miles, Daniel Locke, DLocke@rideuta.com.