# TECHNICAL SUPPORT DOCUMENT FOR NON-ROAD MOBILE SOURCES: EMISSIONS INVENTORIES FOR PM2.5 MAINTENANCE SIP, PROVO AREA, BASE YEAR 2017 AND PROJECTION YEARS 2026 AND 2035

June 2019
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 PM2.5 Maintenance SIP for the Provo area, base year 2017 and projection years 2026 and 2035.

Non-road mobile sources include 1) non-road engines and motorized equipment from MOVES2014b, 2) aircraft, 3) airport ground support equipment and 4) diesel locomotives. The majority of non-road emissions come from non-road engines and motorized equipment from MOVES2014b.

In 2017, for NOx, about 42% of total non-road mobile source emissions comes from non-road engines and motorized equipment in MOVES2014b, and another 50% comes from diesel locomotives.

For PM2.5 exhaust, about 75% of total non-road mobile source emissions comes from non-road engines and motorized equipment in MOVES2014b and another 16% comes from diesel locomotives.

For VOC, about 92% of total non-road mobile source emissions comes from MOVES2014b.

For SO2, about 88% of total non-road mobile source emissions comes from aircraft and ground support.

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 2014 was used to obtain inventories for these areas.)

Counties included in each PM2.5 non-attainment area (under the 24-hour standard) are as follows:

Salt Lake: Box Elder, Davis, Salt Lake, Tooele and Weber
Provo: Utah (County)
Logan: Cache and portions of southern Idaho counties (in process of redesignation)

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

Temperatures modeled for the base year and projection years are the average temperatures over the three PM2.5 episodes:

Sat, Jan 1 – Wed, Jan 12, 2011
Sat, Dec 7 – Thu, Dec 19, 2013
Mon, Feb 1 – Wed, Feb 17, 2016

This document includes inventory results for the base year 2017 and projection years 2026 and 2035. Units were converted to tons per year for easy comparison to other source groups—point, area, and on-road mobile.

## TABLE OF CONTENTS


i. Abstract…… 2

ii. Table of Contents…….. 3

iii. Introduction…… 5

iv. Overview…… 8
A. MOVES/NR (Non-road Vehicles, Equipment and Engines)……. 9
B. Aircraft and Ground Support Equipment…….. 9
C. Diesel Locomotives……... 10
D. Comments…… 11

v. Emission Inventories……. 11
A. Summary of Statewide Non-road Mobile Source Emissions (Base Year 2017)…. 13
B. Charts of Statewide Non-road Mobile Source Emissions: NOx, PM2.5 Exhaust and VOC……. 13

vi. Non-road Emissions Sources and Models……. 18

vii. Non-road Engines and Motorized Equipment (MOVES2014b Model)……. 18
A. Input Data…….. 19
1. Sulfur Content of Fuels…….. 19
2. Hourly Temperatures by Episode Day and County…….. 20

B. Snowmobile Adjustments……. 22
1. Reallocation of Snowmobile Counts in MOVES2014b Database…….. 22
2. Utah Snowmobile Population (1990) Changed in MOVES2014b Database…….. 23
3. Utah Snowmobile Counts in Future Years…… 23
4. Snowmobile Activity (Seasonal) Changed in MOVES2014 Database……. 23
5. Additional MOVES2014b Files Related to Snowmobiles……. 24
6. No Additional Changes to MOVES2014b Database…… 25

viii. Aircraft……. 24
A. Four Main Operation Types for Aircraft……. 24
B. Aircraft Activity (Landings and Takeoffs, or LTOs)…….. 25

C. Aircraft Types…… 26
1. Commercial……. 26
2. Air Taxi and General Aviation…… 26
3. Military…… 27

D. Emissions and Dispersion Modeling System (EDMS) Software…….. 27
E. Airport Ground Support Equipment (GSE)…… 27

ix. Diesel Locomotives…….. 28

x. Output…… 29
A. MOVES2014b……. 29
B. Aircraft and Ground Support Equipment (EDMS 5.1.4.1)……... 30
C. Locomotives…….. 30
D. SMOKE Formats for Air Dispersion Model……. 30

xi. Appendix Items……. 30

B. 2026 Projection Year Tables…… 36

C. 2035 Projection Year Tables…… 41

D.

B. MOVES2014b Model: Changes to Underlying Database for Snowmobiles…….. 46
1. File Name: nrstatesurrogate……. 46
2. File Name: nrbaseyearequippopulation…….. 46
3. File Name: nrgrowthindex…….. 47
4. File Name: nrmonthallocation…… 57
5. File Name: zonemonthhour……. 57

xii. Footnotes…… 57

xiii. References……. 59

iii. Introduction

This inventory includes emissions of carbon monoxide (CO), nitrogen oxides (NOx), PM10 and PM2.5 exhaust, sulfur dioxide (SO2), volatile organic compounds (VOC) and ammonia (NH3) from non-road engines, aircraft, airport ground support equipment (GSE) and locomotives.

In addition, for the CAMX air dispersion model, the following additional compounds and groups of compounds were modeled:

| Pollutant No. | Abbreviation | Name |
|---|---|---|
| 1 | TGH | Total Gaseous Hydrocarbons |
| 5 | CH4 | Methane |
| 20 | C6H6 | Benzene |
| 45 | C6H5-CH3 | Toluene |
| 46 | C6H4-(CH3)2 | Xylenes |
| 79 | NMHC | Non-Methane Hydrocarbons |
| 80 | NMOG | Non-Methane Organic Gases |
| 86 | TOG | Total Organic Gases |

Inventories were computed for the base year 2017 and for projection years 2026 and 2035.

The PM2.5 domain consists of all 29 counties in Utah and portions of Colorado and Wyoming.

UT County Names, FIPs Codes, Abbreviations and Human Population (2010, 2017 and 2020)

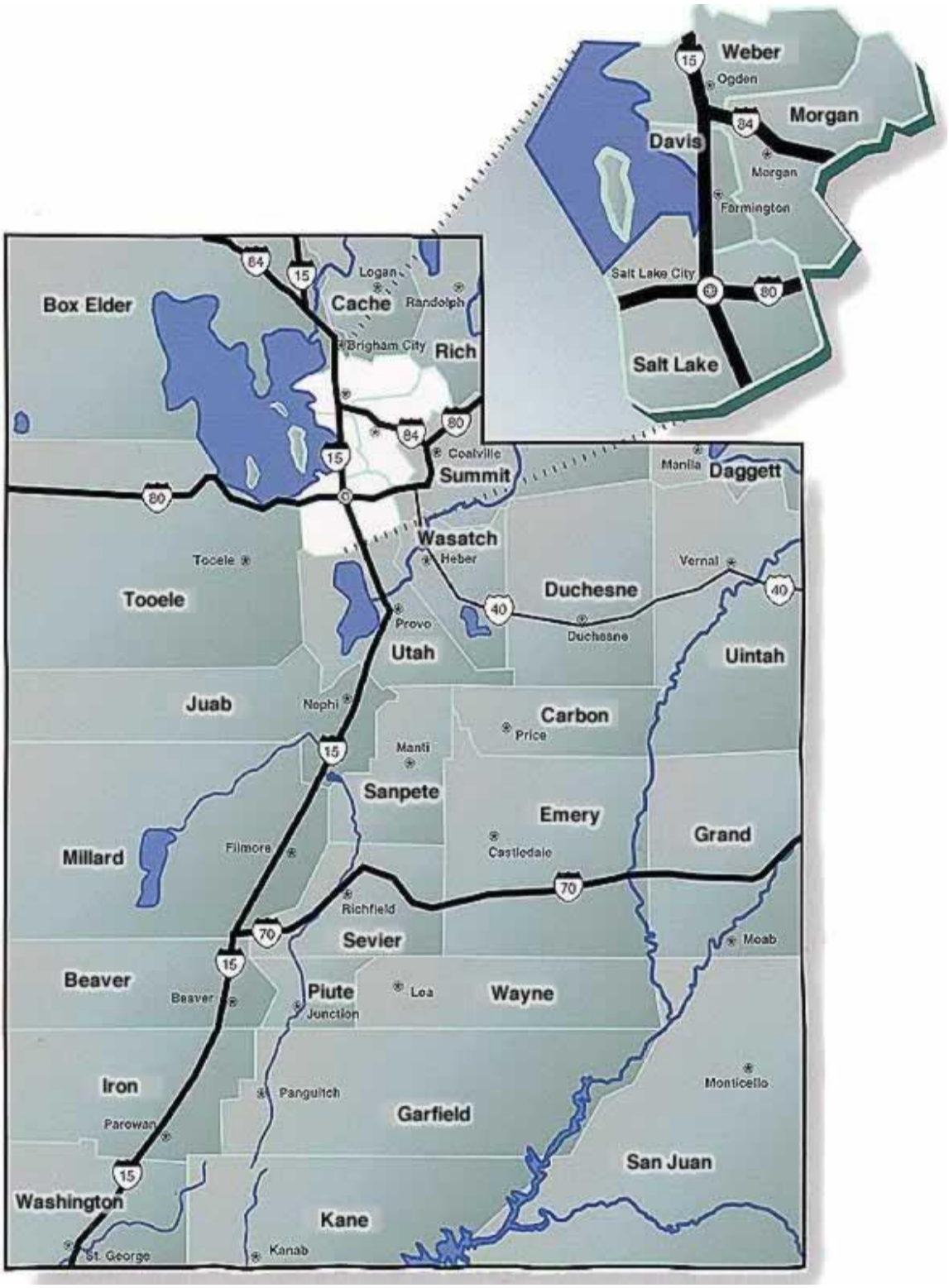
| No. | County Name | FIPs | Abbrev | Human Populations and Projections (2010) | (2018) | (2020) |
|---|---|---|---|---|---|---|
| 1 | Beaver | 49001 | BE | 6,629 | 7,539 | 7,766 |
| 2 | Box Elder | 49003 | BX | 49,975 | 53,652 | 54,571 |
| 3 | Cache | 49005 | CA | 112,656 | 133,913 | 139,228 |
| 4 | Carbon | 49007 | CR | 21,403 | 21,562 | 21,602 |
| 5 | Daggett | 49009 | DG | 1,059 | 1,367 | 1,444 |
| 6 | Davis | 49011 | DA | 306,479 | 346,870 | 356,968 |
| 7 | Duchesne | 49013 | DU | 18,607 | 21,959 | 22,797 |
| 8 | Emery | 49015 | EM | 10,976 | 11,179 | 11,230 |
| 9 | Garfield | 49017 | GA | 5,172 | 5,885 | 6,063 |
| 10 | Grand | 49019 | GR | 9,225 | 10,085 | 10,300 |
| 11 | Iron | 49021 | IR | 46,163 | 54,877 | 57,055 |
| 12 | Juab | 49023 | JU | 10,246 | 13,049 | 13,750 |
| 13 | Kane | 49025 | KA | 7,125 | 8,111 | 8,357 |
| 14 | Millard | 49027 | MI | 12,503 | 12,730 | 12,787 |
| 15 | Morgan | 49029 | MO | 9,469 | 11,450 | 11,945 |
| 16 | Piute | 49031 | PI | 1,556 | 1,619 | 1,635 |
| 17 | Rich | 49033 | RI | 2,264 | 2,478 | 2,532 |
| 18 | Salt Lake | 49035 | SL | 1,029,655 | 1,150,618 | 1,180,859 |
| 19 | San Juan | 49037 | SJ | 14,746 | 15,464 | 15,644 |
| 20 | Sanpete | 49039 | SP | 27,822 | 30,874 | 31,637 |
| 21 | Sevier | 49041 | SE | 20,802 | 22,064 | 22,380 |
| 22 | Summit | 49043 | SU | 36,324 | 43,658 | 45,491 |
| 23 | Tooele | 49045 | TO | 58,218 | 71,545 | 74,877 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 24 | Uintah | 49047 | UI | 32,588 | 37,704 | 38,982 |
| 25 | Utah | 49049 | UT | 516,564 | 638,164 | 668,564 |
| 26 | Wasatch | 49051 | WA | 23,530 | 30,899 | 32,741 |
| 27 | Washington | 49053 | WS | 138,115 | 185,033 | 196,762 |
| 28 | Wayne | 49055 | WY | 2,778 | 2,832 | 2,845 |
| 29 | Weber | 49057 | WE | 231,236 | 255,986 | 258,423 |
| SUM | | | ALL | 2,763,885 | 3,200,165 | 3,309,234 |

The University of Utah Kem C. Gardner Policy Institute website shows Utah human population projections by county on the following URL:

https://gardner.utah.edu/demographics/population-projections/

See menu item “2015 – 2065 State and County Projections (EXCEL Download)”.


Weber
Ogden
Morgan
Davis
Morgan
Farmington
Salt Lake City
Salt Lake
Box Elder
Logan
Cache
Randolph
Brigham City
Rich
Coalville
Summit
Manila
Daggett
Wasatch
Heber
Tooele
Vernal
Duchesne
Provo
Utah
Uintah
Juab
Nephi
Carbon
Price
Manti
Sanpete
Emery
Grand
Millard
Fillmore
Castledale
Richfield
Sevier
Moab
Beaver
Beaver
Piute
Junction
Loa
Wayne
Iron
Panguitch
Monticello
Garfield
Parowan
San Juan
Washington
Kane
St. George
Kanab

iv. Overview

The purpose of this document is to explain how the non-road mobile source emission inventories were created for the PM2.5 Maintenance SIP for the base year 2017 and projection years 2026 and 2035. Non-road mobile sources include a) non-road vehicles, motorized equipment and engines from MOVES2014b; 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 baseline inventory covered a January 2017 day based on the average of temperatures recorded during the three $PM_{2.5}$ episodes which took place during the following periods:

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 base year inventory covers the entire state—all 29 counties. In addition, counties outside Utah were included in the PM2.5 SIP domain. The NEI 2014 was used for these counties.

Emissions units for the base year inventory were tons per year, obtained as follows:

| Non-road Sector | Units |
|---|---|
| Non-road Engines and Motorized Equipment (MOVES2014b) | (5*Wkdy + 2*Wknd)/7 = Daily Emissions * 365.25 = Tons per Year |
| Aircraft and Airport Ground Support Equipment | (January emissions) * (365.25/31) = Tons per Year |
| Diesel Locomotives | 2017 Annual Emissions x Scaling Factors |

The CAMX model then converts the ton-per-year inventories back to tons per winter weekday and tons per winter weekend day.

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
Federal Aviation Administration (FAA) "Terminal Area Forecast ("TAF") Database, Current TAF Data (download 2017 data): Airport Operations.xlsx.

Railroad companies operating in Utah—reports of locomotive fuel consumption by county

FAA Airport Master Record—Airport IQ 5010—aircraft activity for small airports--air taxi and general aviation (this is a backup database if data is not found in the FAA TAF db).

Utah Division of Motor Vehicles (UDMV)—snowmobile inventory for Utah
Utah Transit Authority—commuter rail "Front Runner" activity

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

Features of MOVES (NONROAD Vehicles and Equipment)

MOVES2014b was used to obtain emission inventories for non-road mobile engines and motorized equipment that operate on unpaved roads or other areas but not on paved roads.

MOVES was run for a January weekday and January weekend day. Emissions were converted to tons per year as shown above.

MOVES models additional compounds that the EPA NONROAD Model does not, including:

CH4, NH3, major mobile HAPs (1,3–butadiene, acetaldehyde, acrolein, benzene, formaldehyde), polycylic 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, movesdb20181022.

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 (1998 – 2017).

Utah obtained meteorological data from one of several reputable websites generally run by colleges and universities in Utah, or from national meteorological websites such as MESOWEST or Western Regional Climate Center.

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

B. **Aircraft Emissions and Ground Support Equipment**

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.

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

Aircraft produce significant amounts of CO and SOx. In fact, the majority of SOx 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.

C. **Diesel Locomotive Emissions**

There are seven major 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.

We have recently found about 7 more railroad companies supposedly operating in Utah. These are likely very small operations, so this inventory does not include emissions from these. In future work including the NEI 2017, we plan to contact these companies and request locomotive activity data from them.

Locomotives produce significant amounts of NOx, 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 2017 used 15-ppm sulfur diesel except that Salt Lake, Garfield & Western Railway did not return our calls (the latter is an extremely small railroad). Therefore, we set its diesel sulfur content the maximum level of 500 ppm. The most recent data received from SL, G & W was for calendar year 2008. Emissions for 2017 were projected using activity scaling factors (described later).

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

D. **Comments**

PM10 and PM2.5 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—Michael Army Air Field (formerly 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.

v. Emission Inventories

A. Base Year Inventory

The base year for this inventory is 2017.

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

The summary table that follows includes emissions for the following:

Non-road Engines and Motorized Equipment (MOVES2014b)
Aircraft
Aircraft Ground Support Equipment
Locomotives
Total Non-road Mobile Source Emissions

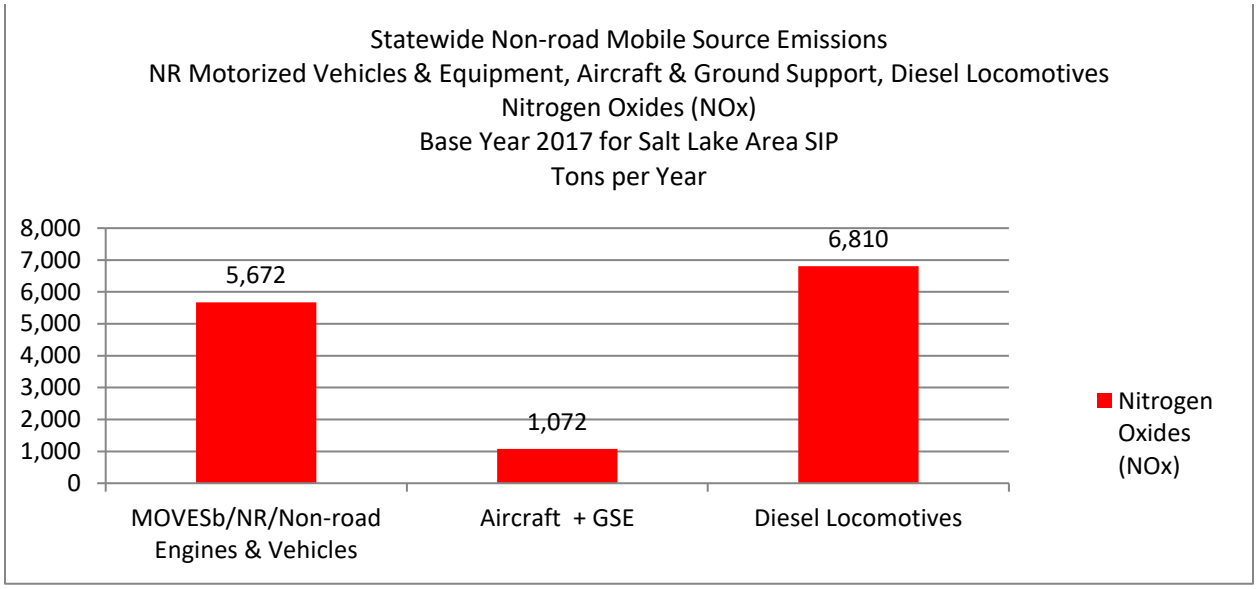
Summary Worksheet for Base Year 2017 Inventory for PM2.5 Maintenance SIP
Statewide Emissions: Non-road Mobile Sources
6/1/2019

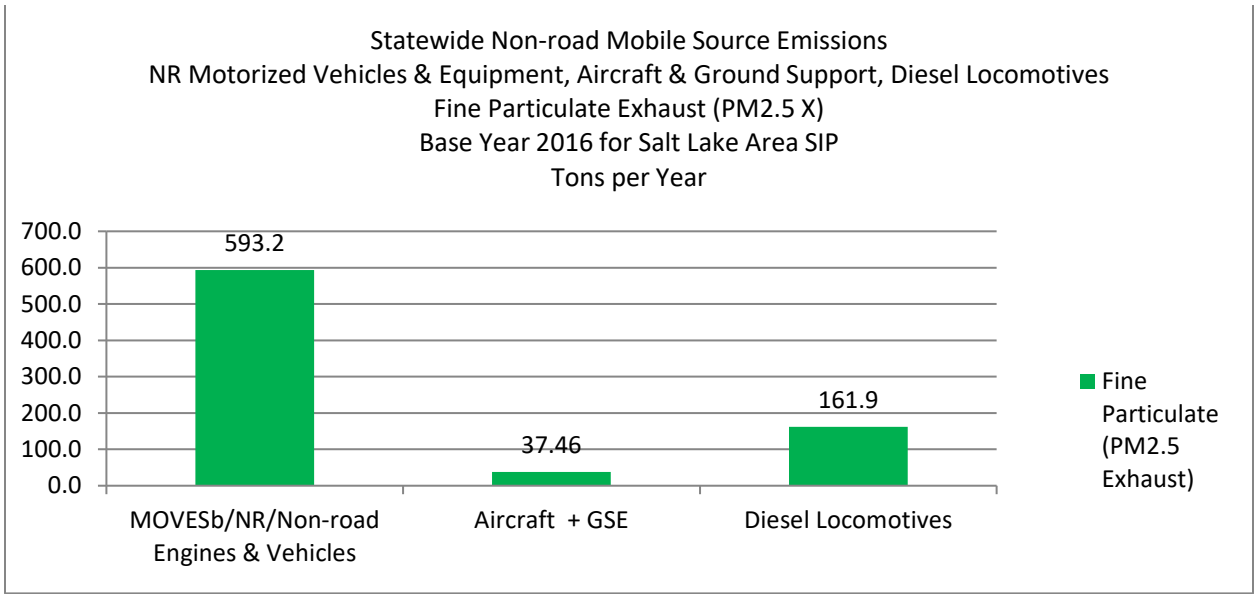
| Cal Yr | Domain | Source Category | CO | NOX | PM10 X | PM2.5 X | SO2 | VOC* | NH3 |
|---|---|---|---|---|---|---|---|---|---|
| | | | TONS PER YEAR | | | | | | |
| 2017 | Entire State | MOVESb/NR/Non-road Engines & Vehicles | 64,412 | 5,672 | 627.1 | 593.2 | 12.31 | 8,638 | 12.06 |
| 2017 | Entire State | Aircraft | 7,997 | 1,026 | 40.66 | 35.65 | 130.1 | 353.8 | N/A** |
| 2017 | Entire State | Airport Ground Support Equipment | 449.3 | 46.26 | 1.905 | 1.809 | 2.302 | 15.51 | N/A** |
| 2017 | Entire State | Diesel Locomotives | 1,423 | 6,810 | 166.9 | 161.9 | 4.977 | 320.2 | 4.421 |
| 2017 | Entire State | **SUM** | **74,281** | **13,554** | **833.2** | **792.6** | **149.7** | **9,328** | **16.48** |

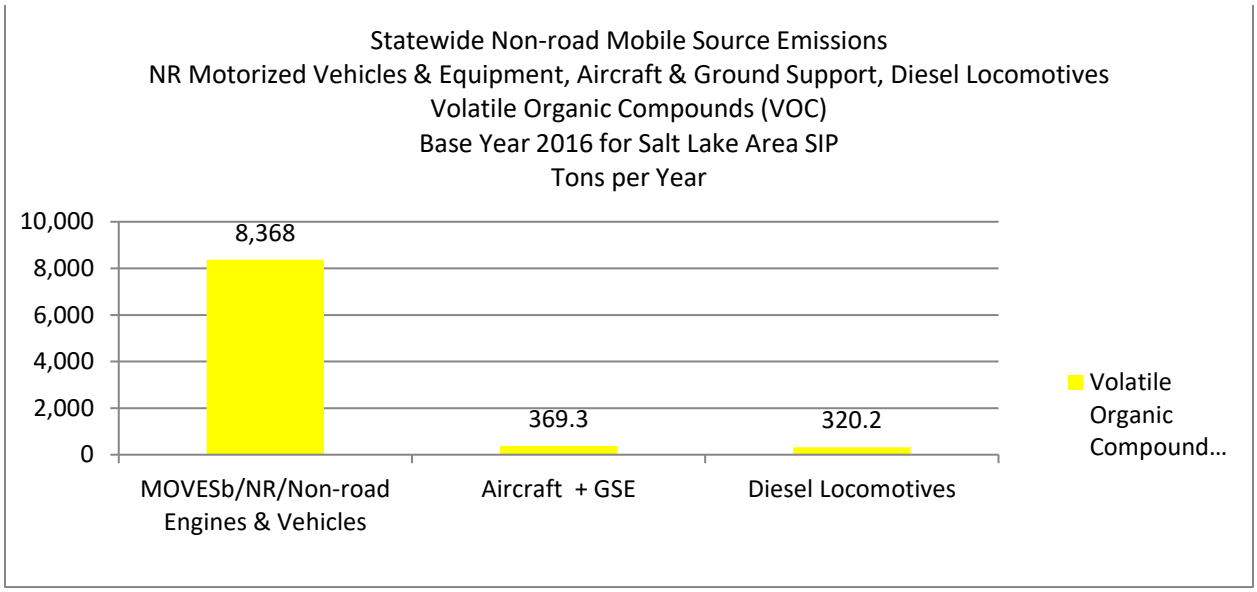
| CH4 | C6H6 | Toluene | Xylene(s) | TGH | NMHC | NMOG | TOG |
|---|---|---|---|---|---|---|---|
| 496.3 | 177.6 | 696.7 | 583.1 | 8,705 | 8,208 | 8,684 | 9,180 |

Emissions for miscellaneous pollutants are from MOVES2014b.

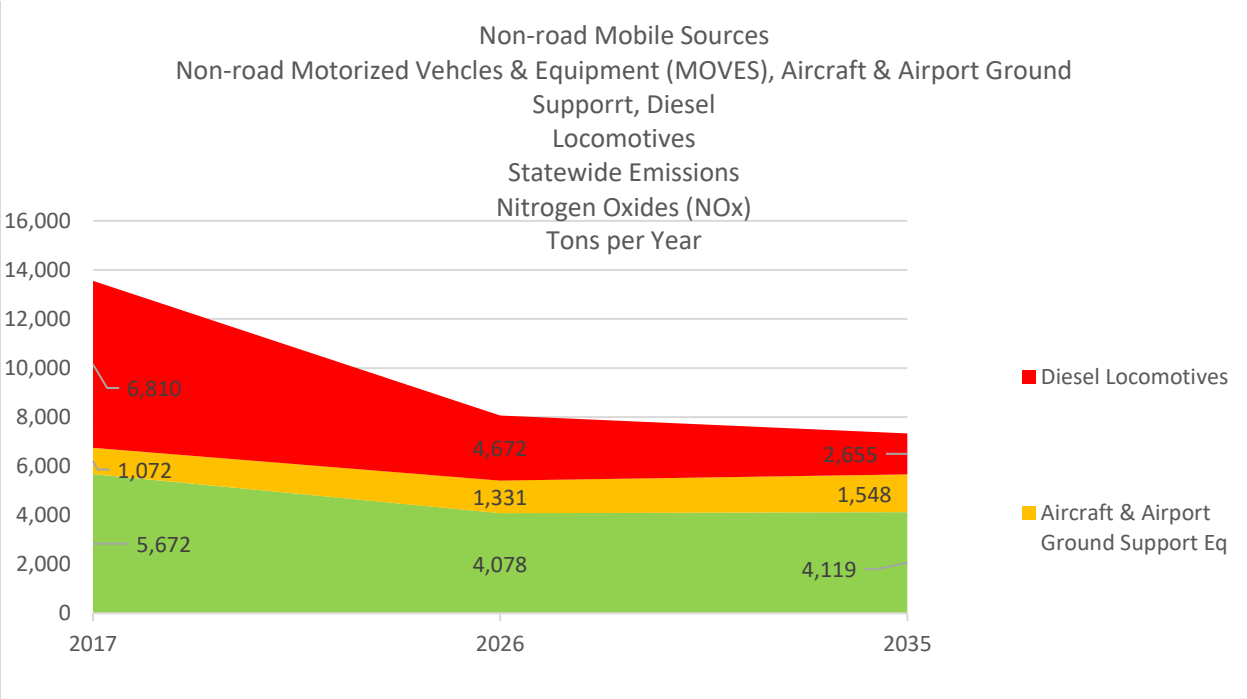
B. Charts of Statewide Non-road Mobile Source Emissions for Base Year 2017: NOx, PM2.5 Exhaust and VOC

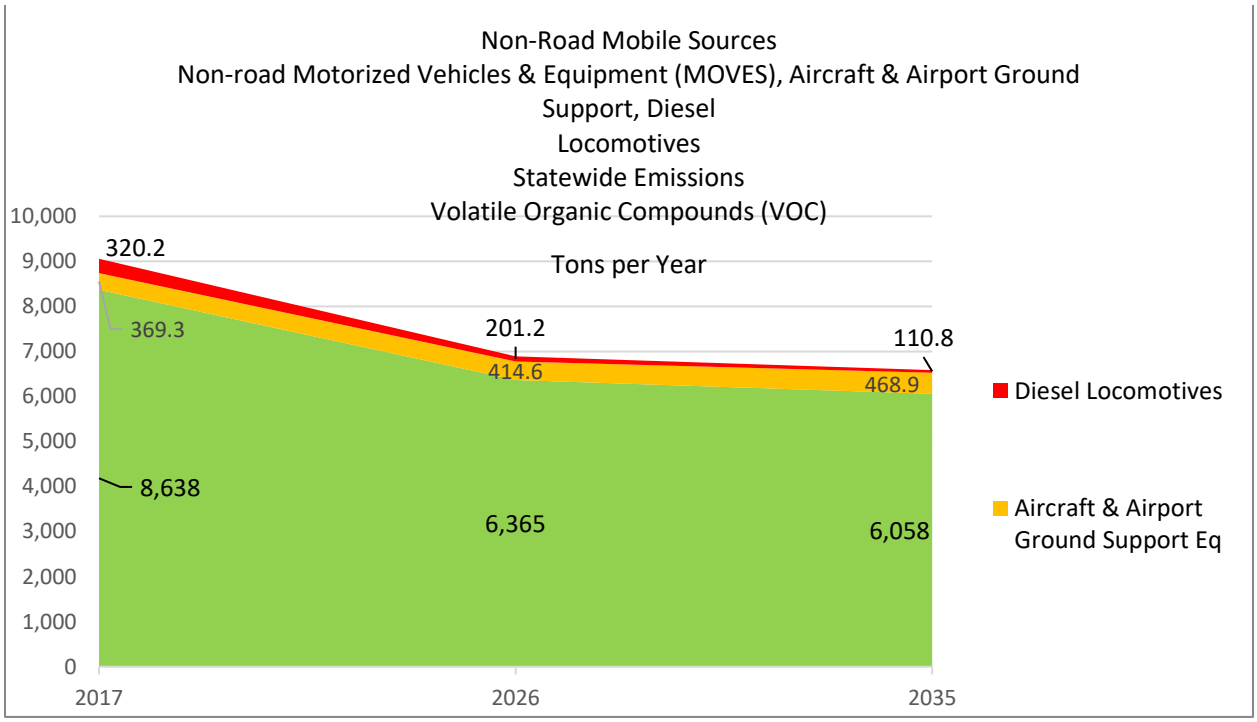


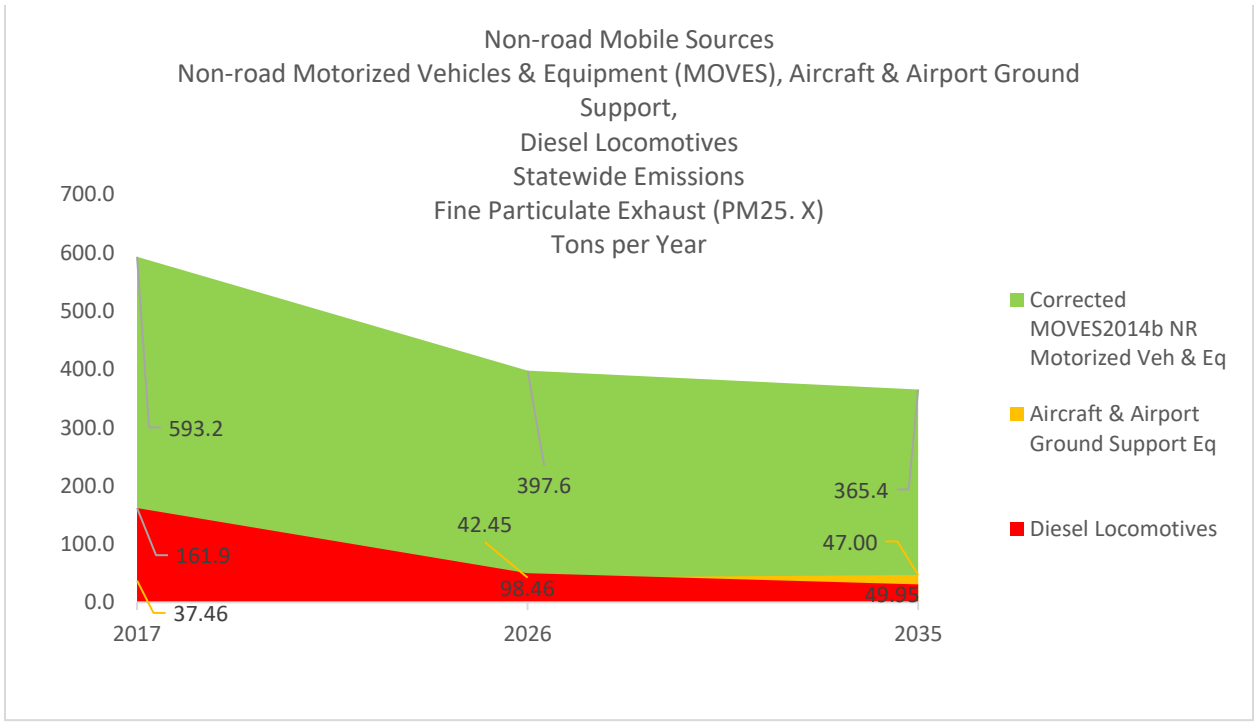




Statewide Non-road Mobile Source Emissions
NR Motorized Vehicles & Equipment, Aircraft & Ground Support, Diesel Locomotives
Volatile Organic Compounds (VOC)
Base Year 2016 for Salt Lake Area SIP
Tons per Year
10,000
8,000
6,000
4,000
2,000
0
8,368
369.3
320.2
MOVESb/NR/Non-road Engines & Vehicles
Aircraft + GSE
Diesel Locomotives
Volatile Organic Compound…

| Calendar Year | Source | Counties | CO | NOx | VOC | PM2.5 Exh |
|---|---|---|---|---|---|---|
| 2017 | MOVES2014b NR Motorized Veh & Eq | ALL | 64,412 | 5,672 | 8,638 | 593.2 |
| 2026 | MOVES2014b NR Motorized Veh & Eq | ALL | 67,861 | 4,078 | 6,365 | 397.6 |
| 2035 | MOVES2014b NR Motorized Veh & Eq | ALL | 77,117 | 4,119 | 6,058 | 365.4 |
| | | | | | | |
| 2017 | Aircraft & Airport Ground Support Eq | ALL | 8,446 | 1,072 | 369.3 | 37.46 |
| 2026 | Aircraft & Airport Ground Support Eq | ALL | 9,113 | 1,331 | 414.6 | 42.45 |
| 2035 | Aircraft & Airport Ground Support Eq | ALL | 9,706 | 1,548 | 468.9 | 47.00 |
| | | | | | | |
| 2017 | Diesel Locomotives | ALL | 1,423 | 6,810 | 320.2 | 161.9 |
| 2026 | Diesel Locomotives | ALL | 1,559 | 4,672 | 201.2 | 98.46 |
| 2035 | Diesel Locomotives | ALL | 1,604 | 2,655 | 110.8 | 49.95 |
| | | | | | | |
| 2017 | SUM | ALL | 74,281 | 13,554 | 9,328 | 792.6 |
| 2026 | SUM | ALL | 78,533 | 10,081 | 13,749 | 687.4 |
| 2035 | SUM | ALL | 112,593 | 8,322 | 14,908 | 682.3 |




Non-Road Mobile Sources
Non-road Motorized Vehicles & Equipment (MOVES), Aircraft & Airport Ground Support, Diesel Locomotives
Statewide Emissions
Volatile Organic Compounds (VOC)
Tons per Year
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
320.2
369.3
201.2
414.6
110.8
468.9
8,638
6,365
6,058
2017
2026
2035
Diesel Locomotives
Aircraft & Airport Ground Support Eq


Non-road Mobile Sources
Non-road Motorized Vehicles & Equipment (MOVES), Aircraft & Airport Ground Support,
Diesel Locomotives
Statewide Emissions
Fine Particulate Exhaust (PM25. X)
Tons per Year
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
593.2
397.6
365.4
42.45
47.00
161.9
98.46
49.95
37.46
2017
2026
2035
Corrected MOVES2014b NR Motorized Veh & Eq
Aircraft & Airport Ground Support Eq
Diesel Locomotives

vi. Nonroad Emissions Sources and Models

| | |
|---|---|
| A. Non-road Engines & Motorized Equipment | EPA MOVES2014b Model (October 2018) |
| B. Aircraft (emissions per landing/ takeoff cycle or LTO) | Federal Aviation Administration "Emissions and 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 "Terminal Area Forecast" Db (3) https://www.faa.gov/data_research/aviation/taf/. Number of air taxi and general aviation LTOs |
| 3. Military Aircraft | U.S. Michael Army Air Field (annual report)<br>U.S. Hill Air Force Base (annual report)<br>FAA "Airport Master Records" and consultation with UT Div. of Aeronautics: number of military aircraft takeoffs and landings (LTOs) |
| C. Airport Ground Support Equip-ment (GSE) | FAA EDMS 5.1.4.1 Model |
| D. Diesel Locomotives | Railroad Companies (reports from):<br>AMTRAK<br>Rio Tinto (Kennecott Utah Copper)<br>Salt Lake, Garfield and Western Railway<br>Union Pacific Railroad (includes activity from Burlington Northern Santa Fe)<br>Utah Railway Company (Genesee & Wyoming)<br>Utah Transit Authority (commuter rail): diesel fuel consumption by county and locomotive type: line-haul, yard and commuter |

vii. Non-road Engines and Motorized Equipment (MOVES2014b)

The EPA MOVES2014b Model (October 2018) was used to compute non-road emissions.

"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 MOVES2014b (small personal watercraft are included).

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

In addition, for the CAMX air dispersion model, additional materials and compounds were modeled: benzene, CH4, NMHC, NMOG, TOG, TGH, toluene and xylenes. For possible future use, CO2 emissions were also modeled. If the output includes SCC code, then fuel type does not need to be output.

For the base year, emissions were computed for a January weekday and a January weekend day. Output units were grams per winter weekday or grams per winter weekend day.

Next, emissions units were converted to January daily and then ton-per-year emissions using the following equation:

(5*Wkdy + 2*Wknd)/7 = Daily Emissions * 365.25 = Tons per Year

Output was organized into "SMOKE" format and transferred to the CAMX air dispersion model for analysis of pollutant concentrations.

A. MOVES 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.

Nonetheless, UDAQ carefully reviewed the MOVES default database tables of fuel supply and fuel formulation to insure that the correct fuel properties were modeled.

1. Sulfur Content of Fuels

For non-road diesel, marine diesel, CNG and LPG, we used MOVES default sulfur content. The sulfur content of these fuels varies slightly with calendar year as follows:

| Table | fuelRegion ID | fuelYearID | monthGroupID | fuelFormulationID |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| nrfuelsupply | 500,000,000 and 578,000,000 | 2017 | 1 | 3393 |
| " | " | " | " | 20008 |
| " | " | " | " | 26012 |
| " | " | " | " | 28001 |
| " | " | " | " | 29001 |

| Table | fuelSubtypeID | RVP | sulfurLevel | ETOHVolume |
|---|---|---|---|---|
| fuelformulation | 12 | 12.68 | 30 | 10 |
| " | 23 | 0.00 | 11 | 0 |
| " | 24 | 0.00 | 56 | 0 |
| " | 30 | 0.00 | 7.6 | 0 |
| " | 40 | NULL | 7.6 | NULL |

| Table | fuelSubtypeID | fuelTypeID | fuelSubtypeDesc |
|---|---|---|---|
| fuelsubtype | 12 | 1 | Gasohol (E-10) |
| " | 30 | 3 | Compressed Natural Gas (CNG) |
| " | 40 | 4 | Liquefied Petroleum Gas (LPG) |

| Table | fuelTypeID | defaultFormulationID | fuelTypeDesc |
|---|---|---|---|
| nrfueltype | 23 | 23 | Nonroad Diesel Fuel |
| " | 2 | 24 | Marine Diesel Fuel |

Gasoline sulfur content was set at 30 ppmw in calendar year 2017. The reason for this is that Utah receives almost 100% of its gasoline from five local refineries. These are considered small refineries and will not produce 10 ppmw S gasoline until 2020. S content was set to 10 ppm in 2026 and 2035.

In the non-road module of MOVES2014b UDAQ ran sensitivity tests which showed that only SO2 emissions are affected by gasoline sulfur content.

2. Meteorological Data

For SIP meteorological data, Utah obtained data from MESOWEST, a meteorological website designed by the University of Utah Department of Atmospheric Sciences. MOVES default values for met data are only approximate, so these were not used.

Temperature and Relative Humidity Data

Hourly temperature and relative humidity data used for the base year and projection years are the average values from the three PM2.5 episodes as shown below:

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 | -4.6 | 12.7 | 010811 | 6.5 | 21.7 |
| 49005 | Cache | 010401 | -4.6 | 12.7 | 010811 | 6.5 | 21.7 |
| 49011 | Davis | 011211 | 11.9 | 17.1 | 010811 | 20.0 | 26.5 |
| 49035 | Salt Lake | 010111 | 6.7 | 19.9 | 010811 | 19.0 | 25.0 |
| 49045 | Tooele | 010111 | 1.4 | 19.4 | 010311 | 15.8 | 24.8 |
| 49049 | Utah | 010111 | 1.4 | 17.6 | 010911 | 14.6 | 24.8 |
| 49057 | Weber | 010111 | 6.8 | 19.3 | 010811 | 18.3 | 25.0 |

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 | -4.8 | 17.8 | 021616 | 33.4 | 48.4 |
| 49005 | Cache | 020216 | -4.8 | 17.8 | 021616 | 33.4 | 48.4 |
| 49011 | Davis | 020216 | 15.1 | 29.8 | 021716 | 35.1 | 58.2 |
| 49035 | Salt Lake | 020216 | 15.3 | 27.9 | 021716 | 37.4 | 59.9 |
| 49045 | Tooele | 020316 | 8.4 | 25.7 | 021716 | 33.6 | 55.9 |
| 49049 | Utah | 020316 | 11.3 | 27.1 | 021716 | 29.3 | 58.7 |
| 49057 | Weber | 020216 | 9.0 | 24.7 | 021716 | 36.6 | 52.9 |

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 |

B. Snowmobile Adjustments (MOVES2014b)

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. MOVES2014b was used to model the NONROAD vehicles and equipment in these inventories.

UDAQ reviewed the PM2.5 SIP inventories from the EPA NONROAD model for the 2008 base year and projection years 2014, 2017 and 2019. Theses 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.

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 MOVES2014b default database. (4, 5)

The survey report on snowmobile activity in Utah also showed that activity was spread over the months of December through April inclusive instead of the default months of December through February that are shown in the MOVES default database.

In addition, UDAQ recently obtained counts of registered snowmobiles by county from the Utah Tax Commission (Division of Motor Vehicle registration data) for calendar years 2005 through 2018. (6)

In summary, reports and databases for Utah showed that actual snowmobile activity differed from data stored in the MOVES2014b database. Therefore, UDAQ created input tables to use in place of defaults stored in the MOVES2014b database as follows:

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

Relative numbers of snowmobiles were reallocated among the counties based on survey data. This was done by modifying the file "nrstatesurrogate" found in the database "movesdb20181022".

For details of changes to the file "nrstatesurrogate", see the Appendix.

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

The MOVES file "nrbaseyearequippopulation" shows the default number of snowmobiles in Utah as of calendar year 1990.

From the data supplied by DMV, the Utah snowmobile population for calendar year 1990 was estimated by performing a linear regression on DMV snowmobile counts over calendar years 2005 through 2018. It was found that Utah had 40,135 snowmobiles in 1990. The default value in the MOVES default database "nrbaseyearequippopulation" showed only 21,784 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 MOVES2014b Database (File "nrgrowthindex")

The MOVES file "nrgrowthindex" determines counts of equipment in future years.

Because the snowmobile count in the base year (1990) was changed in MOVES, and because data from DMV showed a different annual growth rate of snowmobiles, it was necessary to adjust snowmobile counts in future years. This was done by changing the growth numbers in the "nrgrowthindex" file.

In addition, through trial and error, we determined that the nrgrowthindex values must also be adjusted for Recreational Gasoline/LPG equipment.

IF THE nrgrowthindex values are NOT adjusted for both the specific equipment type (snowmobiles) AND the group (recreational gasoline/LPG equipment), the results will be in error.

Specifically, the values of the nrgrowthindex table were adjusted for growthPatternIDs 1002 – 1010 (which pertain to snowmobiles), and were also adjusted for growthPattern ID 2402, which are recreational gasoline/LPG equipment.

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

4. Snowmobile Seasonality Changed in MOVES2014a Database (File "nrmonthallocation)
The MOVES default file "nrmonthallocation" shows that snowmobile activity 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 MOVES2014b, folders named "nrjan2017_500" and "nrjan2017_578" were added to the MySQL data folder to store changes made to the default snowmobile tables. When the MOVES GUI is opened, the user must go to the menu item "Manage Input Data Series" and choose, using the drop-down list, the name of the data folder that contains the modified snowmobile data ("nrjan2017_500" or "nrjan2017_578").

In summary, MOVES default values in the following files were changed for snowmobiles:

| File Name | Description |
|---|---|
| nrstatesurrogateyear | 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 | Snowmobile annual growth rate. Snowmobiles have growth pattern IDs 1002 – 1010. |
| nrgrowthindex | Recreational gasoline/LPG equipment (growth pattern ID = 2402) nrgrowthindex values were changed as well. |
| nrmonthallocation | Relative snowmobile activity by month |

5. Additional MOVES2014b 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 IDs = 1002 - 1010 identifies snowmobiles |
| nrgrowthpattern | Growth pattern ID = 2402 = recreational gasoline/LPG x equipment |
| nrsurrogate | Surrogate ID = 14 identifies residential snowmobiles |

6. No Additional Changes to the MOVES2014b Database

No other changes were made to the MOVES2014b default database.

viii. 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

| Operation Type | Description | Source of Emission Factors | SCC Code Groups |
|---|---|---|---|
| Commercial Flights/Air Carriers | Operations at Salt Lake City International Airport and smaller municipal airports. | EDMS 5.1.4.1 | 2275020000 |
| Air Taxi | Small privately-owned commuter planes | EDMS 5.1.4.1 | 2275060000 |
| General Aviation | Small municipal airport operations (aircraft are "based" in small cities and towns) | EDMS 5.1.4.1 | 2275050000 |
| Military Aircraft | Military operations | Reports from Military Bases | 2275010000 |

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. (7)

Air taxi, general aviation and military aircraft operations are treated the same way: one LTO cycle consists of one landing and one takeoff.

For air taxis, general aviation, and military aircraft, only annual activity data are available. Annual activity is reported by the FAA in its "Terminal Area Forecast" database. This database is updated each year.

If the TAF database does not include a given airport, the FAA Airport Master Records can be searched to find the aircraft activity. These records are updated periodically. Some of the airport records have not been updated since 2011, while others are current to December 31, 2017. For those records that are not up-to-date, FAA scaling factors were used to adjust the number of LTOs to the base year. (8)

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/.

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 year/month was January 2017.

On the web page, boxes are checked for the following:

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 10,414 LTO cycles that took place in January 2017 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 2017 activity, the annualized number of commercial LTOs in Utah were about 10414 * (365.25/31) = 122,700.

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 in the FAA database "Terminal Area Forecast at:
https://www.faa.gov/data_research/aviation/taf/ (3).

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.

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)

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

Statewide Aircraft LTOs by Calendar Year and Operational Type

Commercial aircraft LTOs were reported for the month of January 2017. The January number of LTOs was multiplied by (365.25/31) to convert the LTOs to an annual count. Air taxi, general aviation and military LTOs were reported in annual units as shown below:

| Calendar Year and Month | Commercial | Air Taxi | General Aviation | Military |
|---|---|---|---|---|
| Jan 2017 | (10,414)*(365.25/31) | 46,916 | 364,402 | 32,537 |

= 122,700

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.

A report (2013) from the Journal of Atmospheric Chemistry and Physics states that more research and modeling are needed to determine whether NH3 emissions from aircraft make any meaningful contribution to PM2.5 concentrations. (9)

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 Michael Army Air Field—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.

ix. Diesel Locomotives

The locomotive source category includes railroad locomotives powered by diesel-electric engines and does not include locomotives powered by electricity or steam. Locomotive diesel engines are significant contributors to NOx emissions

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). (10)

For NH3, the EPA document "Documentation for Locomotive Component of the National Emissions Inventory Methodology" (May 2011) was used because the document "Emission Factors for Locomotives" does not include EFs for NH3. (11)

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.

Diesel locomotive fuel consumption data were reported to UDAQ by the individual railroad companies that operate in Utah. For 2017, these companies include: Amtrak, Burlington Northern Santa Fe Railway (BNSF), Rio Tinto (Kennecott Utah Copper), Union Pacific Railroad Company (UPRR), Utah Railway and Utah Transit Authority (UTA)--commuter rail operations.

In addition, Utah Transit Authority reported its 2017 diesel fuel consumption for commuter rail.

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 for passenger locomotives was projected to increase 2% per year as well. (12)

For projections of freight diesel fuel consumption, scaling factors were obtained by searching for documents from reputable sources that projected growth of freight ton-miles from as early as calendar year 2000 through at least calendar year 2026. These documents include the following:

National Petroleum Council, "Rail Transportation Demand, Topic Paper #2", Aug 1, 2012. (13)

U.S. DOE, Energy Efficiency & Renewable Energy (EERE), "Freight Transportation Demand: Energy-Efficient Scenarios for a Low-Carbon Future", March 2013. (14)

U.S. DOT, "National Freight Strategic Plan", 2015. (15)

Each of the above three reports includes charts that show the growth in freight miles or ton-miles to some distant year:

| Milestone Years | Cumulative Percent Growth in Freight Ton-Miles | | |
|---|---|---|---|
| | National Petroleum Association (Medium Growth) | U.S. DOE EERE (High Growth) | U.S. DOT: Nat'l Freight Strategic Plan (Low Growth) |
| 2017 – 2026 | 9.00% | 16.7% | 5.87% |

Since we do not know which projection is the most accurate, the "medium-growth" scenario was used, i.e., data from the National Petroleum Association.

x. Output

A. MOVES2014b

MOVES was run for each of the 29 counties in Utah for a January weekday and January weekend day in 2016. Hourly temperature and relative humidity (RH) data were obtained by taking the average hourly temperature and RH values from all the PM2.5 episode days in January 2011, December 2013 and February 2016. These meteorological data were used in the previous SIP for which the base year was 2017.

The resulting output in units of grams per January weekday or weekend day were converted to January daily emissions using the equation:

(5*Wkdy + 2*Wknd)/7 = Daily Emissions * 365.25 = Tons per Year

B. Aircraft (EDMS v. 5.1.4.1)

Commercial aircraft activity (landings and takeoffs, or LTOs) were downloaded for January 2017. 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 will also be 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.

D. SMOKE Formats for Air Dispersion Model

For the "Comprehensive Air Quality Model with Extensions" (CAMx), emissions were formatted into EXCEL tables. Data in SMOKE formats include calendar year, county name, FIPs code, pollutant id (from MOVES and applied to all non-road sources), SCC and TPY.

xi. APPENDIX ITEMS

A. Inventories

Jan 2017 Emissions: MOVES2014b, Aircraft, Airport Ground Support Equipment, Locomotives
Jan 2026
Jan 2035

B. MOVES2014b Model: Changes to Underlying Database for Snowmobiles
1. nrstatesurrogate table
2. nrbaseyearequippopulation
3. nrgrowthindex
4. nrmonthallocation

January 2017 Emissions from MOVES2014b: Non-road Motorized Vehicles & Equipment
TONS PER YEAR

| County | FIPS | CO | NOx | PM10X | PM2.5X | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 104.1 | 11.20 | 1.187 | 1.132 | 0.0176 | 8.924 | 0.0191 |
| Box Elder | 49003 | 1,721 | 199.7 | 12.77 | 12.13 | 0.4343 | 259.2 | 0.3177 |
| Cache | 49005 | 2,772 | 265.0 | 32.86 | 30.98 | 0.6562 | 599.0 | 0.6221 |
| Carbon | 49007 | 976.9 | 133.6 | 17.13 | 16.27 | 0.2388 | 246.0 | 0.2317 |
| Daggett | 49009 | 266.0 | 9.741 | 3.244 | 2.992 | 0.0577 | 109.1 | 0.0462 |
| Davis | 49011 | 4,651 | 504.9 | 47.58 | 45.31 | 0.9668 | 412.0 | 1.0284 |
| Duchesne | 49013 | 528.4 | 55.87 | 4.643 | 4.402 | 0.1005 | 67.80 | 0.0994 |
| Emery | 49015 | 432.9 | 101.6 | 11.69 | 11.16 | 0.1485 | 137.4 | 0.1544 |
| Garfield | 49017 | 266.6 | 28.23 | 3.727 | 3.508 | 0.0678 | 72.43 | 0.0698 |
| Grand | 49019 | 460.6 | 55.31 | 4.013 | 3.813 | 0.0897 | 50.89 | 0.0920 |
| Iron | 49021 | 901.5 | 101.2 | 10.97 | 10.38 | 0.2147 | 175.6 | 0.2159 |
| Juab | 49023 | 384.2 | 44.50 | 4.146 | 3.917 | 0.0854 | 70.56 | 0.0836 |
| Kane | 49025 | 247.7 | 23.88 | 1.986 | 1.871 | 0.0536 | 45.14 | 0.0459 |
| Millard | 49027 | 395.0 | 48.18 | 3.151 | 3.003 | 0.0919 | 59.21 | 0.0730 |
| Morgan | 49029 | 155.9 | 19.61 | 1.363 | 1.310 | 0.0319 | 7.809 | 0.0337 |
| Piute | 49031 | 98.50 | 4.756 | 1.283 | 1.188 | 0.0221 | 39.86 | 0.0183 |
| Rich | 49033 | 1,266 | 43.36 | 16.08 | 14.83 | 0.2649 | 502.8 | 0.2154 |
| Salt Lake | 49035 | 25,559 | 1,804 | 189.8 | 179.8 | 3.918 | 1,868 | 3.799 |
| San Juan | 49037 | 311.1 | 28.94 | 2.231 | 2.104 | 0.0575 | 45.63 | 0.0484 |
| Sanpete | 49039 | 733.0 | 40.59 | 8.722 | 8.116 | 0.1529 | 235.4 | 0.1338 |
| Sevier | 49041 | 596.2 | 129.7 | 13.94 | 13.36 | 0.1687 | 97.18 | 0.1851 |
| Summit | 49043 | 2,444 | 147.5 | 30.75 | 28.65 | 0.5267 | 770.4 | 0.4924 |
| Tooele | 49045 | 686.9 | 94.00 | 6.802 | 6.481 | 0.1809 | 98.92 | 0.1673 |
| Uintah | 49047 | 1,713 | 250.0 | 14.72 | 14.05 | 0.3824 | 172.8 | 0.3897 |
| Utah | 49049 | 6,992 | 733.3 | 74.36 | 70.71 | 1.416 | 655.1 | 1.5221 |
| Wasatch | 49051 | 1,865 | 93.45 | 25.55 | 23.69 | 0.4376 | 752.8 | 0.3882 |
| Washington | 49053 | 2,877 | 304.4 | 33.95 | 32.24 | 0.5679 | 283.4 | 0.6602 |
| Wayne | 49055 | 78.13 | 6.886 | 0.9204 | 0.8676 | 0.0136 | 12.26 | 0.0141 |
| Weber | 49057 | 4,930 | 388.9 | 47.59 | 44.84 | 0.9456 | 782.8 | 0.8962 |
| | **SUM** | **64,412** | **5,672** | **627.1** | **593.2** | **12.31** | **8,638** | **12.06** |

January 2017 Emissions from Aircraft
TONS PER YEAR

| County Number | County Name | County FIPs | CO | NOX | PM10X | PM2.5X | SOX | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Beaver | 49001 | 28.55 | 0.1448 | 0.0691 | 0.0671 | 0.0590 | 0.6506 | N/A |
| 2 | Box Elder | 49003 | 179.8 | 0.5318 | 0.4015 | 0.3896 | 0.2564 | 2.338 | N/A |
| 3 | Cache | 49005 | 645.2 | 2.009 | 1.460 | 1.416 | 0.9737 | 9.435 | N/A |
| 4 | Carbon | 49007 | 33.50 | 1.271 | 0.0905 | 0.0884 | 0.2030 | 0.8835 | N/A |
| 5 | Daggett | 49009 | 17.39 | 0.0358 | 0.0381 | 0.0370 | 0.0217 | 0.1940 | N/A |
| 6 | Davis | 49011 | 439.1 | 35.15 | 5.771 | 2.039 | 3.402 | 11.49 | N/A |
| 7 | Duchesne | 49013 | 63.33 | 0.1584 | 0.1393 | 0.1352 | 0.0827 | 0.7183 | N/A |
| 8 | Emery | 49015 | 49.00 | 0.6702 | 0.1155 | 0.1124 | 0.1372 | 0.7862 | N/A |
| 9 | Garfield | 49017 | 61.77 | 0.3076 | 0.1405 | 0.1364 | 0.1065 | 0.8991 | N/A |
| 10 | Grand | 49019 | 120.6 | 4.486 | 0.3278 | 0.3199 | 0.7451 | 3.415 | N/A |
| 11 | Iron | 49021 | 61.35 | 5.819 | 1.622 | 1.575 | 1.727 | 15.99 | N/A |
| 12 | Juab | 49023 | 27.89 | 0.0469 | 0.0654 | 0.0635 | 0.0432 | 0.5532 | N/A |
| 13 | Kane | 49025 | 29.01 | 0.1285 | 0.0646 | 0.0627 | 0.0454 | 0.3526 | N/A |
| 14 | Millard | 49027 | 37.39 | 0.1610 | 0.0832 | 0.0808 | 0.0579 | 0.4526 | N/A |
| 15 | Morgan | 49029 | 39.26 | 0.0534 | 0.0863 | 0.0837 | 0.0465 | 0.4565 | N/A |
| 16 | Piute | 49031 | 8.353 | 0.0073 | 0.0182 | 0.0176 | 0.0091 | 0.0890 | N/A |
| 17 | Rich | 49033 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | N/A |
| 18 | Salt Lake | 49035 | 2,741 | 943.0 | 19.47 | 18.92 | 114.2 | 243.1 | N/A |
| 19 | San Juan | 49037 | 71.84 | 0.3206 | 0.1600 | 0.1553 | 0.1127 | 0.8741 | N/A |
| 20 | Sanpete | 49039 | 12.65 | 0.0420 | 0.0280 | 0.0271 | 0.0179 | 0.1478 | N/A |
| 21 | Sevier | 49041 | 95.77 | 0.2669 | 0.2111 | 0.2048 | 0.1288 | 1.098 | N/A |
| 22 | Summit | 49043 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | N/A |
| 23 | Tooele | 49045 | 743.0 | 8.135 | 3.517 | 3.129 | 1.531 | 11.03 | N/A |
| 24 | Uintah | 49047 | 118.3 | 1.820 | 1.171 | 1.137 | 0.3953 | 7.523 | N/A |
| 25 | Utah | 49049 | 958.4 | 7.688 | 2.276 | 2.209 | 2.122 | 17.24 | N/A |
| 26 | Wasatch | 49051 | 173.7 | 1.828 | 0.4061 | 0.3947 | 0.4226 | 2.790 | N/A |
| 27 | Washington | 49053 | 565.5 | 6.564 | 1.361 | 1.322 | 1.698 | 10.49 | N/A |
| 28 | Wayne | 49055 | 25.64 | 0.0946 | 0.0568 | 0.0552 | 0.0376 | 0.3037 | N/A |
| 29 | Weber | 49057 | 650.1 | 5.460 | 1.514 | 1.471 | 1.429 | 10.57 | N/A |
| **ALL** | | **GRAND TOTAL** | **7,997** | **1,026** | **40.66** | **35.65** | **130.1** | **353.8** | **N/A** |

Aircraft VOC above does not include refueling VOCs.
*EDMS does not calculate NH3 for aircraft.

January 2017 Emissions from Airport Ground Support Equipment
Tons per Year

| County Number | County Name | County FIPs | CO | NOX | PM10 | PM2.5 | SOX | VOC |
|---|---|---|---|---|---|---|---|---|
| 1 | Beaver | 49001 | 0.0800 | 0.0117 | 0.0002 | 0.0002 | 0.0003 | 0.0038 |
| 2 | Box Elder | 49003 | 0.3102 | 0.0602 | 0.0007 | 0.0007 | 0.0012 | 0.0185 |
| 3 | Cache | 49005 | 1.200 | 0.2216 | 0.0027 | 0.0027 | 0.0049 | 0.0690 |
| 4 | Carbon | 49007 | 1.057 | 0.0881 | 0.0025 | 0.0025 | 0.0045 | 0.0347 |
| 5 | Daggett | 49009 | 0.0190 | 0.0050 | 0.0000 | 0.0000 | 0.0001 | 0.0015 |
| 6 | Davis | 49011 | 0.1627 | 0.0782 | 0.0003 | 0.0003 | 0.0006 | 0.0211 |
| 7 | Duchesne | 49013 | 0.1040 | 0.0209 | 0.0002 | 0.0002 | 0.0004 | 0.0064 |
| 8 | Emery | 49015 | 0.6440 | 0.0596 | 0.0015 | 0.0015 | 0.0027 | 0.0226 |
| 9 | Garfield | 49017 | 0.2523 | 0.0319 | 0.0006 | 0.0006 | 0.0011 | 0.0109 |
| 10 | Grand | 49019 | 5.684 | 0.4621 | 0.0135 | 0.0135 | 0.0243 | 0.1837 |
| 11 | Iron | 49021 | 5.896 | 0.5291 | 0.0136 | 0.0133 | 0.0216 | 0.1883 |
| 12 | Juab | 49023 | 0.0028 | 0.0057 | 0.0000 | 0.0000 | 0.0000 | 0.0014 |
| 13 | Kane | 49025 | 0.1081 | 0.0142 | 0.0003 | 0.0003 | 0.0005 | 0.0048 |
| 14 | Millard | 49027 | 0.1347 | 0.0180 | 0.0003 | 0.0003 | 0.0006 | 0.0061 |
| 15 | Morgan | 49029 | 0.0209 | 0.0096 | 0.0000 | 0.0000 | 0.0001 | 0.0026 |
| 16 | Piute | 49031 | 0.0009 | 0.0018 | 0.0000 | 0.0000 | 0.0000 | 0.0004 |
| 17 | Rich | 49033 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 18 | Salt Lake | 49035 | 411.3 | 42.03 | 1.798 | 1.704 | 2.138 | 14.05 |
| 19 | San Juan | 49037 | 0.2703 | 0.0354 | 0.0006 | 0.0006 | 0.0011 | 0.0120 |
| 20 | Sanpete | 49039 | 0.0329 | 0.0051 | 0.0001 | 0.0001 | 0.0001 | 0.0017 |
| 21 | Sevier | 49041 | 0.1969 | 0.0346 | 0.0004 | 0.0004 | 0.0008 | 0.0109 |
| 22 | Summit | 49043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 23 | Tooele | 49045 | 2.834 | 0.4050 | 0.0096 | 0.0092 | 0.0131 | 0.1281 |
| 24 | Uintah | 49047 | 2.531 | 0.2289 | 0.0083 | 0.0083 | 0.0112 | 0.0846 |
| 25 | Utah | 49049 | 3.631 | 0.5545 | 0.0141 | 0.0137 | 0.0165 | 0.1723 |
| 26 | Wasatch | 49051 | 1.704 | 0.1664 | 0.0040 | 0.0040 | 0.0072 | 0.0619 |
| 27 | Washington | 49053 | 6.583 | 0.6889 | 0.0223 | 0.0208 | 0.0314 | 0.2414 |
| 28 | Wayne | 49055 | 0.0763 | 0.0111 | 0.0002 | 0.0002 | 0.0003 | 0.0037 |
| 29 | Weber | 49057 | 4.448 | 0.4886 | 0.0115 | 0.0114 | 0.0189 | 0.1725 |
| **ALL** | | **GRAND TOTAL** | **449.3** | **46.26** | **1.905** | **1.809** | **2.302** | **15.51** |

*EDMS does not report NH3 from airport ground support equipment.

January 2017 Emissions from Diesel Locomotives
Tons per Year

| County | FIPs | CO | NOx | PM10 | PM2.5 | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 51.25 | 219.4 | 5.582 | 5.415 | 0.1808 | 9.324 | 0.1603 |
| Box Elder | 49003 | 125.3 | 536.7 | 13.65 | 13.24 | 0.4421 | 22.80 | 0.3922 |
| Cache | 49005 | 6.481 | 27.75 | 0.7059 | 0.6848 | 0.0229 | 1.179 | 0.0203 |
| Carbon | 49007 | 21.96 | 93.91 | 2.386 | 2.314 | 0.0775 | 3.990 | 0.0687 |
| Daggett | 49009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Davis | 49011 | 99.07 | 459.9 | 11.34 | 11.00 | 0.3476 | 21.19 | 0.3084 |
| Duchesne | 49013 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Emery | 49015 | 19.83 | 84.74 | 2.151 | 2.087 | 0.0699 | 3.608 | 0.0620 |
| Garfield | 49017 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grand | 49019 | 28.29 | 120.9 | 3.069 | 2.977 | 0.0998 | 5.147 | 0.0885 |
| Iron | 49021 | 66.74 | 285.7 | 7.269 | 7.051 | 0.2354 | 12.14 | 0.2088 |
| Juab | 49023 | 59.96 | 256.8 | 6.531 | 6.336 | 0.2115 | 10.91 | 0.1876 |
| Kane | 49025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Millard | 49027 | 207.2 | 887.0 | 22.56 | 21.89 | 0.7306 | 37.69 | 0.6481 |
| Morgan | 49029 | 54.67 | 234.1 | 5.954 | 5.776 | 0.1928 | 9.946 | 0.1710 |
| Piute | 49031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rich | 49033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salt Lake | 49035 | 236.1 | 1,480 | 33.59 | 32.58 | 0.8031 | 82.86 | 0.7184 |
| San Juan | 49037 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sanpete | 49039 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sevier | 49041 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Summit | 49043 | 93.71 | 401.3 | 10.21 | 9.901 | 0.3305 | 17.05 | 0.2932 |
| Tooele | 49045 | 136.3 | 583.1 | 14.82 | 14.38 | 0.4806 | 24.79 | 0.4263 |
| Uintah | 49047 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Utah | 49049 | 114.4 | 598.7 | 14.24 | 13.81 | 0.3982 | 30.21 | 0.3533 |
| Wasatch | 49051 | 1.497 | 6.399 | 0.163 | 0.158 | 0.0053 | 0.271 | 0.0047 |
| Washington | 49053 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wayne | 49055 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Weber | 49057 | 100.3 | 533.8 | 12.68 | 12.30 | 0.3486 | 27.12 | 0.3092 |
| SUM | | **1,423** | **6,810** | **166.9** | **161.9** | **4.977** | **320.2** | **4.421** |

January 2017 Emissions from Non-road Mobile Sources

Tons per Year

| County | FIPs | CO | NOx | PM10 Exh | PM2.5 Exh | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 184.0 | 230.8 | 6.839 | 6.614 | 0.2576 | 18.90 | 0.1794 |
| Box Elder | 49003 | 2,026 | 737.0 | 26.83 | 25.77 | 1.134 | 284.3 | 0.7099 |
| Cache | 49005 | 3,425 | 295.0 | 35.03 | 33.09 | 1.658 | 609.6 | 0.6424 |
| Carbon | 49007 | 1,033 | 228.9 | 19.61 | 18.68 | 0.5237 | 251.0 | 0.3004 |
| Daggett | 49009 | 283.4 | 9.782 | 3.282 | 3.029 | 0.0794 | 109.3 | 0.0462 |
| Davis | 49011 | 5,189 | 1,000 | 64.69 | 58.35 | 4.717 | 444.7 | 1.337 |
| Duchesne | 49013 | 591.8 | 56.04 | 4.782 | 4.537 | 0.1836 | 68.52 | 0.0994 |
| Emery | 49015 | 502.4 | 187.1 | 13.43 | 13.36 | 0.3584 | 141.8 | 0.2165 |
| Garfield | 49017 | 328.6 | 28.57 | 3.649 | 3.645 | 0.1754 | 73.34 | 0.0698 |
| Grand | 49019 | 615.1 | 181.1 | 7.223 | 7.123 | 0.9589 | 59.63 | 0.1805 |
| Iron | 49021 | 1,036 | 393.3 | 19.28 | 19.02 | 2.198 | 203.9 | 0.4247 |
| Juab | 49023 | 472.1 | 301.3 | 10.51 | 10.32 | 0.3401 | 82.03 | 0.2713 |
| Kane | 49025 | 276.8 | 24.02 | 1.94 | 1.93 | 0.0994 | 45.49 | 0.0459 |
| Millard | 49027 | 639.7 | 935.4 | 25.65 | 24.97 | 0.8810 | 97.36 | 0.7212 |
| Morgan | 49029 | 249.9 | 253.7 | 7.351 | 7.170 | 0.2712 | 18.21 | 0.2047 |
| Piute | 49031 | 106.9 | 4.766 | 1.207 | 1.206 | 0.0312 | 39.95 | 0.0183 |
| Rich | 49033 | 1,266 | 43.36 | 14.83 | 14.83 | 0.2649 | 502.8 | 0.2154 |
| Salt Lake | 49035 | 28,947 | 4,269 | 244.6 | 233.0 | 121.1 | 2,208 | 4.517 |
| San Juan | 49037 | 383.2 | 29.29 | 2.391 | 2.260 | 0.1713 | 46.52 | 0.0484 |
| Sanpete | 49039 | 745.7 | 40.63 | 8.750 | 8.143 | 0.1710 | 235.5 | 0.1338 |
| Sevier | 49041 | 692.1 | 130.0 | 14.15 | 13.56 | 0.2983 | 98.29 | 0.1851 |
| Summit | 49043 | 2,538 | 548.7 | 40.96 | 38.55 | 0.8572 | 787.4 | 0.7856 |
| Tooele | 49045 | 1,569 | 685.6 | 25.15 | 24.00 | 2.206 | 134.9 | 0.5936 |
| Uintah | 49047 | 1,834 | 252.0 | 15.90 | 15.19 | 0.7889 | 180.4 | 0.3897 |
| Utah | 49049 | 8,068 | 1,340 | 90.89 | 86.74 | 3.953 | 702.7 | 1.875 |
| Wasatch | 49051 | 2,041 | 101.8 | 26.12 | 24.25 | 0.8727 | 756.0 | 0.3929 |
| Washington | 49053 | 3,449 | 311.7 | 35.34 | 33.58 | 2.297 | 294.1 | 0.6602 |
| Wayne | 49055 | 103.8 | 6.992 | 0.9774 | 0.9230 | 0.0515 | 12.56 | 0.0141 |
| Weber | 49057 | 5,685 | 928.6 | 61.79 | 58.62 | 2.742 | 820.7 | 1.205 |
| **SUM** | | **74,282** | **13,555** | **833.2** | **792.5** | **149.6** | **9,328** | **16.48** |

Jan 2026 MOVES2014b Non-road Motorized Vehicles & Equipment
Tons per Year

| County | FIPs | CO | NOx | PM10 Exh | PM2.5 Exh | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 113.9 | 6.705 | 0.7633 | 0.7178 | 0.0164 | 9.052 | 0.0215 |
| Box Elder | 49003 | 1,713 | 158.2 | 8.165 | 7.758 | 0.3284 | 151.3 | 0.3758 |
| Cache | 49005 | 2,491 | 187.2 | 18.53 | 17.42 | 0.5417 | 337 | 0.657 |
| Carbon | 49007 | 849 | 125.4 | 12.85 | 12.27 | 0.1903 | 135.9 | 0.2237 |
| Daggett | 49009 | 154.2 | 8.35 | 1.559 | 1.437 | 0.0163 | 49.1 | 0.0333 |
| Davis | 49011 | 5,252 | 348.0 | 32.22 | 30.33 | 1.003 | 399.6 | 1.232 |
| Duchesne | 49013 | 537.7 | 30.73 | 2.458 | 2.307 | 0.0795 | 44.9 | 0.1067 |
| Emery | 49015 | 320.5 | 90.7 | 8.36 | 8.36 | 0.1336 | 71.5 | 0.1481 |
| Garfield | 49017 | 199.0 | 17.44 | 1.681 | 1.681 | 0.0501 | 36.4 | 0.0693 |
| Grand | 49019 | 460.8 | 27.62 | 1.897 | 1.897 | 0.0779 | 35.01 | 0.1009 |
| Iron | 49021 | 830 | 62.89 | 5.46 | 5.46 | 0.1799 | 99.7 | 0.2282 |
| Juab | 49023 | 353.4 | 24.18 | 1.944 | 1.944 | 0.0646 | 39.4 | 0.0860 |
| Kane | 49025 | 224.5 | 17.07 | 0.979 | 0.979 | 0.0345 | 24.77 | 0.0494 |
| Millard | 49027 | 392.0 | 34.18 | 1.510 | 1.510 | 0.0584 | 32.12 | 0.0810 |
| Morgan | 49029 | 180.1 | 11.83 | 0.7056 | 0.7056 | 0.0319 | 7.769 | 0.0399 |
| Piute | 49031 | 57.7 | 3.60 | 0.562 | 0.562 | 0.0072 | 18.03 | 0.0136 |
| Rich | 49033 | 771 | 37.0 | 7.79 | 7.79 | 0.0767 | 232 | 0.1563 |
| Salt Lake | 49035 | 30,008 | 1,374 | 150.9 | 141.5 | 3.784 | 2,049 | 4.687 |
| San Juan | 49037 | 307.7 | 19.44 | 1.322 | 1.237 | 0.0367 | 29.74 | 0.0527 |
| Sanpete | 49039 | 541 | 31.49 | 4.61 | 4.29 | 0.0769 | 117.5 | 0.1167 |
| Sevier | 49041 | 597.4 | 113.7 | 11.40 | 10.92 | 0.1814 | 72.0 | 0.1967 |
| Summit | 49043 | 1,821 | 104.0 | 16.47 | 15.29 | 0.2850 | 387 | 0.440 |
| Tooele | 49045 | 687.4 | 67.13 | 3.864 | 3.657 | 0.1511 | 62.52 | 0.1933 |
| Uintah | 49047 | 1,759 | 117.6 | 6.39 | 6.04 | 0.3303 | 110.5 | 0.4236 |
| Utah | 49049 | 7,863 | 507.0 | 51.37 | 48.29 | 1.493 | 640.7 | 1.818 |
| Wasatch | 49051 | 1,113 | 70.8 | 12.42 | 11.49 | 0.1824 | 344 | 0.310 |
| Washington | 49053 | 3,205 | 192.2 | 23.43 | 21.95 | 0.6078 | 290.0 | 0.7723 |
| Wayne | 49055 | 73.0 | 4.134 | 0.582 | 0.5434 | 0.0108 | 8.56 | 0.0149 |
| Weber | 49057 | 4,984 | 285.7 | 31.28 | 29.30 | 0.792 | 530 | 0.993 |
| **SUM** | | **67,859** | **4,078** | **421.5** | **397.6** | **10.82** | **6,366** | **13.64** |

January 2026 Aircraft Emissions
Tons per Year

| County | FIPs | CO | NOX | PM10 | PM2.5 | SOX | VOC | NH3* |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 29.42 | 0.1255 | 0.0709 | 0.0688 | 0.0576 | 0.6611 | N/A |
| Box Elder | 49003 | 185.5 | 0.4583 | 0.4129 | 0.4006 | 0.2524 | 2.374 | N/A |
| Cache | 49005 | 665.5 | 1.751 | 1.501 | 1.456 | 0.9616 | 9.599 | N/A |
| Carbon | 49007 | 33.87 | 0.9924 | 0.0874 | 0.0852 | 0.1663 | 0.7714 | N/A |
| Daggett | 49009 | 17.94 | 0.0316 | 0.0393 | 0.0381 | 0.0217 | 0.1979 | N/A |
| Davis | 49011 | 449.7 | 35.13 | 5.794 | 2.061 | 3.411 | 11.62 | N/A |
| Duchesne | 49013 | 65.33 | 0.1369 | 0.1434 | 0.1391 | 0.0818 | 0.7299 | N/A |
| Emery | 49015 | 50.22 | 0.5296 | 0.1162 | 0.1129 | 0.1196 | 0.7396 | N/A |
| Garfield | 49017 | 63.64 | 0.2551 | 0.1438 | 0.1396 | 0.1015 | 0.9006 | N/A |
| Grand | 49019 | 122.7 | 3.607 | 0.3209 | 0.3127 | 0.6380 | 3.134 | N/A |
| Iron | 49021 | 61.53 | 4.945 | 1.196 | 1.191 | 1.656 | 3.680 | N/A |
| Juab | 49023 | 28.80 | 0.0484 | 0.0676 | 0.0655 | 0.0446 | 0.5712 | N/A |
| Kane | 49025 | 29.89 | 0.1060 | 0.0662 | 0.0643 | 0.0432 | 0.3522 | N/A |
| Millard | 49027 | 38.54 | 0.1331 | 0.0853 | 0.0828 | 0.0552 | 0.4525 | N/A |
| Morgan | 49029 | 40.53 | 0.0509 | 0.0890 | 0.0863 | 0.0474 | 0.4694 | N/A |
| Piute | 49031 | 8.625 | 0.0075 | 0.0188 | 0.0182 | 0.0094 | 0.0919 | N/A |
| Rich | 49033 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Salt Lake | 49035 | 3,154 | 1,194 | 23.95 | 23.25 | 143.6 | 294.7 | N/A |
| San Juan | 49037 | 74.03 | 0.2643 | 0.1640 | 0.1591 | 0.1073 | 0.8729 | N/A |
| Sanpete | 49039 | 13.04 | 0.0353 | 0.0287 | 0.0279 | 0.0174 | 0.1491 | N/A |
| Sevier | 49041 | 98.78 | 0.2281 | 0.2170 | 0.2106 | 0.1265 | 1.112 | N/A |
| Summit | 49043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Tooele | 49045 | 766.5 | 8.829 | 3.575 | 3.185 | 1.640 | 11.30 | N/A |
| Uintah | 49047 | 133.3 | 1.557 | 1.474 | 1.430 | 0.3862 | 9.274 | N/A |
| Utah | 49049 | 990.4 | 8.959 | 2.368 | 2.297 | 2.318 | 17.97 | N/A |
| Wasatch | 49051 | 178.4 | 1.459 | 0.4111 | 0.3994 | 0.3782 | 2.691 | N/A |
| Washington | 49053 | 585.6 | 6.398 | 1.412 | 1.371 | 1.768 | 10.95 | N/A |
| Wayne | 49055 | 26.44 | 0.0790 | 0.0583 | 0.0566 | 0.0363 | 0.3053 | N/A |
| Weber | 49057 | 669.0 | 4.930 | 1.549 | 1.504 | 1.378 | 10.53 | N/A |
| | | **8,581** | **1,275** | **45.35** | **40.22** | **159.5** | **396.2** | N/A |

*The aircraft model does not produce NH3 emissions.

Jan 2026 Airport Ground Support Equipment Emissions
Tons per Year

| County | FIPs | CO | NOX | PM10 | PM2.5 | SOX | VOC | NH3* |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 0.0626 | 0.0103 | 0.0001 | 0.0001 | 0.0003 | 0.0033 | N/A |
| Box Elder | 49003 | 0.2444 | 0.0551 | 0.0005 | 0.0005 | 0.0010 | 0.0165 | N/A |
| Cache | 49005 | 0.9632 | 0.2032 | 0.0021 | 0.0021 | 0.0038 | 0.0616 | N/A |
| Carbon | 49007 | 0.8320 | 0.0707 | 0.0020 | 0.0020 | 0.0035 | 0.0276 | N/A |
| Daggett | 49009 | 0.0151 | 0.0047 | 0.0000 | 0.0000 | 0.0001 | 0.0013 | N/A |
| Davis | 49011 | 0.1337 | 0.0760 | 0.0002 | 0.0002 | 0.0004 | 0.0202 | N/A |
| Duchesne | 49013 | 0.0820 | 0.0192 | 0.0002 | 0.0002 | 0.0003 | 0.0057 | N/A |
| Emery | 49015 | 0.4998 | 0.0484 | 0.0012 | 0.0012 | 0.0021 | 0.0180 | N/A |
| Garfield | 49017 | 0.1968 | 0.0276 | 0.0005 | 0.0005 | 0.0008 | 0.0092 | N/A |
| Grand | 49019 | 5.147 | 0.4205 | 0.0122 | 0.0122 | 0.0220 | 0.1668 | N/A |
| Iron | 49021 | 5.139 | 0.4771 | 0.0124 | 0.0120 | 0.0186 | 0.1654 | N/A |
| Juab | 49023 | 0.0028 | 0.0057 | 0.0000 | 0.0000 | 0.0000 | 0.0014 | N/A |
| Kane | 49025 | 0.0844 | 0.0124 | 0.0002 | 0.0002 | 0.0003 | 0.0041 | N/A |
| Millard | 49027 | 0.1052 | 0.0157 | 0.0002 | 0.0002 | 0.0004 | 0.0051 | N/A |
| Morgan | 49029 | 0.0171 | 0.0093 | 0.0000 | 0.0000 | 0.0001 | 0.0025 | N/A |
| Piute | 49031 | 0.0009 | 0.0018 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | N/A |
| Rich | 49033 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Salt Lake | 49035 | 497.0 | 51.73 | 2.254 | 2.131 | 2.621 | 17.07 | N/A |
| San Juan | 49037 | 0.2110 | 0.0308 | 0.0005 | 0.0005 | 0.0009 | 0.0102 | N/A |
| Sanpete | 49039 | 0.0257 | 0.0046 | 0.0001 | 0.0001 | 0.0001 | 0.0014 | N/A |
| Sevier | 49041 | 0.1547 | 0.0314 | 0.0003 | 0.0003 | 0.0006 | 0.0096 | N/A |
| Summit | 49043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Tooele | 49045 | 2.984 | 0.4301 | 0.0109 | 0.0104 | 0.0142 | 0.1342 | N/A |
| Uintah | 49047 | 2.490 | 0.2312 | 0.0089 | 0.0089 | 0.0112 | 0.0838 | N/A |
| Utah | 49049 | 3.934 | 0.6044 | 0.0166 | 0.0161 | 0.0182 | 0.1857 | N/A |
| Wasatch | 49051 | 1.323 | 0.1369 | 0.0031 | 0.0031 | 0.0056 | 0.0499 | N/A |
| Washington | 49053 | 6.524 | 0.7057 | 0.0243 | 0.0223 | 0.0322 | 0.2421 | N/A |
| Wayne | 49055 | 0.0597 | 0.0098 | 0.0001 | 0.0001 | 0.0002 | 0.0031 | N/A |
| Weber | 49057 | 3.714 | 0.4368 | 0.0101 | 0.0100 | 0.0159 | 0.1500 | N/A |
| | TOTAL | **531.9** | **55.81** | **2.361** | **2.235** | **2.774** | **18.45** | **N/A** |

*The aircraft model does not produce NH3 emissions for ground support.

January 2026 Emissions from Locomotives
Tons per Year

| **County** | **FIPs** | CO | NOx | PM10 | PM2.5 | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 55.82 | 144.65 | 3.145 | 3.050 | 0.1969 | 5.519 | 0.1746 |
| Box Elder | 49003 | 136.5 | 353.8 | 7.691 | 7.460 | 0.4815 | 13.498 | 0.4271 |
| Cache | 49005 | 7.058 | 18.293 | 0.3977 | 0.3857 | 0.0249 | 0.6979 | 0.0221 |
| Carbon | 49007 | 24.09 | 62.06 | 1.3356 | 1.2955 | 0.0849 | 2.329 | 0.0754 |
| Daggett | 49009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Davis | 49011 | 110.2 | 314.4 | 6.929 | 6.721 | 0.3868 | 13.359 | 0.3432 |
| Duchesne | 49013 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Emery | 49015 | 21.85 | 56.09 | 1.1991 | 1.1631 | 0.0771 | 2.0820 | 0.0684 |
| Garfield | 49017 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Grand | 49019 | 31.16 | 80.02 | 1.7114 | 1.6601 | 0.1099 | 2.973 | 0.0975 |
| Iron | 49021 | 72.68 | 188.4 | 4.095 | 3.972 | 0.2563 | 7.186 | 0.2274 |
| Juab | 49023 | 65.31 | 169.25 | 3.679 | 3.569 | 0.2303 | 6.457 | 0.2043 |
| Kane | 49025 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Millard | 49027 | 225.6 | 584.7 | 12.711 | 12.330 | 0.7957 | 22.31 | 0.7059 |
| Morgan | 49029 | 59.54 | 154.30 | 3.354 | 3.254 | 0.2100 | 5.887 | 0.1863 |
| 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 | 259.4 | 1090.7 | 23.63 | 22.92 | 0.8835 | 56.55 | 0.7897 |
| 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 | 102.1 | 264.5 | 5.750 | 5.578 | 0.3600 | 10.092 | 0.3193 |
| Tooele | 49045 | 148.9 | 384.9 | 8.324 | 8.074 | 0.5252 | 14.562 | 0.4659 |
| Uintah | 49047 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Utah | 49049 | 127.5 | 424.3 | 9.264 | 8.986 | 0.4439 | 19.78 | 0.3939 |
| Wasatch | 49051 | 1.642 | 4.230 | 0.0909 | 0.0882 | 0.0058 | 0.1585 | 0.0051 |
| 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 | 109.7 | 377.7 | 8.194 | 7.948 | 0.3814 | 17.74 | 0.3384 |
| **SUM** | | **1,559** | **4,672** | **101.5** | **98.46** | **5.454** | **201.2** | **4.844** |

January 2026 Emissions from Non-road Mobile Sources

Tons per Year

| County | FIPs | CO | NOx | PM10 | PM2.5 | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 199.2 | 151.5 | 3.979 | 3.837 | 0.2711 | 15.24 | 0.1961 |
| Box Elder | 49003 | 2,035 | 512.5 | 16.27 | 15.62 | 1.063 | 167.2 | 0.8029 |
| Cache | 49005 | 3,165 | 207.4 | 20.43 | 19.26 | 1.532 | 347.1 | 0.6795 |
| Carbon | 49007 | 907.6 | 188.5 | 14.27 | 13.65 | 0.4451 | 139.0 | 0.2991 |
| Daggett | 49009 | 172.2 | 8.387 | 1.598 | 1.475 | 0.0380 | 49.27 | 0.0333 |
| Davis | 49011 | 5,812 | 697.6 | 44.95 | 39.11 | 4.801 | 424.6 | 1.575 |
| Duchesne | 49013 | 603.1 | 30.89 | 2.602 | 2.446 | 0.1616 | 45.66 | 0.1067 |
| Emery | 49015 | 393.1 | 147.3 | 9.675 | 9.636 | 0.3324 | 74.38 | 0.2165 |
| Garfield | 49017 | 262.8 | 17.72 | 1.825 | 1.821 | 0.1524 | 37.34 | 0.0693 |
| Grand | 49019 | 619.8 | 111.7 | 3.941 | 3.882 | 0.8477 | 41.28 | 0.1984 |
| Iron | 49021 | 969.7 | 256.7 | 10.76 | 10.64 | 2.111 | 110.7 | 0.4556 |
| Juab | 49023 | 447.5 | 193.5 | 5.691 | 5.579 | 0.3396 | 46.47 | 0.2903 |
| Kane | 49025 | 254.5 | 17.19 | 1.045 | 1.043 | 0.0781 | 25.13 | 0.0494 |
| Millard | 49027 | 656.3 | 619.0 | 14.31 | 13.92 | 0.9098 | 54.89 | 0.7869 |
| Morgan | 49029 | 280.2 | 166.2 | 4.149 | 4.046 | 0.2894 | 14.13 | 0.2262 |
| Piute | 49031 | 66.32 | 3.606 | 0.5810 | 0.5804 | 0.0166 | 18.12 | 0.0136 |
| Rich | 49033 | 770.8 | 36.97 | 7.790 | 7.790 | 0.0767 | 232.1 | 0.1563 |
| Salt Lake | 49035 | 33,918 | 3,710 | 200.7 | 189.8 | 150.9 | 2,417 | 5.477 |
| San Juan | 49037 | 381.9 | 19.74 | 1.486 | 1.397 | 0.1449 | 30.62 | 0.0527 |
| Sanpete | 49039 | 553.7 | 31.53 | 4.641 | 4.313 | 0.0944 | 117.7 | 0.1167 |
| Sevier | 49041 | 696.3 | 114.0 | 11.62 | 11.13 | 0.3085 | 73.15 | 0.1967 |
| Summit | 49043 | 1,923 | 368.5 | 22.22 | 20.87 | 0.6450 | 397.1 | 0.7590 |
| Tooele | 49045 | 1,606 | 461.2 | 15.77 | 14.93 | 2.331 | 88.52 | 0.6592 |
| Uintah | 49047 | 1,895 | 119.4 | 7.873 | 7.479 | 0.7277 | 119.9 | 0.4236 |
| Utah | 49049 | 8,985 | 940.8 | 63.02 | 59.59 | 4.273 | 678.6 | 2.212 |
| Wasatch | 49051 | 1,294 | 76.62 | 12.93 | 11.98 | 0.5719 | 347.0 | 0.3153 |
| Washington | 49053 | 3,797 | 199.3 | 24.87 | 23.34 | 2.408 | 301.2 | 0.7723 |
| Wayne | 49055 | 99.52 | 4.223 | 0.6407 | 0.6001 | 0.0473 | 8.868 | 0.0149 |
| Weber | 49057 | 5,766 | 668.7 | 41.03 | 38.76 | 2.568 | 558.8 | 1.331 |
| **SUM** | | **78,531** | **10,081** | **570.7** | **538.5** | **178.5** | **6,981** | **18.49** |

Jan 2035 MOVES2014b NR Motorized Vehicles & Equipment
Tons per Year

| County | FIPs | CO | NOx | PM10 Exh | PM2.5 Exh | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 130.6 | 5.745 | 0.6522 | 0.6071 | 0.0175 | 10.04 | 0.0237 |
| Box Elder | 49003 | 1,909 | 168.7 | 8.252 | 7.859 | 0.4120 | 139.2 | 0.4443 |
| Cache | 49005 | 2,646 | 188.8 | 14.94 | 14.07 | 0.6183 | 256 | 0.703 |
| Carbon | 49007 | 870 | 127.0 | 11.58 | 11.09 | 0.1989 | 100.4 | 0.2238 |
| Daggett | 49009 | 101.4 | 6.00 | 0.874 | 0.806 | 0.0118 | 27.4 | 0.0229 |
| Davis | 49011 | 6,162 | 351.2 | 30.53 | 28.58 | 1.143 | 442.2 | 1.402 |
| Duchesne | 49013 | 584.3 | 27.44 | 1.952 | 1.822 | 0.0837 | 39.4 | 0.1131 |
| Emery | 49015 | 282.3 | 90.2 | 7.81 | 7.52 | 0.1353 | 49.0 | 0.1441 |
| Garfield | 49017 | 166.3 | 14.16 | 1.124 | 1.050 | 0.0492 | 23.4 | 0.0663 |
| Grand | 49019 | 474.5 | 24.40 | 1.581 | 1.480 | 0.0814 | 29.9 | 0.1065 |
| Iron | 49021 | 875 | 58.29 | 4.39 | 4.12 | 0.1949 | 76.4 | 0.2392 |
| Juab | 49023 | 359.9 | 20.84 | 1.509 | 1.411 | 0.0666 | 29.6 | 0.0874 |
| Kane | 49025 | 219.8 | 15.80 | 0.789 | 0.739 | 0.0365 | 19.35 | 0.0514 |
| Millard | 49027 | 424.4 | 31.11 | 1.180 | 1.115 | 0.0643 | 27.86 | 0.0886 |
| Morgan | 49029 | 213.7 | 11.20 | 0.6036 | 0.5695 | 0.0356 | 8.813 | 0.0454 |
| Piute | 49031 | 39.4 | 2.58 | 0.341 | 0.315 | 0.0055 | 10.22 | 0.0099 |
| Rich | 49033 | 547 | 25.9 | 5.43 | 5.00 | 0.0560 | 135 | 0.1085 |
| Salt Lake | 49035 | 36,091 | 1,487 | 154.8 | 144.6 | 4.546 | 2,358 | 5.596 |
| San Juan | 49037 | 323.6 | 18.44 | 1.162 | 1.083 | 0.0398 | 27.11 | 0.0568 |
| Sanpete | 49039 | 485 | 28.06 | 3.17 | 2.95 | 0.0771 | 76.8 | 0.1053 |
| Sevier | 49041 | 651.5 | 115.2 | 10.96 | 10.49 | 0.1929 | 67.0 | 0.2085 |
| Summit | 49043 | 1,627 | 84.3 | 11.36 | 10.53 | 0.2691 | 254 | 0.392 |
| Tooele | 49045 | 743.9 | 65.29 | 3.317 | 3.125 | 0.1694 | 58.84 | 0.2139 |
| Uintah | 49047 | 1,888 | 102.7 | 4.83 | 4.54 | 0.3433 | 94.8 | 0.4469 |
| Utah | 49049 | 9,213 | 516.8 | 48.99 | 45.83 | 1.710 | 702.5 | 2.072 |
| Wasatch | 49051 | 784 | 52.5 | 7.27 | 6.72 | 0.1551 | 196 | 0.243 |
| Washington | 49053 | 3,664 | 179.1 | 21.83 | 20.32 | 0.6576 | 318.2 | 0.8463 |
| Wayne | 49055 | 72.0 | 3.484 | 0.491 | 0.4557 | 0.0110 | 7.42 | 0.0152 |
| Weber | 49057 | 5,569 | 296.6 | 28.42 | 26.59 | 0.916 | 475 | 1.101 |
| SUM | | **77,117** | **4,119** | **390.1** | **365.4** | **12.30** | **6,058** | **15.18** |

Jan 2035 Aircraft Emissions
Tons per Year

| County | FIPs | CO | NOX | PM10 | PM2.5 | SOX | VOC | NH3* |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 30.22 | 0.1339 | 0.0729 | 0.0707 | 0.0598 | 0.6809 | N/A |
| Box Elder | 49003 | 190.5 | 0.4895 | 0.4242 | 0.4116 | 0.2617 | 2.445 | N/A |
| Cache | 49005 | 683.4 | 1.865 | 1.542 | 1.496 | 0.9966 | 9.885 | N/A |
| Carbon | 49007 | 34.93 | 1.087 | 0.0911 | 0.0888 | 0.1800 | 0.8229 | N/A |
| Daggett | 49009 | 18.42 | 0.0336 | 0.0404 | 0.0392 | 0.0224 | 0.2037 | N/A |
| Davis | 49011 | 458.7 | 35.15 | 5.814 | 2.081 | 3.423 | 11.74 | N/A |
| Duchesne | 49013 | 67.09 | 0.1461 | 0.1473 | 0.1429 | 0.0847 | 0.7518 | N/A |
| Emery | 49015 | 51.64 | 0.5777 | 0.1199 | 0.1166 | 0.1274 | 0.7744 | N/A |
| Garfield | 49017 | 65.37 | 0.2750 | 0.1479 | 0.1436 | 0.1060 | 0.9304 | N/A |
| Grand | 49019 | 126.9 | 3.957 | 0.3356 | 0.3272 | 0.6950 | 3.375 | N/A |
| Iron | 49021 | 64.08 | 5.356 | 1.209 | 1.204 | 1.725 | 3.927 | N/A |
| Juab | 49023 | 29.57 | 0.0497 | 0.0694 | 0.0673 | 0.0458 | 0.5864 | N/A |
| Kane | 49025 | 30.70 | 0.1144 | 0.0681 | 0.0661 | 0.0451 | 0.3640 | N/A |
| Millard | 49027 | 39.58 | 0.1436 | 0.0877 | 0.0851 | 0.0577 | 0.4677 | N/A |
| Morgan | 49029 | 41.61 | 0.0532 | 0.0914 | 0.0886 | 0.0488 | 0.4823 | N/A |
| Piute | 49031 | 8.855 | 0.0077 | 0.0193 | 0.0187 | 0.0096 | 0.0944 | N/A |
| Rich | 49033 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Salt Lake | 49035 | 3,504 | 1,397 | 27.62 | 26.82 | 167.9 | 340.9 | N/A |
| San Juan | 49037 | 76.03 | 0.2853 | 0.1686 | 0.1636 | 0.1120 | 0.9024 | N/A |
| Sanpete | 49039 | 13.39 | 0.0380 | 0.0295 | 0.0287 | 0.0181 | 0.1538 | N/A |
| Sevier | 49041 | 101.4 | 0.2442 | 0.2230 | 0.2164 | 0.1312 | 1.146 | N/A |
| Summit | 49043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Tooele | 49045 | 786.9 | 9.598 | 3.627 | 3.236 | 1.758 | 11.63 | N/A |
| Uintah | 49047 | 145.6 | 1.729 | 1.707 | 1.656 | 0.4295 | 10.74 | N/A |
| Utah | 49049 | 1,018 | 10.22 | 2.448 | 2.376 | 2.510 | 18.71 | N/A |
| Wasatch | 49051 | 183.4 | 1.588 | 0.4238 | 0.4117 | 0.4004 | 2.802 | N/A |
| Washington | 49053 | 604.5 | 7.199 | 1.471 | 1.428 | 1.948 | 11.72 | N/A |
| Wayne | 49055 | 27.15 | 0.0850 | 0.0600 | 0.0582 | 0.0377 | 0.3151 | N/A |
| Weber | 49057 | 687.3 | 5.423 | 1.596 | 1.550 | 1.464 | 10.92 | N/A |
| SUM | | **9,089** | **1,483** | **49.65** | **44.39** | **184.6** | **447.5** | **N/A** |

The aircraft model does not produce NH3 emissions.

Jan 2035 Airport Ground Support Equipment Emissions
Tons per Year

| County | FIPS | CO | NOX | PM10 | PM2.5 | SOX | VOC | NH3* |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 0.0683 | 0.0108 | 0.0002 | 0.0002 | 0.0003 | 0.0035 | N/A |
| Box Elder | 49003 | 0.2662 | 0.0568 | 0.0006 | 0.0006 | 0.0011 | 0.0172 | N/A |
| Cache | 49005 | 1.050 | 0.2099 | 0.0023 | 0.0023 | 0.0042 | 0.0643 | N/A |
| Carbon | 49007 | 0.9145 | 0.0771 | 0.0022 | 0.0022 | 0.0039 | 0.0302 | N/A |
| Daggett | 49009 | 0.0164 | 0.0048 | 0.0000 | 0.0000 | 0.0001 | 0.0014 | N/A |
| Davis | 49011 | 0.1433 | 0.0767 | 0.0003 | 0.0003 | 0.0005 | 0.0205 | N/A |
| Duchesne | 49013 | 0.0893 | 0.0197 | 0.0002 | 0.0002 | 0.0004 | 0.0059 | N/A |
| Emery | 49015 | 0.5475 | 0.0521 | 0.0013 | 0.0013 | 0.0023 | 0.0195 | N/A |
| Garfield | 49017 | 0.2152 | 0.0290 | 0.0005 | 0.0005 | 0.0009 | 0.0098 | N/A |
| Grand | 49019 | 5.768 | 0.4687 | 0.0137 | 0.0137 | 0.0246 | 0.1863 | N/A |
| Iron | 49021 | 5.572 | 0.5156 | 0.0139 | 0.0134 | 0.0206 | 0.1796 | N/A |
| Juab | 49023 | 0.0028 | 0.0057 | 0.0000 | 0.0000 | 0.0000 | 0.0014 | N/A |
| Kane | 49025 | 0.0923 | 0.0130 | 0.0002 | 0.0002 | 0.0004 | 0.0043 | N/A |
| Millard | 49027 | 0.1150 | 0.0165 | 0.0003 | 0.0003 | 0.0005 | 0.0054 | N/A |
| Morgan | 49029 | 0.0184 | 0.0094 | 0.0000 | 0.0000 | 0.0001 | 0.0025 | N/A |
| Piute | 49031 | 0.0009 | 0.0018 | 0.0000 | 0.0000 | 0.0000 | 0.0004 | N/A |
| Rich | 49033 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Salt Lake | 49035 | 578.3 | 60.31 | 2.635 | 2.491 | 3.056 | 19.87 | N/A |
| San Juan | 49037 | 0.2306 | 0.0324 | 0.0005 | 0.0005 | 0.0010 | 0.0108 | N/A |
| Sanpete | 49039 | 0.0281 | 0.0047 | 0.0001 | 0.0001 | 0.0001 | 0.0015 | N/A |
| Sevier | 49041 | 0.1687 | 0.0324 | 0.0004 | 0.0004 | 0.0007 | 0.0100 | N/A |
| Summit | 49043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | N/A |
| Tooele | 49045 | 3.351 | 0.4686 | 0.0124 | 0.0119 | 0.0161 | 0.1468 | N/A |
| Uintah | 49047 | 2.831 | 0.2619 | 0.0103 | 0.0103 | 0.0128 | 0.0949 | N/A |
| Utah | 49049 | 4.475 | 0.6662 | 0.0191 | 0.0186 | 0.0209 | 0.2057 | N/A |
| Wasatch | 49051 | 1.449 | 0.1467 | 0.0034 | 0.0034 | 0.0061 | 0.0539 | N/A |
| Washington | 49053 | 7.417 | 0.7908 | 0.0279 | 0.0257 | 0.0368 | 0.2720 | N/A |
| Wayne | 49055 | 0.0652 | 0.0102 | 0.0001 | 0.0001 | 0.0003 | 0.0033 | N/A |
| Weber | 49057 | 4.067 | 0.4679 | 0.0112 | 0.0111 | 0.0174 | 0.1616 | N/A |
| | | **617.3** | **64.76** | **2.757** | **2.608** | **3.228** | **21.38** | **N/A** |

The aircraft model does not produce ground support equipment emissions.

Jan 2035 Diesel Locomotive Emissions
Tons per Year

| County | FIPs | CO | NOx | PM10 | PM2.5 | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 55.82 | 77.57 | 1.468 | 1.423 | 0.1969 | 2.870 | 0.1746 |
| Box Elder | 49003 | 136.6 | 189.8 | 3.592 | 3.484 | 0.4818 | 7.024 | 0.4274 |
| Cache | 49005 | 7.103 | 9.871 | 0.1867 | 0.1811 | 0.0251 | 0.3652 | 0.0222 |
| Carbon | 49007 | 24.88 | 34.24 | 0.6372 | 0.6181 | 0.0878 | 1.226 | 0.0779 |
| Daggett | 49009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Davis | 49011 | 116.60 | 180.24 | 3.556 | 3.450 | 0.4091 | 6.865 | 0.3629 |
| Duchesne | 49013 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Emery | 49015 | 22.96 | 31.40 | 0.5782 | 0.5609 | 0.0810 | 1.100 | 0.0718 |
| Garfield | 49017 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Grand | 49019 | 32.69 | 44.74 | 0.8245 | 0.7998 | 0.1153 | 1.570 | 0.1023 |
| Iron | 49021 | 72.68 | 101.0 | 1.911 | 1.854 | 0.2563 | 3.737 | 0.2274 |
| Juab | 49023 | 65.31 | 90.76 | 1.717 | 1.666 | 0.2303 | 3.358 | 0.2043 |
| Kane | 49025 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Millard | 49027 | 225.6 | 313.5 | 5.932 | 5.754 | 0.7957 | 11.60 | 0.7059 |
| Morgan | 49029 | 59.54 | 82.74 | 1.565 | 1.518 | 0.2100 | 3.061 | 0.1863 |
| 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 | 278.77 | 671.24 | 13.494 | 13.089 | 0.9498 | 33.908 | 0.8485 |
| 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 | 102.1 | 141.8 | 2.683 | 2.603 | 0.3600 | 5.248 | 0.3193 |
| Tooele | 49045 | 150.4 | 208.0 | 3.902 | 3.785 | 0.5305 | 7.567 | 0.4706 |
| Uintah | 49047 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Utah | 49049 | 137.87 | 253.86 | 5.040 | 4.889 | 0.4799 | 10.971 | 0.4258 |
| Wasatch | 49051 | 1.703 | 2.342 | 0.0435 | 0.0422 | 0.0060 | 0.0836 | 0.0053 |
| 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 | 113.85 | 221.62 | 4.369 | 4.238 | 0.3955 | 10.243 | 0.3509 |
| **SUM** | | **1,604** | **2,655** | **51.50** | **49.95** | **5.611** | **110.8** | **4.984** |

Jan 2035 Total Non-road Mobile Sources
Tons per Year

| County | FIPs | CO | NOx | PM10 | PM2.5 | SO2 | VOC | NH3 |
|---|---|---|---|---|---|---|---|---|
| Beaver | 49001 | 216.7 | 83.46 | 2.193 | 2.101 | 0.2745 | 13.59 | 0.1983 |
| Box Elder | 49003 | 2,237 | 359.1 | 12.27 | 11.76 | 1.157 | 148.7 | 0.8717 |
| Cache | 49005 | 3,338 | 200.8 | 16.67 | 15.75 | 1.644 | 266.4 | 0.7256 |
| Carbon | 49007 | 931.1 | 162.4 | 12.31 | 11.80 | 0.4705 | 102.5 | 0.3017 |
| Daggett | 49009 | 119.8 | 6.041 | 0.9146 | 0.8451 | 0.0343 | 27.58 | 0.0229 |
| Davis | 49011 | 6,737 | 566.7 | 39.90 | 34.11 | 4.976 | 460.8 | 1.765 |
| Duchesne | 49013 | 651.5 | 27.60 | 2.099 | 1.965 | 0.1688 | 40.14 | 0.1131 |
| Emery | 49015 | 357.5 | 122.2 | 8.512 | 8.198 | 0.3461 | 50.86 | 0.2159 |
| Garfield | 49017 | 231.9 | 14.47 | 1.273 | 1.194 | 0.1561 | 24.33 | 0.0663 |
| Grand | 49019 | 639.8 | 73.56 | 2.755 | 2.621 | 0.9164 | 35.01 | 0.2088 |
| Iron | 49021 | 1,018 | 165.2 | 7.518 | 7.188 | 2.197 | 84.19 | 0.4666 |
| Juab | 49023 | 454.7 | 111.6 | 3.295 | 3.144 | 0.3428 | 33.57 | 0.2917 |
| Kane | 49025 | 250.6 | 15.93 | 0.8573 | 0.8052 | 0.0821 | 19.72 | 0.0514 |
| Millard | 49027 | 689.7 | 344.8 | 7.199 | 6.954 | 0.9181 | 39.93 | 0.7945 |
| Morgan | 49029 | 314.8 | 94.00 | 2.260 | 2.177 | 0.2944 | 12.36 | 0.2317 |
| Piute | 49031 | 48.28 | 2.587 | 0.3601 | 0.3334 | 0.0152 | 10.31 | 0.0099 |
| Rich | 49033 | 547.2 | 25.89 | 5.429 | 5.002 | 0.0560 | 134.6 | 0.1085 |
| Salt Lake | 49035 | 40,452 | 3,616 | 198.5 | 187.0 | 176.4 | 2,752 | 6.445 |
| San Juan | 49037 | 399.9 | 18.76 | 1.331 | 1.247 | 0.1528 | 28.02 | 0.0568 |
| Sanpete | 49039 | 498.2 | 28.11 | 3.196 | 2.974 | 0.0953 | 76.97 | 0.1053 |
| Sevier | 49041 | 753.1 | 115.5 | 11.18 | 10.70 | 0.3248 | 68.18 | 0.2085 |
| Summit | 49043 | 1,729 | 226.2 | 14.04 | 13.13 | 0.6291 | 258.9 | 0.7114 |
| Tooele | 49045 | 1,684 | 283.3 | 10.86 | 10.16 | 2.474 | 78.18 | 0.6845 |
| Uintah | 49047 | 2,036 | 104.7 | 6.547 | 6.209 | 0.7856 | 105.6 | 0.4469 |
| Utah | 49049 | 10,373 | 781.6 | 56.50 | 53.11 | 4.720 | 732.4 | 2.498 |
| Wasatch | 49051 | 970.2 | 56.56 | 7.739 | 7.181 | 0.5677 | 199.0 | 0.2485 |
| Washington | 49053 | 4,276 | 187.1 | 23.33 | 21.77 | 2.643 | 330.1 | 0.8463 |
| Wayne | 49055 | 99.21 | 3.579 | 0.5514 | 0.5140 | 0.0490 | 7.736 | 0.0152 |
| Weber | 49057 | 6,374 | 524.1 | 34.39 | 32.39 | 2.792 | 495.9 | 1.452 |
| **SUM** | | **88,428** | **8,322** | **494.0** | **462.3** | **205.7** | **6,638** | **20.16** |

B. MOVES2014b Model: Changes to Underlying Database for Snowmobiles

The following files in the MOVES2014b 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 | 48 | Daggett |
| 14 | 49011 | 2002 | 0 | 0 | Davis |
| 14 | 49013 | 2002 | 67 | 16 | 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 1990, 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 | 1990 | 1002 | 2-Str Snowm | 1 | 3 | 87.54 | 161.3 |
| 49000 | 1990 | 1003 | 2-Str Snowm | 3 | 6 | 51.64 | 95.15 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 49000 | 1990 | 1004 | 2-Str Snowm | 11 | 16 | 55.45 | 95.15 |
| 49000 | 1990 | 1005 | 2-Str Snowm | 16 | 25 | 4,419. | 8,142. |
| 49000 | 1990 | 1006 | 2-Str Snowm | 25 | 40 | 4,461. | 8,218. |
| 49000 | 1990 | 1007 | 2-Str Snowm | 40 | 50 | 2,002. | 3,689. |
| 49000 | 1990 | 1008 | 2-Str Snowm | 50 | 75 | 7,053. | 12,995. |
| 49000 | 1990 | 1009 | 2-Str Snowm | 75 | 100 | 2,899. | 5,341. |
| 49000 | 1990 | 1010 | 2-Str Snowm | 100 | 175 | 755.2 | 1,391. |
| SUM | | | | | | 21,784. | 40.135. |

3. File Name: nrgrowthindex

The 1990 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 2018. Therefore, growth factors also decrease over calendar years as follows:

Note that the growth index values are the same for each growth pattern ID from 1002 – 1010 because Utah does not have snowmobile counts by HP class.

Snowmobile Indicator Codes: 1002 - 1010
SCC: 226001020
Type: 2-Stroke Snowmobile

By trial and error, we found that, if the above growth index values are changed, the INPUT and OUTPUT populations of snowmobiles do not agree. In fact, the output populations are 3 to 8 or times higher than the input populations.

To fix this problem, staff reviewed related tables in the MOVES2014b default database.

The table “nrgrowthpatternfinder” gives a clue as to what might be going on inside the model. The SCC for snowmobiles is not included, but a “generic” SCC is found, which is 2260-001-1000. For stateID = 49, the growthPatternID = 2402.

When we adjusted the nrgrowthindex values for the growth pattern IDs 1002 – 1010 AND for 2402, then input and output snowmobile populations agreed.

Thus the nrgrowthindex values were adjusted for growth pattern ID = 2402 such that the complete set of nrgrowthindex values are as shown below:

| growthPatternID | yearID | growthIndex | n | NEW values → | growthPatternID | yearID | growthIndex |
|---|---|---|---|---|---|---|---|
| 1002 - 1010 | 1990 | 1000 | 40,135 | | 2402 | 1990 | 861.0 |
| 1002 - 1010 | 1999 | 1083 | 33,913 | | 2402 | 1999 | 727.5 |
| 1002 - 1010 | 2000 | 1093 | 33,222 | | 2402 | 2000 | 712.7 |
| 1002 - 1010 | 2001 | 1101 | 32,531 | | 2402 | 2001 | 697.9 |
| 1002 - 1010 | 2002 | 1108 | 31,839 | | 2402 | 2002 | 683.0 |
| 1002 - 1010 | 2003 | 1114 | 31,148 | | 2402 | 2003 | 668.2 |
| 1002 - 1010 | 2004 | 1121 | 30,457 | | 2402 | 2004 | 653.4 |
| 1002 - 1010 | 2005 | 1127 | 29,765 | | 2402 | 2005 | 638.5 |
| 1002 - 1010 | 2006 | 1135 | 29,074 | | 2402 | 2006 | 623.7 |
| 1002 - 1010 | 2007 | 1141 | 28,383 | | 2402 | 2007 | 608.9 |
| 1002 - 1010 | 2008 | 1147 | 27,691 | | 2402 | 2008 | 594.1 |
| 1002 - 1010 | 2009 | 1153 | 27,000 | | 2402 | 2009 | 579.2 |
| 1002 - 1010 | 2010 | 1158 | 26,309 | | 2402 | 2010 | 564.4 |
| 1002 - 1010 | 2011 | 1164 | 25,618 | | 2402 | 2011 | 549.6 |
| 1002 - 1010 | 2012 | 1169 | 24,926 | | 2402 | 2012 | 534.7 |
| 1002 - 1010 | 2013 | 1175 | 24,235 | | 2402 | 2013 | 519.9 |
| 1002 - 1010 | 2014 | 1180 | 23,544 | | 2402 | 2014 | 505.1 |
| 1002 - 1010 | 2015 | 1187 | 22,852 | | 2402 | 2015 | 490.2 |
| 1002 - 1010 | 2016 | 1194 | 22,161 | | 2402 | 2016 | 475.4 |
| 1002 - 1010 | 2017 | 1201 | 21,470 | | 2402 | 2017 | 460.6 |
| 1002 - 1010 | 2018 | 1208 | 20,778 | | 2402 | 2018 | 445.8 |
| 1002 - 1010 | 2019 | 1215 | 20,087 | | 2402 | 2019 | 430.9 |
| 1002 - 1010 | 2020 | 1222 | 19,396 | | 2402 | 2020 | 416.1 |
| 1002 - 1010 | 2021 | 1228 | 18,704 | | 2402 | 2021 | 401.3 |
| 1002 - 1010 | 2022 | 1234 | 18,013 | | 2402 | 2022 | 386.4 |
| 1002 - 1010 | 2023 | 1240 | 17,322 | | 2402 | 2023 | 371.6 |
| 1002 - 1010 | 2024 | 1246 | 16,631 | | 2402 | 2024 | 356.8 |
| 1002 - 1010 | 2025 | 1252 | 15,939 | | 2402 | 2025 | 341.9 |
| 1002 - 1010 | 2026 | 1259 | 15,248 | | 2402 | 2026 | 327.1 |
| 1002 - 1010 | 2027 | 1265 | 14,557 | | 2402 | 2027 | 312.3 |
| 1002 - 1010 | 2028 | 1271 | 13,865 | | 2402 | 2028 | 297.4 |
| 1002 - 1010 | 2029 | 1278 | 13,174 | | 2402 | 2029 | 282.6 |
| 1002 - 1010 | 2030 | 1284 | 12,483 | | 2402 | 2030 | 267.8 |
| 1002 - 1010 | 2031 | 1289 | 11,791 | | 2402 | 2031 | 253.0 |
| 1002 - 1010 | 2032 | 1293 | 11,100 | | 2402 | 2032 | 238.1 |
| 1002 - 1010 | 2033 | 1297 | 10,409 | | 2402 | 2033 | 223.3 |
| 1002 - 1010 | 2034 | 1301 | 9,718 | | 2402 | 2034 | 208.5 |
| 1002 - 1010 | 2035 | 1305 | 9,026 | | 2402 | 2035 | 193.6 |
| 1002 - 1010 | 2036 | 1310 | 8,335 | | 2402 | 2036 | 178.8 |

| | | | |
|---|---|---|---|
| 1002 - 1010 | 2037 | 1314 | 7,644 |
| 1002 - 1010 | 2038 | 1318 | 6,952 |
| 1002 - 1010 | 2039 | 1323 | 6,261 |
| 1002 - 1010 | 2040 | 1327 | 5,570 |

| | | |
|---|---|---|
| 2402 | 2037 | 164.0 |
| 2402 | 2038 | 149.1 |
| 2402 | 2039 | 134.3 |
| 2402 | 2040 | 119.5 |

UT Tax Commission--Statewide Snowmobile Counts

6/11/2019

| | |
|---|---|
| 2005 | 28,248 |
| 2006 | 28,222 |
| 2007 | 29,241 |
| 2008 | 30,782 |
| 2009 | 28,768 |
| 2010 | 26,294 |
| 2011 | 26,167 |
| 2012 | 22,144 |
| 2013 | 23,184 |
| 2014 | 20,993 |
| 2015 | 21,747 |
| 2016 | 23,603 |
| 2017 | 24,015 |
| 2018 | 20,398 |

**The oldest year in the UT Tax Comm db for SNO is 2005.**

Procedure

**For MOVES, we need base year (1990) estimate.**

| | |
|---|---|
| SLOPE | -691.301 |
| INTERCEPT | 1415824 |
| CORREL | -0.8493 |

Predicted Pop from L.R.

| | |
|---|---|
| 1990 | 40,135 |
| 1991 | 39,444 |
| 1992 | 38,752 |

Motor Vehicle Stats\Registrations: 1990s and 2000s\2005\
Utah Vehicle Registrations Classified by County\

https://tax.utah.gov/econstats/mv/registrations

Home Page UT Tax Commission https://tax.utah.gov/

GO TO Box "Useful Info" https://tax.utah.gov/info

Click on "Economics & Statistics" https://tax.utah.gov/econstats

Click on "Motor Vehicle Statistics"

Click on "Vehicle Registrations" and choose year.
Open EXCEL workbook and move right through tabs to Off-road registrations.

| | |
|---|---|
| 1993 | 38,061 |
| 1994 | 37,370 |
| 1995 | 36,678 |
| 1996 | 35,987 |
| 1997 | 35,296 |
| 1998 | 34,604 |
| 1999 | 33,913 |
| 2000 | 33,222 |
| 2001 | 32,531 |
| 2002 | 31,839 |
| 2003 | 31,148 |
| 2004 | 30,457 |
| 2005 | 29,765 |
| 2006 | 29,074 |
| 2007 | 28,383 |
| 2008 | 27,691 |
| 2009 | 27,000 |
| 2010 | 26,309 |
| 2011 | 25,618 |
| 2012 | 24,926 |
| 2013 | 24,235 |
| 2014 | 23,544 |
| 2015 | 22,852 |
| 2016 | 22,161 |
| 2017 | 21,470 |
| 2018 | 20,778 |
| 2019 | 20,087 |
| 2020 | 19,396 |
| 2021 | 18,704 |
| 2022 | 18,013 |
| 2023 | 17,322 |
| 2024 | 16,631 |
| 2025 | 15,939 |
| 2026 | 15,248 |
| 2027 | 14,557 |
| 2028 | 13,865 |
| 2029 | 13,174 |
| 2030 | 12,483 |
| 2031 | 11,791 |
| 2032 | 11,100 |
| 2033 | 10,409 |

| | |
|---|---|
| 2034 | 9,718 |
| 2035 | 9,026 |
| 2036 | 8,335 |
| 2037 | 7,644 |
| 2038 | 6,952 |
| 2039 | 6,261 |
| 2040 | 5,570 |
| 2041 | 4,878 |
| 2042 | 4,187 |
| 2043 | 3,496 |
| 2044 | 2,805 |
| 2045 | 2,113 |
| 2046 | 1,422 |
| 2047 | 731 |
| 2048 | 39 |
| 2049 | -652 |
| 2050 | -1,343 |

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 |
|---|---|---|---|---|---|---|---|
| 0 | 2260001020 | Snowmobiles | 0.200 | 0.200 | 0.200 | 0.200 | 0.200 |

(Fractions for all other months are zero.)

5. File Name: zonemonthhour (see EXCEL workbook, "Jan 2017 MOVES2014b Zone Month Hour.xlsx".

xii. 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". 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 year and month was January 2017. 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: "Terminal Area Forecast" Db, https://www.faa.gov/data_research/aviation/taf/.

4. McCoy, N., Fujisaki, I., Keith, J., *An Economic and Social Assessment of Snowmobiling in Utah*, January 2001.
http://static.stateparks.utah.gov/plans/snowmobilingassessment.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
https://tax.utah.gov/econstats/mv

a. Click on "Registrations – 1990s and 2000s". Data for snowmobiles is available for calendar years 2005 – 2009.

b. Click on "Vehicle Registrations – Recent". Data for snowmobiles is available for calendar years 2010 – 2018. Under a given calendar year, go to the menu item or tab "Off-road Registrations".

7. Federal Aviation Administration, Office of Environment and Energy, "Aviation Emissions and Air Quality Handbook, v. 3, update 1, January 2015, Glossary, Landing and Takeoff (LTO):

> **"Landing and Takeoff (LTO) -**LTO refers to an aircraft's landing and takeoff cycle. One aircraft LTO is equivalent to two aircraft operations (one landing and one takeoff). The standard L TO cycle begins when the aircraft crosses into the mixing zone as it approaches the airport on its descent from cruising altitude, lands and taxis to the gate. The cycle continues as the aircraft taxis back out to the runway for takeoff and climbout as its heads out of the mixing zone and back up to cruising altitude. The five specific operating modes in a standard LTO are: approach, taxi/idle-in, taxi/idle-out, takeoff, and climbout. Most aircraft go through this sequence during a complete standard operating cycle."

https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/Air_Quality_Handbook_Appendices.pdf

Google search keys: FAA aircraft operations and LTO

Finding: FAA "aviation emissions and air quality handbook"

8. 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 2018-2038 Forecast Tables", (choose TOTAL COMBINED OPERATIONS/ Tables 32 – 34).

9. Atmospheric Chemistry and Physics, "Impacts of aircraft emissions on the air quality near the ground", 2013, http://www.atmos-chem-phys.net/13/5505/2013/acp-13-5505-2013.pdf.

10. U.S. EPA, *Emission Factors for Locomotives* (EPA-420-F-09-025), April 2009, https://nepis.epa.gov/Exe/ZyPDF.cgi/P100500B.PDF?Dockey=P100500B.PDF

11. 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).

12. AMTRAK, "2013 AMTRAK Sustainability Report".
https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/environmental1/2013-Amtrak-Sustainability-Report.pdf

13. National Petroleum Council, "Rail Transportation Demand, Topic Paper #2", Aug 1, 2012.
https://www.npc.org/FTF_Topic_papers/2-Rail_Transportation_Demand.pdf

14. U.S. DOE, Energy Efficiency & Renewable Energy, "Freight Transportation Demand: Energy-Efficient Scenarios for a Low-Carbon Future", Rail Freight Ton-Miles 1980 – 2030, pp. 32 – 33, March 2013.
https://www.nrel.gov/docs/fy13osti/55641.pdf (copy and paste link into browser)

15. U.S. DOT, "National Freight Strategic Plan: DRAFT FOR PUBLIC COMMENT", 2015, https://www.bmwe.org/cms/file/02152016_171655_DOT_NFSP_Public_Comment.pdf

xiii. References

The following documents were used as references in creating the non-road mobile source PM2.5 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, "MOVES2014a User Guide", EPA-420-B-15-095, November 2015,
https://nepis.epa.gov/Exe/ZyPDF.cgi/P100NNCY.PDF?Dockey=P100NNCY.PDF

3. U.S. EPA, "MOVES2014, MOVES2014a and MOVES2014b Technical Guidance: Using

MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity", EPA-420-B-15-093, August 2018, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100V7EY.pdf

4. Western Regional Climate Center, http://www.wrcc.dri.edu/Climsum.html (on map, click on "Utah").

Reports from Railroads

5. AMTRAK 2017.xlsx fuel consumption (Utah), Laura Fotiou, Laura.Fotiou@amtrak.com

6. Rio Tinto (Kennecott Utah Copper) Locomotives (2017), Jenny Esker, Environmental Engineer, Air Quality Permitting & Compliance, Jenny Esker@riotinto.com .

7. Salt Lake Garfield & Western Railway, 2008 fuel consumption, Donald M. Hogle, 801-322-3429.

8. Union Pacific Railroad Company (UPRR), James L. Brannen, Manager Environmental, Sept 14, 2018, 2017 Est Fuel Consumption (Utah), JLBRANNEN@up.com . The report includes fuel consumption from Burlington Northern & Santa Fe Railroad.

9. Utah Railway, "Genesee & Wyoming – Utah Railway 2017 submittal, Greg Feyerabend, Greg.Feyerabend@gwrr.com.

10. Utah Transit Authority, "2017 Front Runner Locomotive Inventory Worksheet", Daniel Locke, DLocke@rideuta.com.

11. U.S. EPA, Federal Register, "Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel", Final Rule, June 29, 2004, https://www.gpo.gov/fdsys/pkg/FR-2004-06-29/pdf/04-11293.pdf.