2015

Southern Ute Indian Reservation Emission Inventory

Southern Ute Indian Tribe
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Final Report for 2015 Southern Ute Indian Tribe Comprehensive Emissions Inventory for Criteria Pollutants, Hazardous Air Pollutants, and Greenhouse Gases

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List of Acronyms

AP-42	EPA Compilation of Air Pollutant Emission Factors
API	American Petroleum Institute
AQP	Air Quality Program
BIA	United States Bureau of Indian Affairs
BSFC	Brake Specific Fuel Consumption
bbl	Barrel (42 U.S. Gallons)
CAA	Clean Air Act
CARMMS	Colorado Air Resource Management Modeling Study
CDPHE	Colorado Department of Health and Environment
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2*e*	Carbon Dioxide Equivalent
COGCC	Colorado Oil and Gas Conservation Commission
CY	Calendar Year
CFR	Code of Federal Regulations
DRMS	Colorado Division of Reclamation Mining and Safety
EI	Emissions Inventory
EIA	Environmental Impact Assessment
EPA	United States Environmental Protection Agency
FAA	Federal Aviation Administration
GHG	Greenhouse gas
GSJB	Greater San Juan Basin
HAP	Hazardous Air Pollutants
hp	Horse Power
H_2S	Hydrogen Sulfide
ICR	Information Collection Request
ITEP	Institute for Tribal Environmental Professionals
Kdf	Cretaceous Fruitland Formation
Kpcl	Cretaceous Picture Cliffs Sandstone
LFG	Landfill Gas
LP	Liquid Petroleum
LTO	Landing and Take-off Cycles

MMscf	Million Standard Cubic Feet
MSW	Municipal Solid Waste
NEI	National Emissions Inventory
NMHC	Non-methane Hydrocarbons
NMOC	Non-methane Organic Compounds
NO_x	Oxides of Nitrogen
NPS	National Park Service
O_3	Ozone
Pb	Lead
PM_{10}	Particulate Matter 10 microns and smaller
$PM_{2.5}$	Particulate Matter 2.5 microns and smaller
PSD	Prevention of Significant Deterioration
PTE	Potential to Emit
QA	Quality Assurance
RICE	Reciprocating internal combustion engine
scf	Standard Cubic Feet
SO_2	Sulfur Dioxide
SUIT	Southern Ute Indian Tribe
TEG	Tri-ethylene Glycol
TEISS	Tribal Emissions Inventory Software Solutions
THC	Total Hydrocarbons
TMNSR	Tribal Minor New Source Review Program
TOC	Total Organic Compounds
tpy	Tons per Year
USFS	United States Forest Service
VOC	Volatile Organic Compounds
WIAC	Waste Industry Air Coalition
WRAP	Western Regional Air Partnership
4SLB	Four stroke lean burn
4SRB	Four stroke rich burn
2SLB	Two stroke lean burn

I. Executive Summary

The Southern Ute Indian Tribe (Tribe) Air Quality Program (AQP) has prepared an emissions inventory of all quantifiable point and non-point sources on the Southern Ute Indian Reservation (Reservation) for calendar year 2015 (CY2015). The emissions inventory was prepared according to the Environmental Protection Agency Class II emission inventory guidelines of using measured data when available or data and emissions factors from reputable sources when measured data were not available.

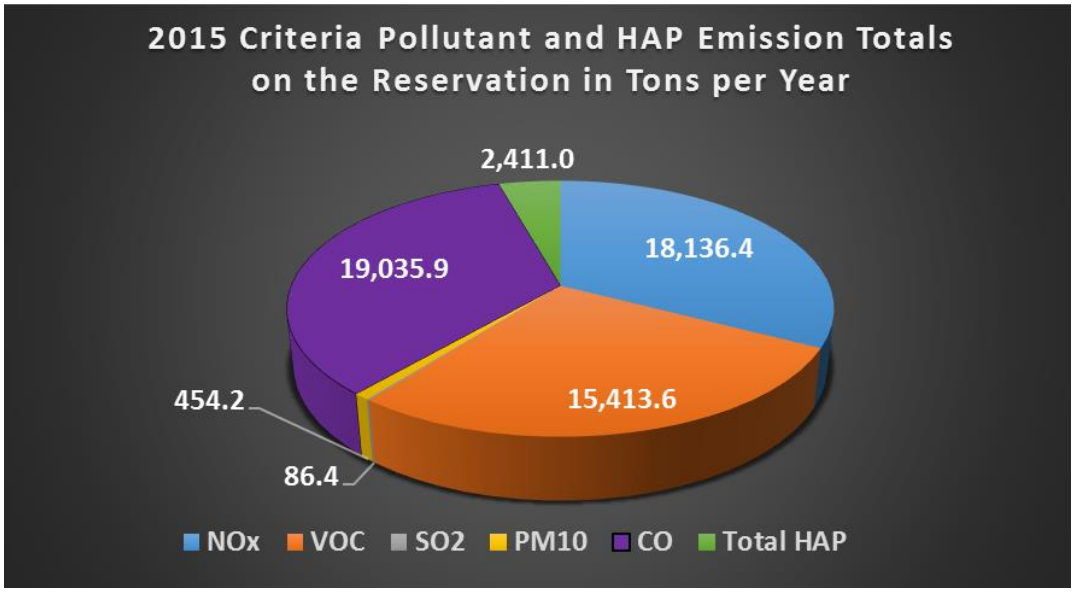
Oil and natural gas production is the predominant industry on the Reservation and emissions data for these sources were collected directly from source operators through annual emission inventories, registrations, and a Clean Air Act (CAA) Section 114 information collection request issued by the Tribe in June, 2016. Data for other sources were collected from various reputable state, local, and federal data sources.

As of January 2016, there were a total of 2,767 oil and gas production sources operating on the Reservation. These sources consisted of 37 sources operating under Title V operating permits, 5 sources operating under Tribal Minor New Source Review (TMNSR) permits, 156 sources registered under the TMNSR program, and 2,569 non-point sources with emissions below the TMNSR program thresholds, referred to in this emissions inventory as "non-registered sources".

Reservation emission totals for CY2015 were 19,231.8 tons per year (tpy) of oxides of Nitrogen (NOx), 15,467.1 tpy of Volatile Organic Compounds (VOC), 86.4 tpy of Sulfur Dioxide (SO2), 537.7 tpy of Particulate Matter 10 micrometers or less in diameter (PM_{10}), 19,957.8 tpy of Carbon Monoxide (CO), 2,431.7 tpy of total Hazardous Air Pollutants (HAP), and 9,357,473 tpy of Greenhouse Gas (GHG) emissions measured in Carbon Dioxide Equivalents (CO2*e*).

Total criteria pollutant and HAP emissions on the Reservation for 2015 are presented below in Figure 1.

Figure 1 – 2015 Total Criteria Pollutant and HAP Emissions on the Southern Ute Indian Reservation in Tons per Year



II. Overview

1. Purpose of Inventory

The purpose of this Emissions Inventory (EI) was to establish baseline emissions estimates for the 2015 calendar year for all quantifiable air emission sources located within the exterior boundaries of Reservation. The emissions data for the Reservation presented in this EI has been organized by source category and pollutant. The EI will be used for future air quality planning purposes, such as development of air quality regulations targeted at ozone precursors for maintaining attainment with the National Ambient Air Quality Standards, emissions modeling, and Title V permitting fee analysis.

The primary air pollutants included in this EI are NOx, CO, PM_{10}, VOC, HAP and GHG.

2. Geographic Location of Southern Ute Indian Reservation

The Reservation is located in southwestern Colorado. The Reservation land area covers 1,066 square miles in three counties (La Plata, Archuleta, and Montezuma) and borders New Mexico to the south. The total area covered by this inventory is approximately 682,590 acres, which encompasses all land within the external boundaries of the Reservation. The Southern Ute Indian Tribe (Tribe) and/or its members own approximately 320,000 acres, while the remaining land mass is comprised of non-Indian and government land in a checkerboard fashion. The primary land use is agricultural and the predominant industry is oil and natural gas production.

3. Climate

The Reservation remains generally semi-arid throughout the year. Located north of northern New Mexico desert land and south of the Colorado alpines, the average temperature range during the winter months is between twenty and forty degrees Fahrenheit. Freezing temperatures are common throughout the winter and during the 2015 calendar year the coldest month was December with a low of -1.0 degrees Fahrenheit and a monthly average of 26.2 degrees Fahrenheit. During the summer months the temperature typically remains in the high eighties to low nineties. The warmest month of 2015 was June with a high of 96.0 degrees Fahrenheit, and a monthly average of 67.6 degrees Fahrenheit. Snow is the dominant form of precipitation on the Reservation and total precipitation for calendar year 2015 was 18.37 inches. The driest month was March with a 0.34 inches of precipitation and the wettest month was October with 2.61 inches of precipitation.[1]

4. Geology

The Reservation is situated in the northern portion of the San Juan Basin, a geologic structural basin underlying southwestern Colorado and northwestern New Mexico. The basin is composed of Cambrian to Holocene aged sedimentary rocks and contains one the largest coal-bed methane natural gas fields in the world within the Cretaceous aged Fruitland Formation.[2] The majority of the natural gas production on the Reservation is coalbed methane from the Fruitland Formation, but conventional natural gas is also produced from Cretaceous aged sandstone reservoirs of the Pictured Cliffs Formation, Mesa Verde Group, and the Dakota Sandstone. Tight gas reservoirs of the Cretaceous aged Mancos Shale have also been drilled, however, no significant exploration and production has occurred within the Reservation as of 2015.

5. Sources

The sources that were included in this emissions inventory were organized according to location and size. These point sources are as follows:

A. Point Sources

1) Title V permitted oil and natural gas sources
2) TMNSR minor oil and natural gas sources, including:
    a. Permitted minor TMNSR sources,

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[1] Southern Ute Indian Tribe: Ambient Monitoring. (2015). *2015 AQS Ute 3 Humidity and Temperature Hourly Data.* Retrieved from: http://www.southernute-nsn.gov/environmental-programs/air-quality/ambient-monitoring/

[2] Fasset, J. E., & Hinds, J. S. (1971). Geology and Fuel Resources of the Fruitland Formation and Kirtland Shale of the San Juan Basin, New Mexico and Colorado. Geological Survey Professional Paper 676. United States Government Printing Office. Retrieved from https://pubs.usgs.gov/pp/0676/report.pdf

b. Registered minor TMNSR sources,
3) Municipal solid waste landfills, and
4) Airports.

B. Non-point Sources

1) Non-registered minor oil and natural gas sources,
2) Fruitland Formation Outcrop natural gas seeps,
3) Gasoline stations,
4) Aviation gasoline dispensing,
5) Gravel pits,
6) Residential heating,
7) Fire events (wildland fires and prescribed burns), and
8) Agricultural burning.

C. Mobile Sources

1) On-road vehicles, and
2) Non-road equipment.

D. Biogenic Sources

III. Data Quality Objectives

Data objectives for this inventory are as follows:

1. Accuracy

- Data for this EI were collected according to EPA level II EI guidelines using measured data when available or data from reputable sources such as EPA, the Colorado Oil and Gas Conservation Commission (COGCC) and professional organizations when measured data were not available.
- Emission factors were developed using measured data or commonly accepted emissions factors and assumptions from EPA and professional organizations.
- All data sources, emission factors, assumptions, and emission calculation methodologies were documented.
- Utilize emission calculation models when available (GRI-GLYCalc 4.0, Tanks 4.09d, etc.) and inputs provided in annual emission reports or 2016 CAA Section 114 Information Collection Request (ICR).
- Compare results of 2015 SUIT EI with results from the CY2006 Western Regional Air Partnership (WRAP) Oil and Gas EI for the North San Juan Basin and the CY2014 WRAP EI for the Greater San Juan Basin.
- Quality Assurance review of emission totals, assumptions, emission factors, and calculation methodologies was conducted by a third party contractor.

2. Uncertainty

- Reported emissions may be inaccurate.
- The number of unreported oil and gas sources is unknown and can only be estimated based on sources reported to COGCC.
- An accurate EI for small oil and gas sources has never been completed for the Reservation.
- Emissions differences between CY2015 SUIT EI with WRAP CY2006 and 2014 EIs may occur due to different preparation methodologies and assumptions.

3. Completeness

- Capture 100% of point source emissions reported in the annual emission fees for CY2015.
- Capture 95% of non-point oil and gas sources in the 2016 CAA 114 ICR.
- Reported information will be used to extrapolate emissions to 100% to fill data gaps.
- Capture 80% of area sources (gas stations, etc.).

4. Comparability

- EI results will be compared with results from the CY2006 WRAP Oil and Gas EI for the North San Juan Basin and the CY2014 WRAP EI for the Greater San Juan Basin.
- Emission factors and assumptions will be compared with methodologies used in similar emission calculation applications.

IV. Point Sources

1. Title V Permitted Oil and Gas Sources

Description of Sources

Thirty-six oil and gas Title V sources operated on the Reservation during calendar year 2015. Sources include natural gas compressor stations, central delivery points, treating plants, and processing plants.

Title V sources are defined as sources with the potential to emit (PTE) one-hundred tons per year (tpy) of a single criteria pollutant, twenty-five tpy of hazardous air pollutants (HAP) in aggregate, or ten tons per year of an individual HAP. The Tribe has full delegation of a Title V operating permit program under 40 CFR Part 70 and during calendar year 2015, thirty-five oil and gas sources operated under Tribally-issued Title V permits. One source, a natural gas processing plant, continued to operate under a Title V permit issued by EPA Region 8.

Data Collection

Title V sources are required to report emissions annually and pay a per-ton emission fee for pollutants emitted. Emissions data for Title V sources were collected directly from the calendar year 2015 fee calculation worksheets submitted by each source to the Tribe and EPA Region 8. Actual emissions data were available for all thirty-six Title V oil and gas sources. Actual CO emissions were only reported for twenty-eight sources and actual GHG emissions (measured in carbon dioxide equivalents (CO2*e*)) were not reported for any sources. The missing CO and CO2*e* emissions data for these sources were obtained from PTE values reported in Title V permit applications representing operation in calendar years 2012 or 2013.[3] This data collection methodology adheres to the EPA level II EI guidelines for utilizing measured data when available.

Emissions

Total criteria pollutant and GHG emissions estimated from Title V sources for the 2015 calendar year are displayed below in Figure 2 and Figure 3.

Figure 2 – 2015 Title V Oil and Gas Source Criteria Pollutant and GHG Emissions Estimations for the Southern Ute Indian Reservation in Tons per Year[1, 2]

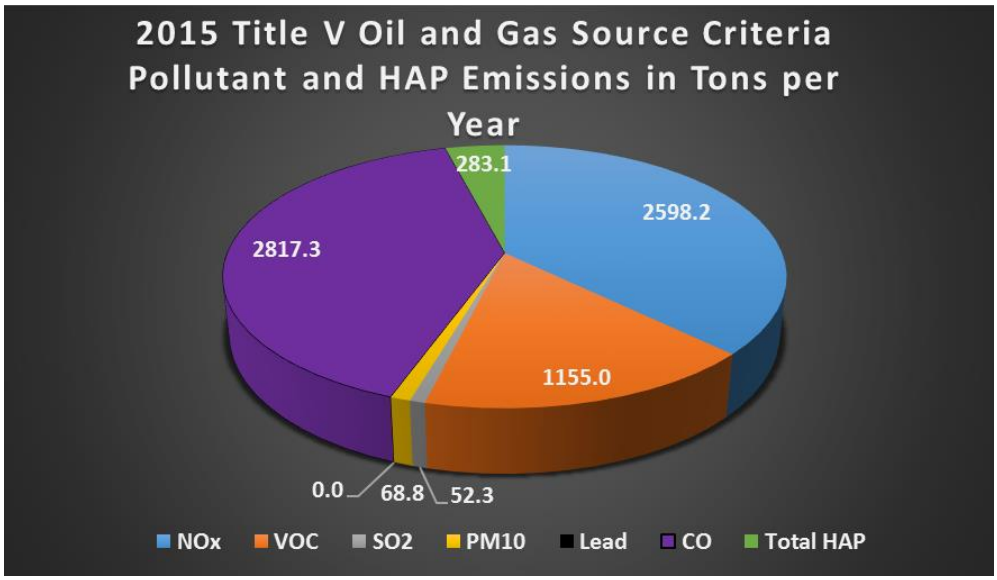
2015 Title V Criteria Pollutant and GHG Emissions Estimations in Tons per Year						
Pollutant	**NOx**	**CO[1]**	**VOC**	**PM_{10}**	**SO_2**	**CO2*e*[2]**
Emissions	2,598.2	2,817.3	1,155.0	68.8	52.3	2,012,320

[1]Actual CO emissions were obtained from the fee calculation worksheet, if the Title V source included the CO actual emissions. There were 28 Title V sources that included the actual CO emissions for the 2015 calendar year. CO emissions for 8 sources are PTE values obtained from Title V permit applications representing operations in calendar years 2012 or 2013.

[2]CO2*e* emissions for all Title V sources are PTE values obtained from Title V permit applications representing operation in calendar years 2012 or 2013

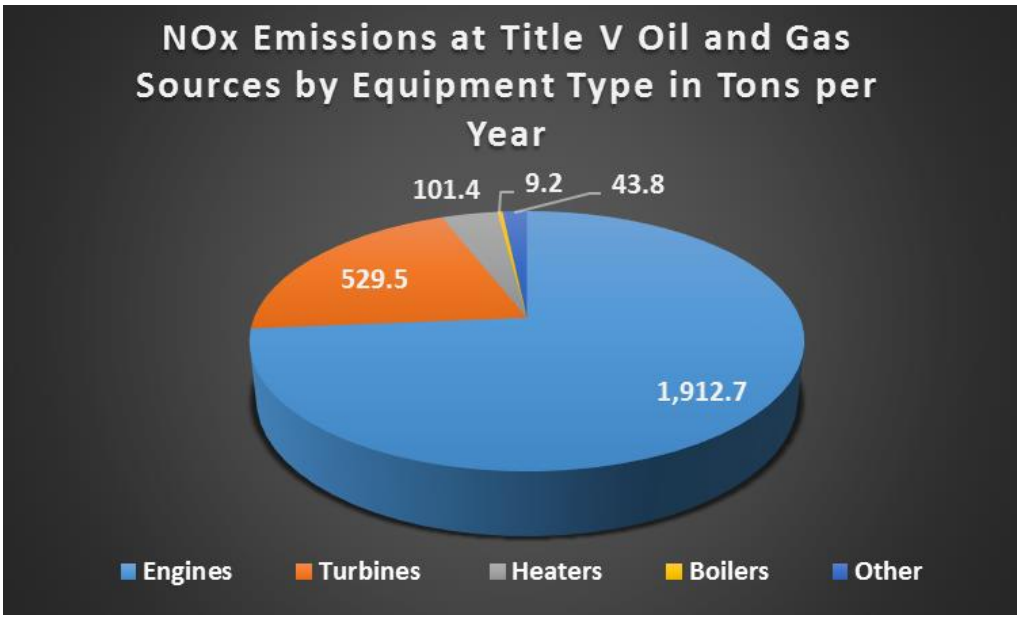
[3] (2016). Southern Ute Indian Tribe or EPA Calendar Year 2015 Part Title V FEE Forms.

Figure 3 – 2015 Title V Oil and Gas Source Criteria Pollutant Emissions on the Southern Ute Indian Reservation in Tons per Year



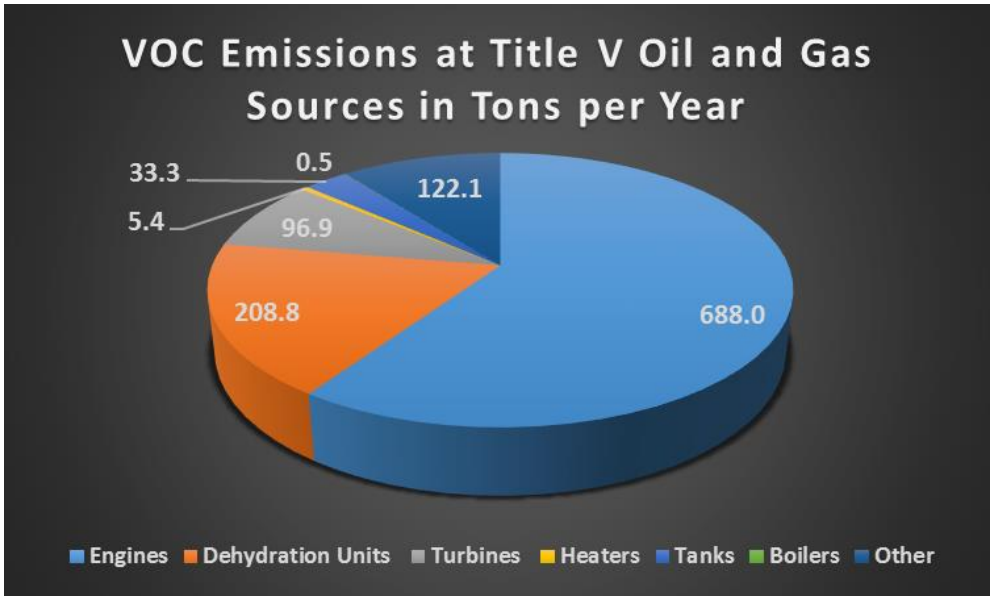
Oxides of Nitrogen emissions by equipment type at Title V sources for the 2015 calendar year are displayed below in Figure 4.

Figure 4 – 2015 NOx Emissions at Title V Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



Volatile organic compound emissions by equipment type at Title V sources for the 2015 calendar year are displayed below in Figure 5.

Figure 5 – 2015 VOC Emissions at Title V Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



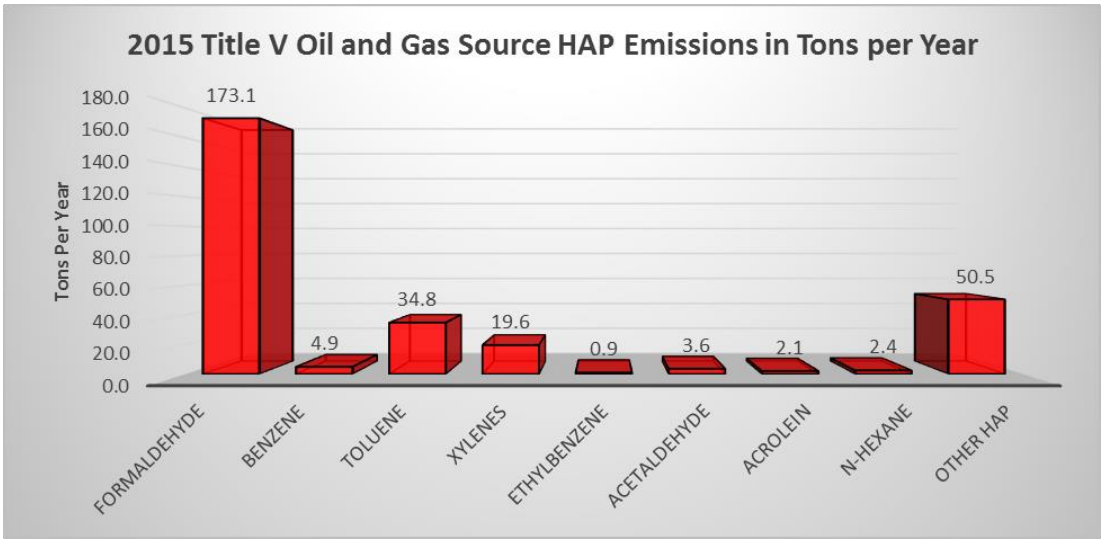
Total and speciated 2015 HAP emissions from Title V sources are displayed below in Figure 6 and Figure 7.

Figure 6 – 2015 Title V Oil and Gas Source Hazardous Air Pollutant Emissions on the Southern Ute Indian Reservation in Tons per Year

2015 Title V Hazardous Air Pollutant Emissions in Tons per Year	
Pollutant	**Emissions**
Formaldehyde	173.1
Benzene	4.9
Toluene	34.8
Xylene	19.6
Ethylbenzene	0.9
Acetaldehyde	3.6
Acrolein	2.1
n-Hexane	2.4
Other HAP[1]	51.2
Total	**291.78**

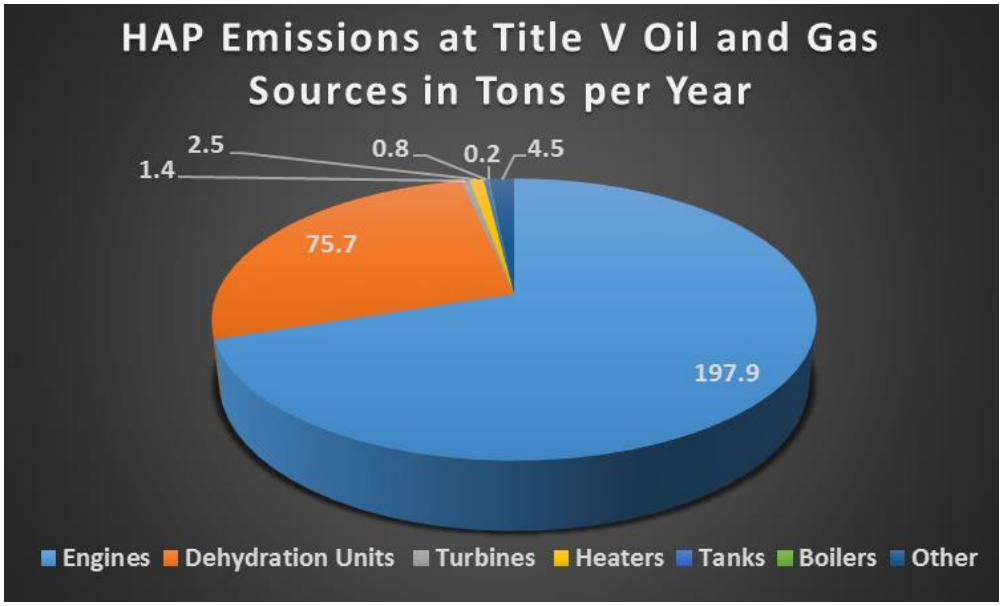
[1]Other HAP is a composite of non-speciated HAP emissions from CY 2015 Title V Fee calculation worksheets.

Figure 7 – 2015 Title V Oil and Gas Source Hazardous Air Pollutant Emissions on the Southern Ute Indian Reservation in Tons per Year



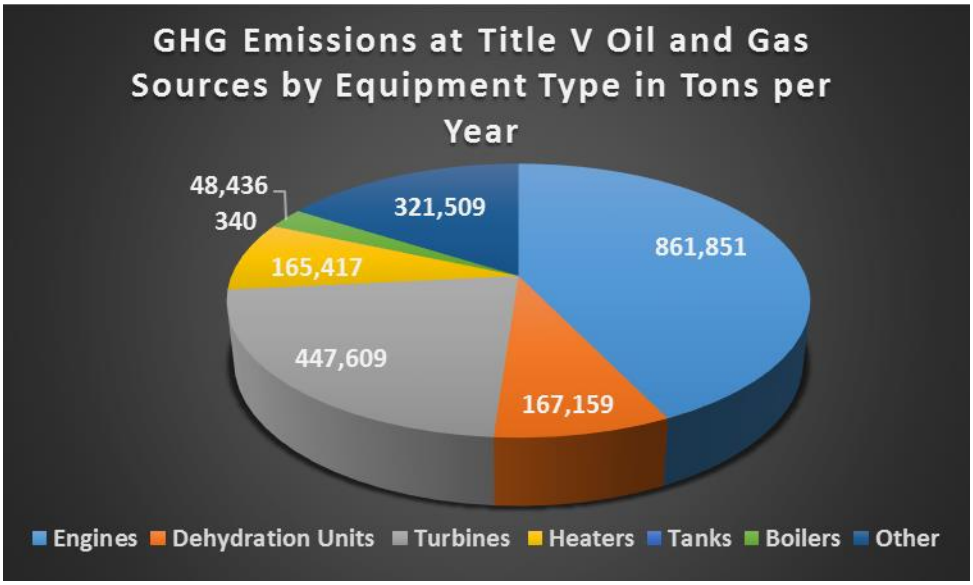
Hazardous Air Pollutant emissions by equipment type at Title V sources for the 2015 calendar year are displayed below in Figure 8.

Figure 8 – 2015 Hazardous Air Pollutant Emissions at Title V Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



Greenhouse Gas emissions by equipment type at Title V sources for the 2015 calendar year are displayed below in Figure 9.

Figure 9 – 2015 Greenhouse Gas Emissions at Title V Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



2. Minor Point Sources

The Tribal Minor New Source Review (TMNSR) permitting program is found at 40 CFR Part §49.151 through §49.164.[4] The TMNSR permitting program includes new or modified source permitting, permits by rule, and a registration program. For the purposes of this inventory, two main categories of emission sources under this program were considered: a.) Permitted TMNSR oil and gas sources, and b.) Registered TMNSR Oil and Gas Sources.

The emission thresholds for the TMNSR permitting program are located at 40 CFR Part §49.153. Minor sources with emissions less than the levels displayed in Figure 10 below are not required to obtain a permit or register under the program.

The emission thresholds from 40 CFR Part 49.153 are displayed below in Figure 10.

[4] 40 CFR Part 49 - Indian Country: Air Quality Planning and Management. (2016). U.S. Government Publishing Office. Retrieved from http://www.ecfr.gov/cgi-bin/text-idx?SID=bc4187dbf0b08beb092efe4251fe4493&mc=true&tpl=/ecfrbrowse/Title40/40cfr49_main_02.tpl

Figure 10 – 40 CFR Part 49 Minor New Source Review Program Emissions Thresholds in Tons per Year

40 CFR 49.153 Minor NSR Thresholds	
Regulated NSR Pollutant	**Minor NSR Thresholds for Attainment/Unclassifiable Areas in Tons per Year**
Carbon Monoxide (CO)	10
Nitrogen Oxides (NO_x)	10
Sulfur Dioxide (SO_2)	10
Volatile Organic Compounds (VOC)	5
PM_{10}	5
$PM_{2.5}$	3
Lead	0.1
Fluorides	1
Sulfuric Acid Mist	2
Hydrogen Sulfide (H_2S)	2
Total Reduced Sulfur (including H_2S)	2
Reduced Sulfur Compounds (including H_2S)	2
Municipal Waste Combustor Emissions	10
Municipal Solid Waste Landfill Emissions (measured as non-methane organic compounds)	10

A. Permitted Tribal Minor New Source Review Oil and Gas Sources

Description of Sources

This category reflects larger emission sources that would be subject to either the Prevention of Significant Deterioration (PSD), Title V operating permit program, or both programs absent enforceable emission limitations to reduce the source's PTE. These types of permits are often referred to as "synthetic minor permits".

During calendar year 2015, twelve sources on the Reservation operated under TMNSR permits. Of the twelve sources in this category, eleven sources were natural gas compressor stations and one source was a natural gas processing plant. Five sources had permits to reduce emissions below Title V permitting thresholds and seven sources had permits to reduce emissions below the PSD permitting thresholds.

Data Collection

Only the five sources with TMNSR permitted emissions below the Title V permitting thresholds were included in this category in order to avoid double counting emissions. Emissions from the remaining seven sources, which hold Title V operating permits issued by the Tribe, were already accounted for under the Title V Oil and Gas Sources category of this inventory.

TMNSR sources are required to submit annual emissions inventories to EPA Region 8 for the pollutants regulated under each permit and emissions data was collected directly from the annual emissions inventories submitted for calendar year 2015.[5] For pollutants not reported in the annual emissions inventories, the Southern Ute Indian Tribe Air Quality Program (AQP) requested and received PTE data from the source operators. This data collection methodology adheres to the EPA level II EI guidelines for using measured data when available.

Emissions

Total 2015 criteria pollutant, HAP, and GHG emissions from permitted TMNSR oil and gas sources on the Southern Ute Indian Reservation are presented below in Figure 11.

Figure 11 – 2015 Criteria Pollutant and HAP Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year[1]

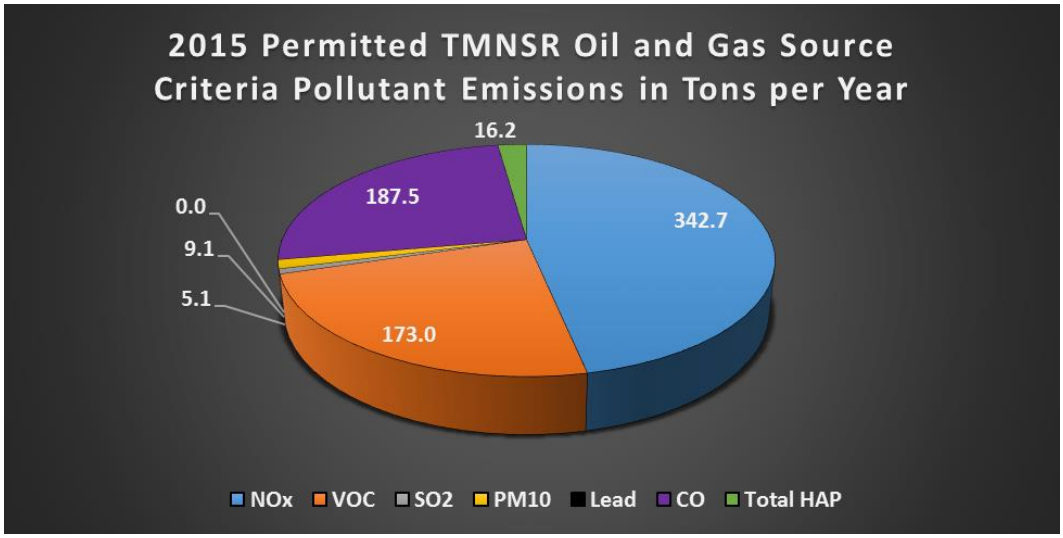
2015 Criteria Pollutant and HAP Emissions for Permitted TMNSR Oil and Gas Sources in Tons per Year							
Pollutant (tons per year)	**NOx**	**CO**	**VOC**	**PM_{10}**	**SO_2**	**Total HAP**	**CO2*e***
Emissions	342.7	187.5	187.5	9.1	5.1	16.2	120,489

[1] Emissions from a composite of (2016). CY 2015 EPA TMNSR Fee Forms and PTE data from source operators.

[5] (2016). CY 2015 EPA TMNSR Fee Forms.

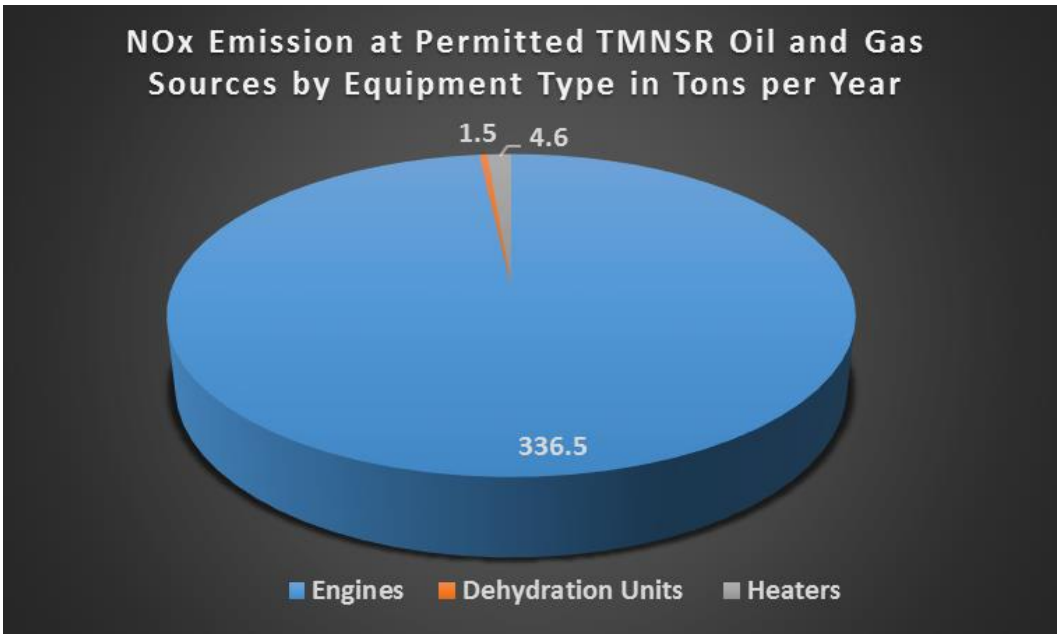
Total criteria pollutant and HAP emissions from permitted TMSNR oil and gas sources on the Southern Ute Indian Reservation are presented below in Figure 12.

Figure 12 – 2015 Criteria Pollutant and HAP Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year



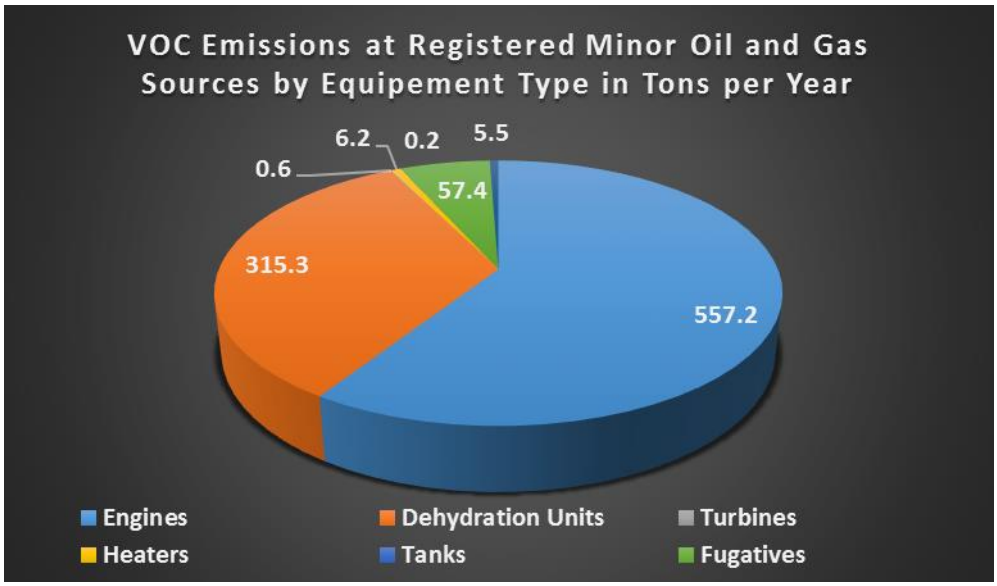
Total 2015 NOx emissions from permitted TMNSR oil and gas sources on the Reservation are displayed below in Figure 13.

Figure 13 – 2015 NOx Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year



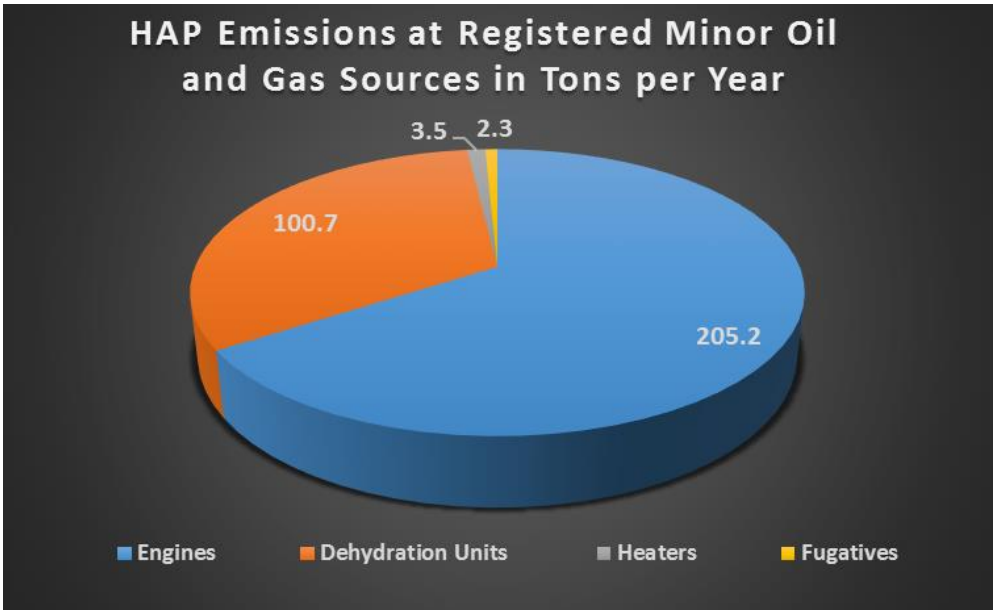
Total 2015 VOC emissions from permitted TMNSR oil and gas sources on the Reservation are displayed below in Figure 14.

Figure 14 – 2015 VOC Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year



Total 2015 HAP emissions from permitted TMNSR oil and gas sources on the Reservation are displayed below in Figure 15.

Figure 15 – 2015 Total HAP Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

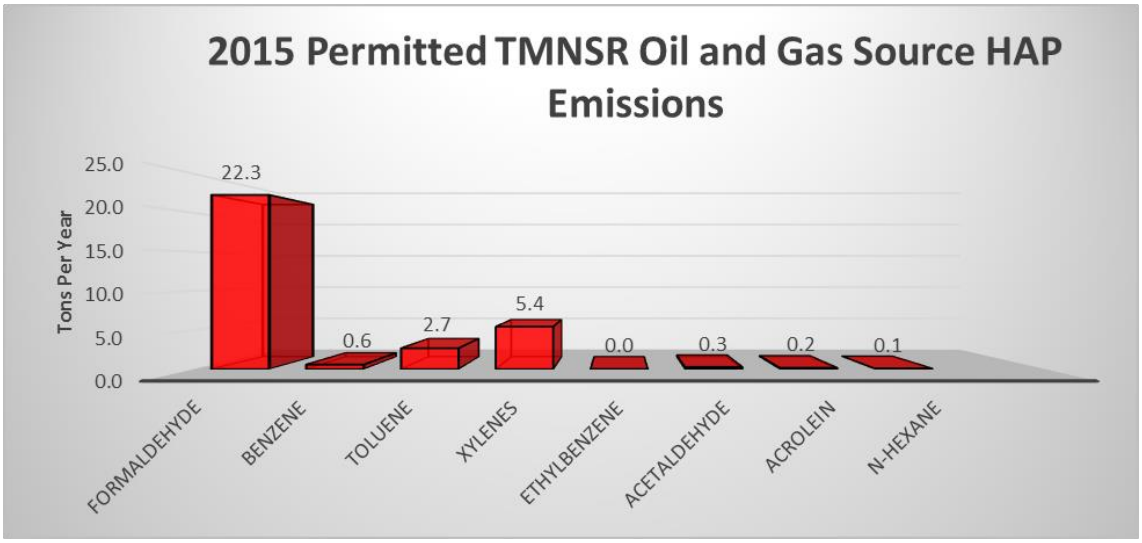


Total 2015 speciated HAP emissions from permitted TMNSR oil and gas sources on the Reservation are displayed below in Figure 16 and Figure 17.

Figure 16 – 2015 Speciated HAP Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

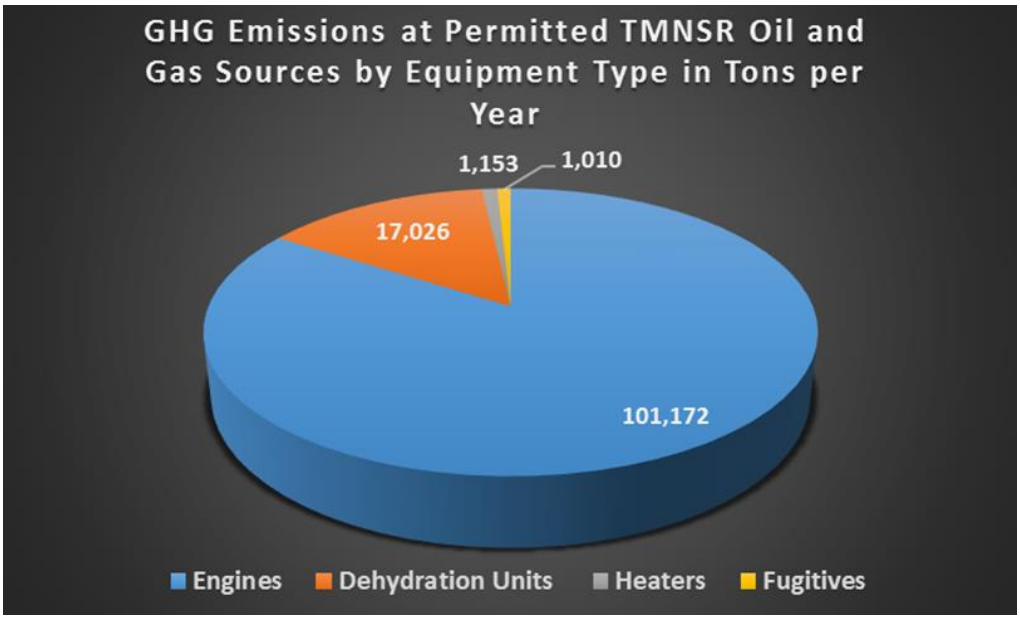
2015 HAP Emissions for Permitted TMNSR Oil and Gas Sources in Tons per Year								
Pollutant (tons per year)	**Formaldehyde**	**Benzene**	**Toluene**	**Xylenes**	**Ethylbenzene**	**Acetaldehyde**	**Acrolein**	**n-Hexane**
Totals:	22.3	0.6	2.7	5.4	0.0	0.3	0.2	0.1

Figure 17 – 2015 Speciated HAP Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year



Total 2015 GHG emissions from permitted TMNSR oil and gas sources on the Reservation are displayed below in Figure 18.

Figure 18 – 2015 GHG Emissions for Permitted Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year



B. Registered Tribal Minor New Source Review Oil and Gas Sources

Description of Sources

The TMNSR program required operators of true minor sources as defined in §49.152, to register each oil and gas source with EPA Region 8 by no later than March 1, 2013. Existing oil and gas sources, constructed or modified after March 1, 2013, but before October 3, 2016 were also required to register. All oil and gas sources constructed after March 1, 2013 are required to apply for a site-specific TMSNR permit or comply with the Oil and Gas Federal Implementation Plan for Indian Country at 40 CFR Part 49, Subpart C.

As of January 2016, EPA Region 8 had received 156 oil and gas source registrations for the Reservation.[6] The registrations included source locations, emission unit descriptions, and actual emissions calculations. All of the registered sources are natural gas production sources, primarily well-sites. Certain non-oil and gas sources, such as hot mix asphalt plants and stone quarrying, crushing and screening operations, also required registration with the EPA under the TMNSR program, but to date, no such sources have been registered. Presumably, non-oil and gas sources that did not register with the EPA

[6] Southern Ute Indian Tribe. (2016). Information Collection Request.

may exist on the Reservation, and this issue will be addressed below in the data collection section.

Data Collection

For the purposes of this emission inventory section, only emissions from registered TMNSR sources were included. Sources with Title V operating permits or synthetic minor permits were not required to register under 40 CFR Part 49; therefore, there is little risk of double counting emissions from these sources. Emissions from Title V sources and synthetic minor sources were assessed separately, as discussed in Chapter IV Section 1 and 2A of this report.

Due to the potential for registration information to be stale or out of date, the AQP issued a mandatory Clean Air Act Chapter 114 ICR in June 2016 to obtain updated and reconciled registration data from each facility operator. The ICR also included data for non-registered oil and gas sources. Specifically, the ICR requested reconciliation of the operational status of each previously registered source, equipment located at each source, and the actual emissions for calendar year 2015.

The ICR also requested information that was exempted from TMNSR registration including emissions estimates for engines less than or equal to 50-hp and facility-wide emissions of HAP and GHG. It was also anticipated that the ICR could result in emissions reporting by sources that had never registered with the EPA. This data collection methodology adheres to the EPA level II EI guidelines for utilizing measured data when available.

Emissions

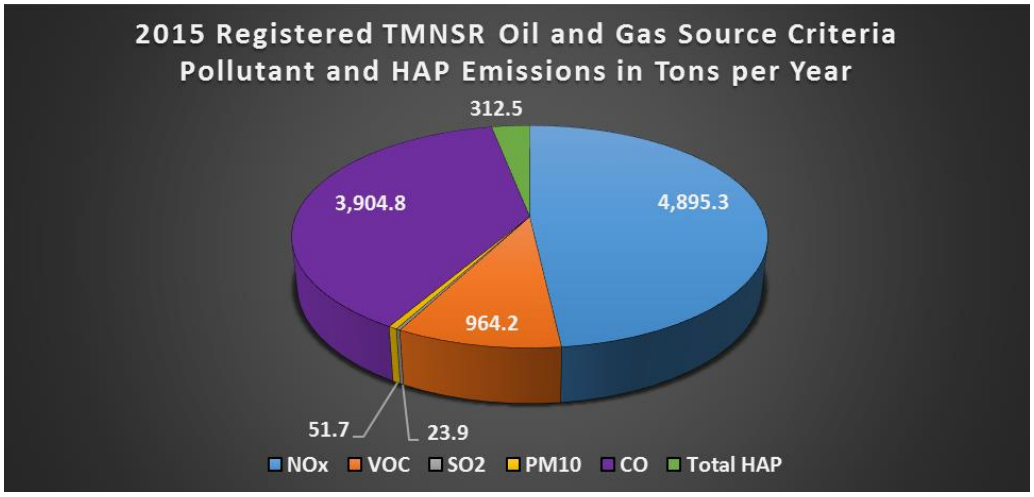
Total 2015 emissions of criteria pollutants, HAP, and GHG from registered TMNSR oil and gas sources on the Reservation are displayed below in Figure 19 and Figure 20.

Figure 19 – 2015 Criteria Pollutant and HAP Emissions from Registered TMNSR Oil and Gas Source on the Southern Ute Indian Reservation in Tons per Year[1]

2015 Registered TMNSR Criteria Pollutant Emissions in Tons per Year							
Pollutant	**NOx**	**CO**	**VOC**	**PM_{10}**	**SO_2**	**Total HAP**	**CO2*e***
Emissions	4,835.3	3,859.1	964.2	51.7	23.9	312.5	631,331

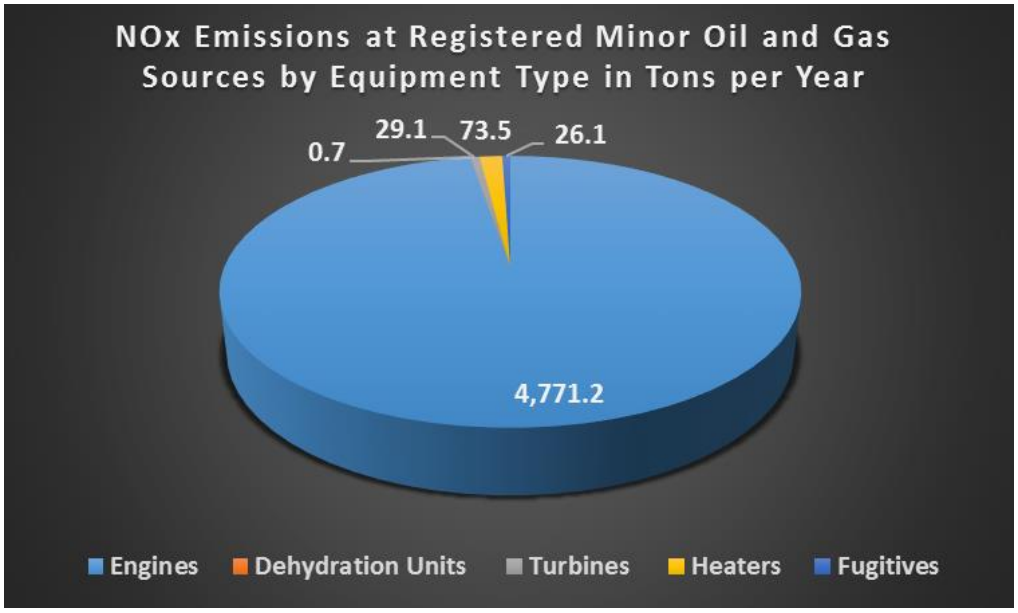
[1]Emissions from Southern Ute Indian Tribe. (2016). Information Collection Request

Figure 20 – 2015 Criteria Pollutant and HAP Emissions from Registered TMNSR Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year



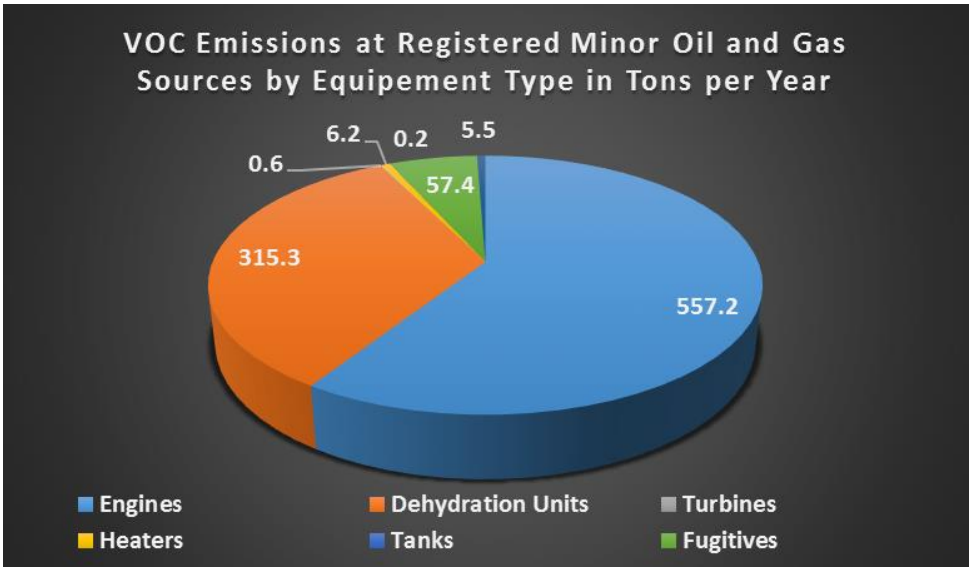
Total 2015 NOx emissions from registered TMNSR oil and gas sources on the Reservation by equipment type are displayed below in Figure 21.

Figure 21 – 2015 Total NOx Emissions for Registered Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



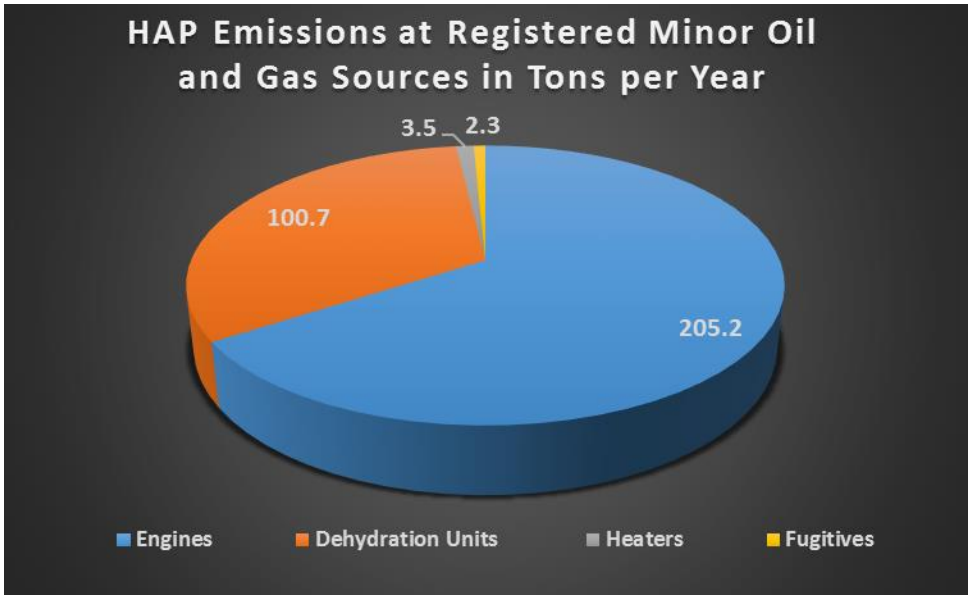
Total 2015 VOC emissions from registered TMNSR oil and gas sources on the Reservation by equipment type are displayed below in Figure 22.

Figure 22 – 2015 Total VOC Emissions for Registered Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



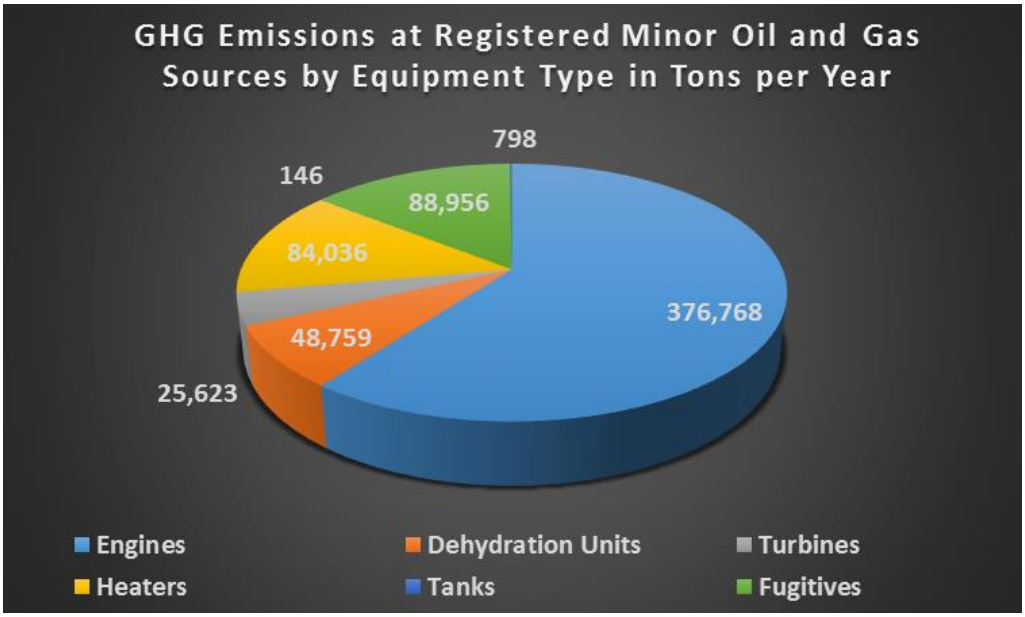
Total 2015 HAP emissions from registered TMNSR oil and gas sources on the Reservation by equipment type are displayed below in Figure 23.

Figure 23 – 2015 Total HAP Emissions for Registered Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



Total 2015 GHG emissions from registered TMNSR oil and gas sources on the Reservation by equipment type are displayed below in Figure 24.

Figure 24 – 2015 Total GHG Emissions for Registered Tribal Minor New Sources Review Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



3. Landfill Gas

The Southern Ute Indian Tribe has two Class II municipal solid waste (MSW) landfills within the Reservation boundaries. The first one is the Bondad Landfill located in Bondad, Colorado and the second one is the Archuleta County Landfill, located south of Pagosa Springs, Colorado. Both of the MSW disposal sites accept non-hazardous residential, commercial, and industrial waste. The Bondad landfill is owned and operated by Transit Waste, LLC and has been in operation since 1997. The Archuleta County landfill is owned and operated by Archuleta County and began operation in 1985. The Bondad Landfill operates under a tribally issued Title V operating permit and the Archuleta County Landfill reports annual landfill gas emissions to the Colorado Department of Public Health and Environment (CDPHE).

Data Collection

Emission data for the Archuleta County Landfill were provided by the Archuleta County Solid Waste Department and included a calendar year 2015 greenhouse gas report and an Air Pollution Emission Notice and Application for Construction Permit and Design Capacity Report. All reports were previously submitted by Archuleta County to the CDPHE.

Emissions data for the Bondad Landfill were directly obtained from the CY2015 Title V emissions fee form submitted to the Tribe.

Emission Calculation Methodology

Emissions for both the Archuleta County and Bondad landfills were estimated using the EPA's MSW landfill emissions model, LandGEM version 3.02 (LandGEM).[7] The LandGEM model estimates total landfill gas, non-methane organic compounds (NMOC), and hazardous air pollutants (HAP).

The LandGEM model is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in MSW landfills.

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_0 \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where:

Q_{CH4} = annual methane generation in the year of calculation (m^3/year)
i = 1 year time increment
n = (year of the calculation) – (initial year of waste acceptance)
j = 0.1 year time increment
k = methane generation rate (year-1)
Lo = potential methane generation capacity (m^3/Mg)
M_i = mass of waste accepted in the i^{th} year (Mg)
t_{ij} = age of the j^{th} section of waste mass M_i accepted the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM Inputs and Assumptions

Complex microbial and biochemical reactions occur within the landfill's interior after the waste has been deposited. The two primary constituents of landfill gas (LFG) are methane (CH_4) and carbon dioxide (CO_2). LFG also contains small amounts of non-methane organic compounds, which includes VOC, HAP, and GHG. LandGEM estimates the LFG from anaerobic decomposition of the waste with CH_4 and CO_2 content between 40 and 60 percent. The LandGEM defaults used for methane is 50 percent by volume (the model default value). The production of LFG is a continuous process until microbial reactions are limited by substrate or moisture. Other factors include climate, moisture conditions and types of solid waste accepted (degradable vs. inert).

Parameters for climatic conditions used in the LandGEM model were a k-value of 0.02 $year^{-1}$ (an arid area that receives less than 25 inches of rain annually) and a L_o-value of 170 cubic

[7] U.S. EPA - Landfill Gas Emissions Model. (2016). Retrieved from https://www.epa.gov/catc/clean-air-technology-center-products#software.

meter per megagram. The VOC concentrations are assumed to be 39 percent of NMOC concentrations, consistent with the footnote C Table 2.4-2 of the EPA's publication titled *AP-42, Fifth Edition Compilation of Air Emission Factors* (EPA AP-42).[8] For the Bondad Landfill the concentrations of HAPs in the LFG were taken from the values reported in the Waste Industry Air Coalition (WIAC) report titled *Comparison of Recent Landfill Gas Analyses with Historic AP-42 Values*.[9] For HAP compounds not listed in the WIAC report, emission factors from EPA AP-42 Table 2.4-1 and Section 2.4-4 were used. HAP emissions for the Archuleta County Landfill are from the LandGEM report using default emissions factors from EPA AP-42. The total estimated emissions of LFG were estimated using the flow rate and molecular weights.

Emissions

The estimated LandGEM emissions for Bondad Landfill were provided to the Tribe in a Title V emissions fee form package submitted by Transit Waste for calendar year 2015. Emissions estimates for Archuleta County Landfill were calculated by the Tribe using LandGEM and the waste acceptance rates and waste-in-place data values for 2015 taken from the 2015 GHG report previously submitted by Archuleta County to the CDPHE. The AQP used the same assumptions and climatic parameters used in the report for Bondad Landfill as these values have been previously reviewed and deemed acceptable when preparing the Title V permit for the Bondad Landfill.

To avoid double counting emissions from the Bondad Landfill, emissions from Bondad Landfill were only included in the Landfill gas emission totals and not included in the Title V emission totals presented in Section I.V.1 of this report.

Total refuse in place in tons and total emissions of VOC and HAP from MSP landfills on the Reservation for 2015 are displayed below in Figure 25 and Figure 26.

[8] U.S. Environmental Protection Agency. (2016). *AP-42: Compilation of Air Emission Factors*. Retrieved from https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factor

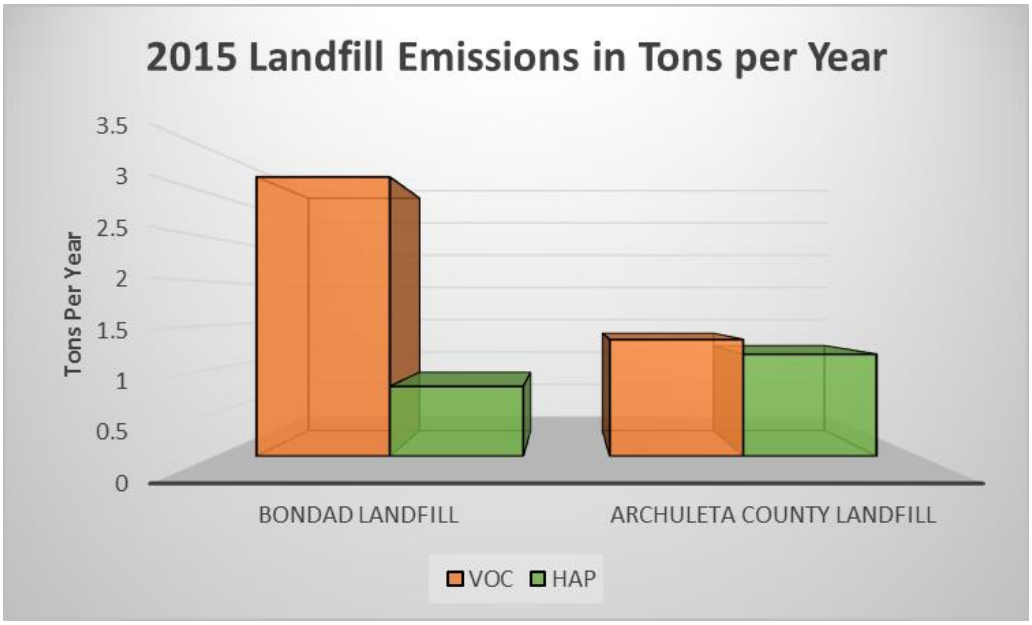
[9] Waste Industry Coalition. (2001, January). Comparison of Recent Landfill Gas Analysis with Historic AP-42 Values.

Figure 25 – 2015 Municipal Solid Waste Landfill Refuse in Place in Tons and Emissions on the Southern Ute Indian Reservation in Tons per Year [1]

2015 MSW Landfill Refuse in Place in Tons and Emissions in Tons per Year			
	Refuse in Place (tons)	**VOC (tons per year)**	**HAPs (tons per year)**
Bondad Landfill	799,873	3.2	0.8
Archuleta County Landfill	268,687	1.3	1.2
Totals	**1,068,560.0**	**4.5**	**2.0**

[1]An insignificant quantity of double counting of VOCs occurs because many reported HAPs are also considered VOCs.

Figure 26 – 2015 Municipal Solid Waste Landfill Refuse in Place in Tons and Emissions on the Southern Ute Indian Reservation in Tons per Year



4. Airports

There are three airports located within the Reservation, the Durango-La Plata County airport, the Animas Air Park and the Animas Air Park Helipark.

Data Collection

The AQP obtained data from EPA's 2014 National Emissions Inventory database (NEI), which include total landing and take-off cycles (LTOs) and piston and turbine engine

emission estimates for the heliport, taxi and general aviation at the Animas Air Park.[10] The LTOs were from the Federal Aviation Administration (FAA). The methodologies used by EPA to calculate airport emissions are detailed in the Eastern Research Group's document titled *Documentation for Aircraft Component of the National Emissions Inventory Methodology.*[11]

Emissions data for the Animas Air Park and Animas Air Park Heliport were submitted to the NEI by EPA. Emissions data for the Durango-La Plata airport were reported to the NEI by the CDPHE.

Assumptions

Calendar year 2014 airport emissions are assumed to be similar to emissions from the airports during CY2015.

Emissions

Total 2015 criteria pollutant and HAP emissions from airports on the Reservation for 2015 are displayed in Figure 27 and Figure 28 below.

Figure 27 –2015 Criteria Pollutant and HAP Emission from Airports on the Southern Ute Indian Reservation in Tons per Year[1]

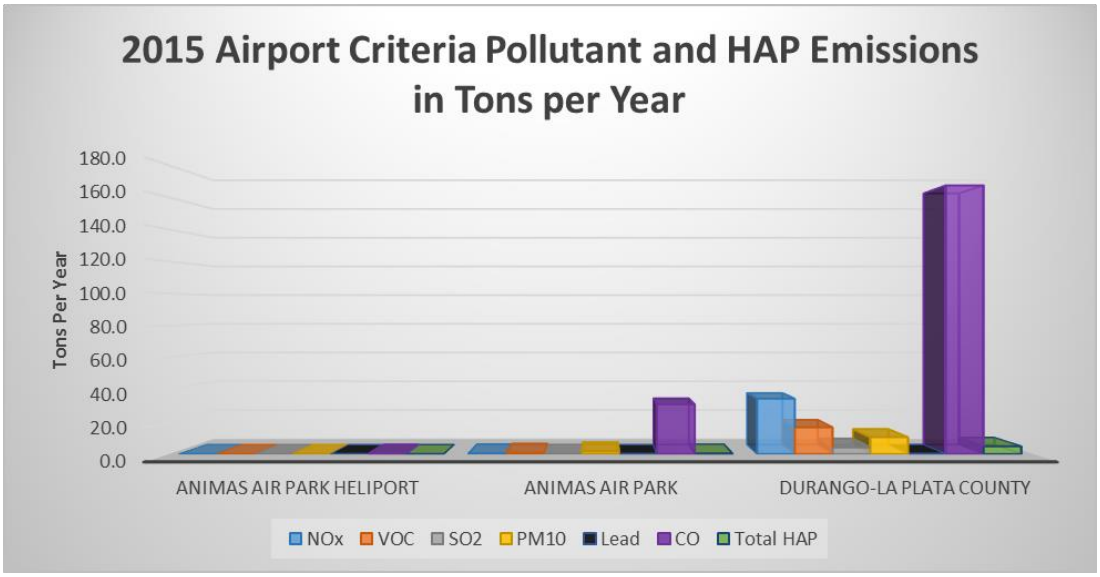
2015 Criteria Pollutant and HAP Emission from Airports in Tons per Year							
	NOx	**VOC**	**SO2**	**PM10**	**Lead**	**CO**	**Total HAP**
Animas Air Park Heliport	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Animas Air Park	0.4	0.8	0.1	1.7	0.0	30.9	0.3
Durango-La Plata County	34.5	16.6	4.2	10.5	0.1	167.2	4.8
Total	**34.9**	**17.5**	**4.3**	**12.2**	**0.1**	**198.4**	**5.1**

[1]Emissions estimations for airports are from the 2014 EPA National Emission Inventory Database and assumed to be realistic estimations of airport emissions for 2015.

[10] U.S. EPA National Emission Inventory Emissions Inventory System. (2014). Retrieved from https://eis.epa.gov/eis-system-web/welcome.html

[11] Eastern Research Group. (2001, January). Documentation for Aircraft Component of the National Emissions Inventory Methodology. (ERG No. 0245.03402.011).

Figure 28 – 2015 Criteria Pollutant and HAP Emissions from Airports on the Southern Ute Indian Reservation in Tons per Year



[1]Emissions estimations for airports are from the 2014 EPA National Emission Inventory Database and assumed to be realistic estimations of airport emissions for 2015.

V. Non-Point Sources

1. Non-registered Oil and Gas Sources

Description of Sources

For the purpose of this EI non-registered oil and gas sources are defined as: *oil and gas sources with emissions below the thresholds that require registration under the EPA Tribal Minor New Source Review (TMNSR) Program at 40 CFR Part 49*. The majority of these sources are natural gas and oil well-sites, which are comprised of artificial lift engines, separators, filter coalescers, compressor engines, reciprocating compressors, lube oil tanks, tank heaters, dehydration units, and produced water, condensate, and oil tanks.

Data Collection

Source information for non-registered oil and gas sources was obtained through a mandatory Clean Air Act Section 114 ICR issued by the AQP in June of 2016 to each known operator with sources operating on the Reservation. To identify the operators within the Reservation

and estimate the total number of non-registered sources on the Reservation, the AQP compiled site and ownership data from the COGCC and Drilling Edge databases.[12,13]

The ICR was the basis for collecting the information necessary to calculate emissions from non-registered oil and gas sources and required each recipient to provide actual equipment counts, production information, and equipment configuration estimations for single and co-located well-sites. Data was requested for each company's operations on the Reservation in its entirety and not specific to any single source location.

Completed ICRs were submitted by 82% of the companies that reported production on the Reservation in CY2015 to the COGCC or Drilling Edge databases. Data obtained from the ICRs accounted for the equipment and production associated with 98% of the 2,588 known non-registered oil and gas sources on the Reservation. The AQP used ground surveys to estimate equipment counts for the remaining unreported sources.

Calculation Methodology

The AQP calculated emissions for non-registered oil and gas sources on equipment basis using widely accepted emission factors and emission calculation methodologies, the equipment counts reported in the ICR, and CY2015 production data from the COGCC and Drilling Edge databases. Emissions totals for the 2% of non-reported sources were extrapolated to 100% based on the equipment configuration estimations derived from data obtained in the returned ICR and equipment counts taken during ground surveys. Descriptions of how emissions were calculated for each equipment type are included later in this section.

Non-Registered Oil and Gas Sources Emissions Summary

Criteria pollutant, HAP and GHG emission estimations from non-registered oil and gas sources on the Reservation in 2015 are displayed below in Figure 29 and Figure 30.

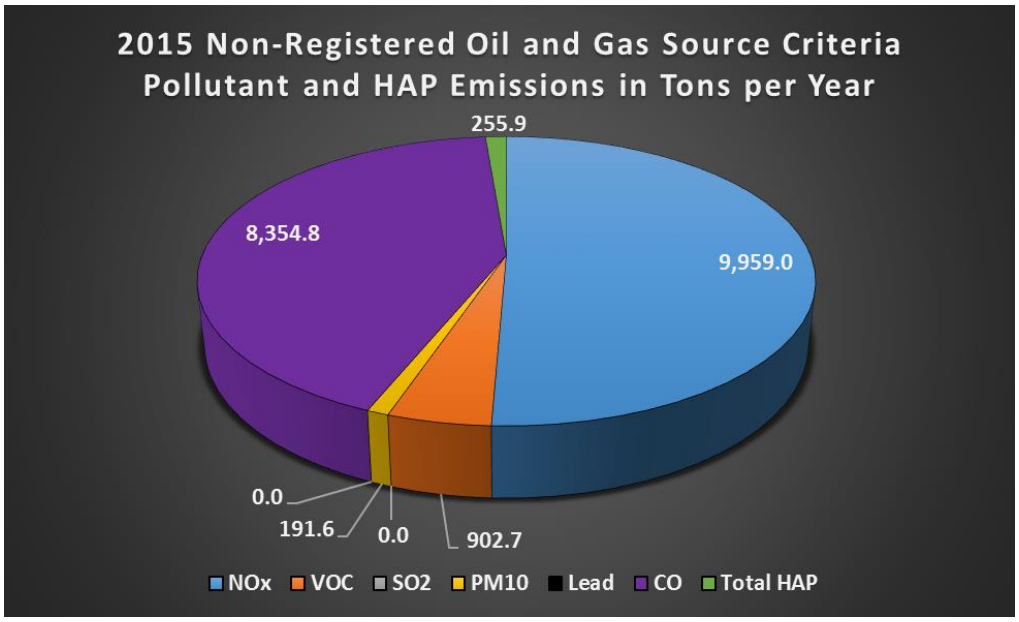
Figure 29 – 2015 Emissions from Non-registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

2015 Emissions from Non-registered Oil and Gas Sources in Tons per Year							
Pollutant	**NOx**	**VOC**	**SO2**	**PM_{10}**	**CO**	**Total HAP**	**GHG ($CO2e$)**
Emissions Totals	9,959.0	902.7	0.0	191.6	8,354.8	255.9	1,505,611

[12] COGCC. (2015). Production Data. La Plata. Retrieved from http://cogcc.state.co.us/data2.html#/downloads

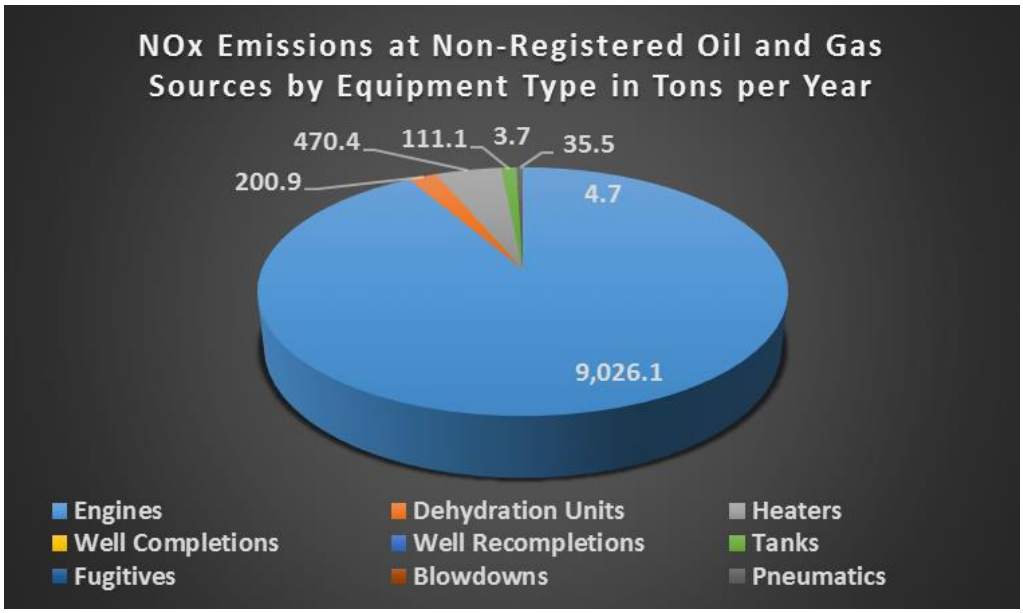
[13] Drilling Edge Database (2015). Retrieved from http://www.drillingedge.com/colorado

Figure 30 – 2015 Criteria Pollutant and HAP Emissions from Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year



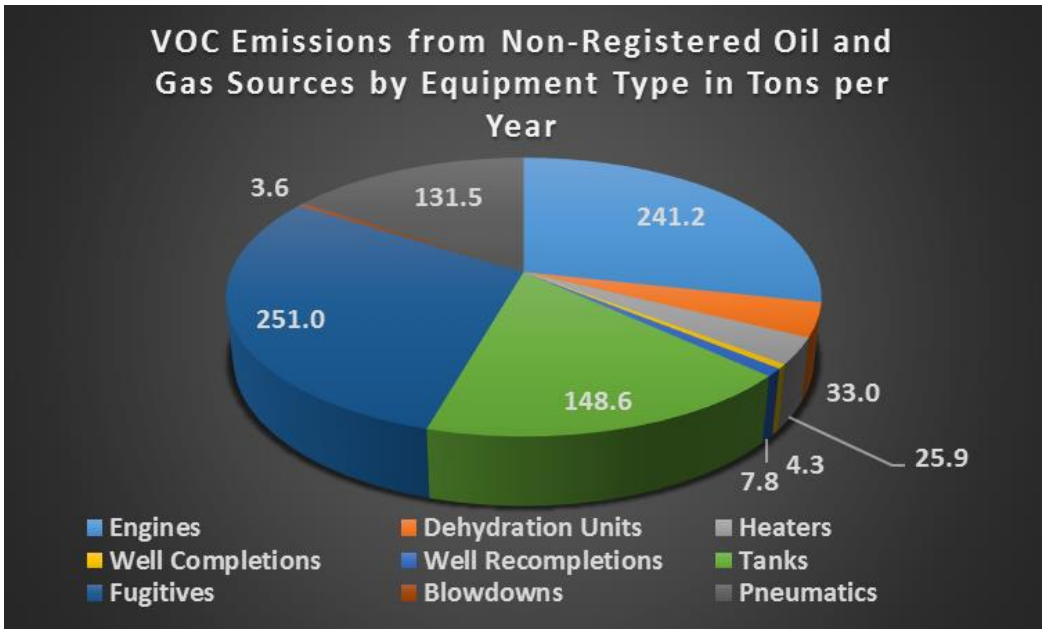
Total 2015 NOx emissions from non-registered oil and gas sources on the Reservation by equipment type are displayed below in Figure 31.

Figure 31 – 2015 NOx Emissions for Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



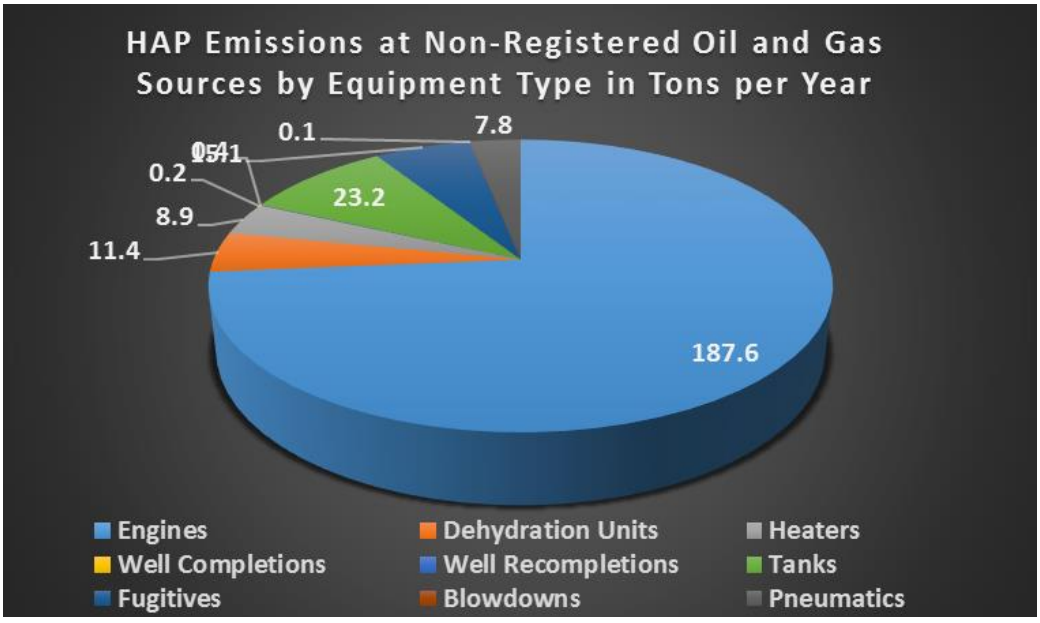
Total 2015 VOC emissions from non-registered oil and gas sources on the Reservation by equipment type are displayed below in Figure 32.

Figure 32 – 2015 VOC Emissions for Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



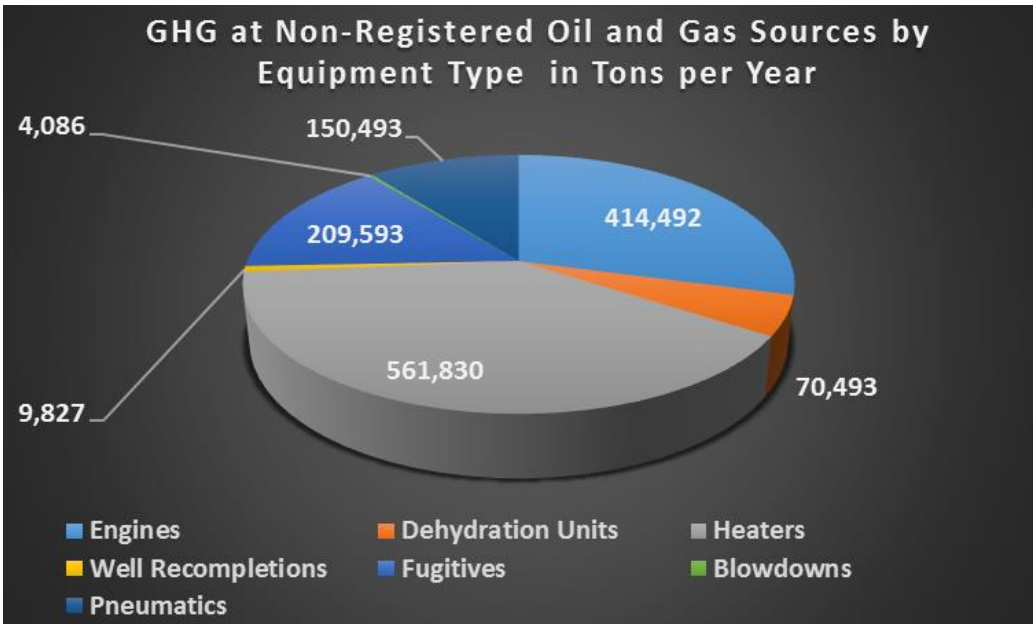
Total 2015 HAP emissions from non-registered oil and gas sources on the Reservation by equipment type are displayed below in Figure 33.

Figure 33 – 2015 HAP Emissions for Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



Total 2015 GHG emissions from non-registered oil and gas sources on the Reservation by equipment type are displayed below in Figure 34.

Figure 34 – 2015 GHG Emissions for Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation by Equipment Type in Tons per Year



A. Natural Gas-Fired Reciprocating Internal Combustion Engines

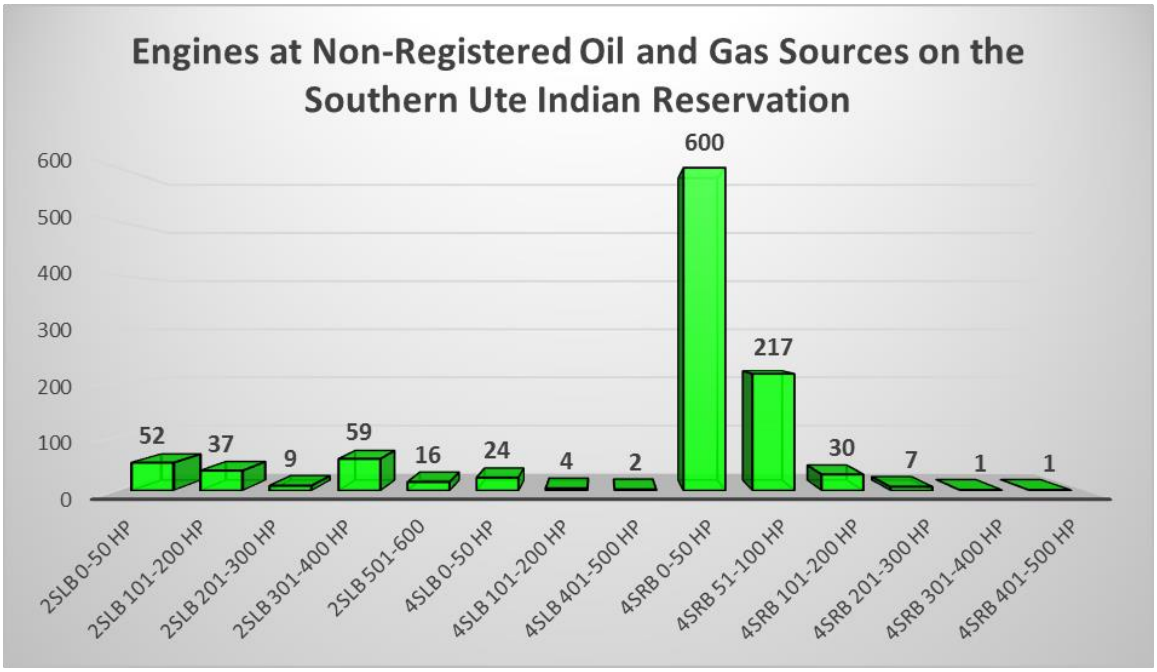
Description of Units

Natural gas-fired spark-ignited reciprocating internal combustion engines (RICE) are used by the oil and gas industry to compress natural gas, pump liquids, generate electricity, and to provide artificial lift. The most prevalent pollutants emitted from natural gas-fired RICE are NOx, CO, VOC, and HAP.

Data Collection

The ICR required recipients to list the total number of natural gas-fired spark-ignition and compression ignition RICE operated by their company on the Reservation. Engines were reported according to horsepower range, and engine configuration. Engine configurations included two-stroke lean-burn (2SLB), four-stroke lean-burn (4SLB), and four-stroke rich-burn (4SRB). The ICR included assumed values for engine operating hours and average brake specific fuel consumption (BSFC), and provided recipients the option to provide values more representative of their operations. A summary of reported engines is listed below in Figure 35.

Figure 35 – Engines Reported for Non-Registered Oil and Gas Source in the 2016 by Engine Configuration and Horsepower)



Emission Calculation Methodology

Criteria Pollutant and HAP Emissions:

Criteria pollutant and HAP emissions were calculated for each engine configuration and horsepower rating category reported in the ICR. Emission calculations were based on the maximum horsepower of each reported horsepower range, the appropriate emission factors for stationary internal combustion sources from Chapter 3 of EPA AP-42, an assumed BSFC of 7,500 Btu/hp-hr, an assumed 100% engine operating load, and assumed operating schedule of 8,760 hours per year. The assumed BSFC value was derived by averaging the BSCF from all natural gas-fired engines in the Caterpillar Gas Engine Rating Pro software.[14] All emissions were calculated for uncontrolled operation. The natural gas on the Reservation contains negligible amounts of sulfur, therefore SO_2 emissions from engines are minimal.

[14] Caterpillar, Inc. (2015). Gas Engine Rating Pro Emissions Estimation Software. Retrieved from http://www.cat.com/en_US/articles/solutions/oil-gas/gas_engine_rating_pro.html

GHG Emissions:

Greenhouse gas emissions were calculated using the default values from Tables C-1 and C-2 of 40 CFR Part 98, Subpart C and the same methodology as used for criteria pollutants and HAP.[15]

Example Calculation

Conversion of EPA AP-42 emission factor (in lb/MMBtu) to grams per horsepower hour using AQP's assumed brake specific fuel consumption (Btu/hp-hr):

g/hp-hr = (lb/MMBtu) x (7500 Btu/hp-hr) x (g/lb)/10^6

Where:

EF = AP-42 emission factor (lb/MMbtu)
HR = heat rating (Btu/hp-hr)

Example NOx AP-42 lb/MMBtu to g/hp-hr emission factor conversion for a four-stroke rich-burn RICE:

g/hp-hr = (2.21 lb/MMBtu) x (7500 Btu/hp-hr) x (456.3/ 1 lb)/10^6 = 0.752 g/hp-hr

Engine emission calculation:

tpy = (EF) x (hp) x (OH)/453.6 g/lb /2000 pounds/ton

Where:

tpy = tons per year
EF = emission factor (g/hp-hr)
hp = horsepower
OH = annual operating hours

Example NOx emissions calculation for a 200 hp four-stroke rich-burn engine operating 8,760 hours per year:

tpy = (0.752 g/hp-hr) x (200 hp) x (8760 hr)/453.6 g/lb)/2000 lb/ton = 1.45 tpy NOx

[15] 40 CFR Part 98 - Mandatory Greenhouse Gas Reporting. (2016). U.S. Government Publishing Office. Retrieved from http://www.ecfr.gov/cgi-bin/text-idx?SID=32c4baa0d0aff54fa651d1cdb1cd7934&mc=true&tpl=/ecfrbrowse/Title40/40cfr98_main_02.tpl

Emissions

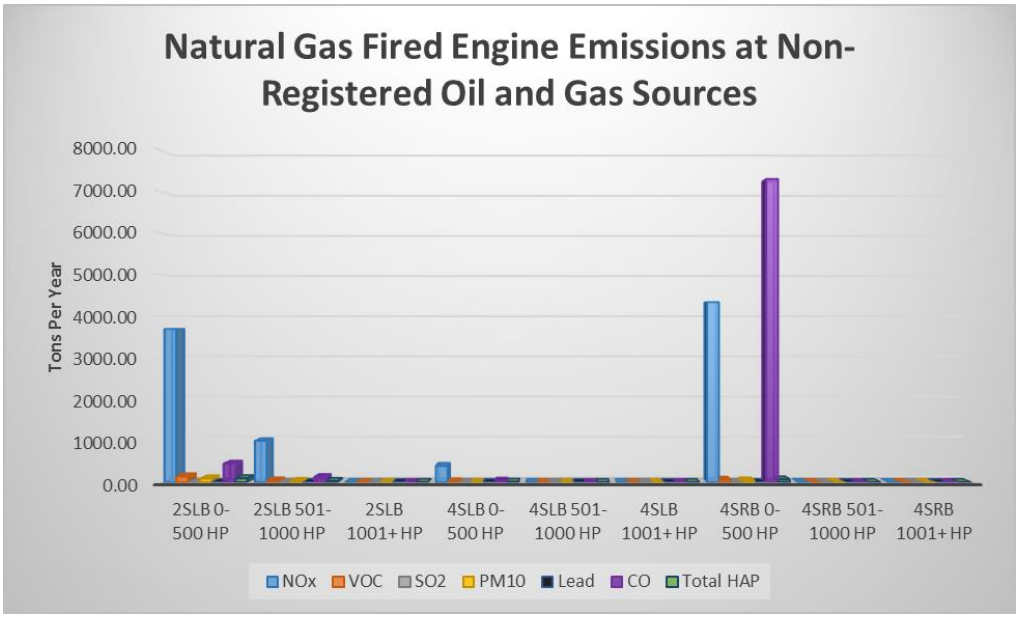
Total criteria pollutant, HAP, and GHG emissions from natural gas-fired RICE at non-registered oil and gas sources are displayed in Figure 36 and Figure 37.

Figure 36 – 2015 Natural Gas-Fired Reciprocating Internal Combustion Engine Counts and Criteria Pollutant, HAP, and GHG Emissions on the Southern Ute Indian Reservation in Tons per Year [1]

2015 Natural Gas-Fired RICE Counts and Emissions in Tons per Year on the Southern Ute Indian Reservation[1]								
Engine Configuration and Horsepower (hp)	**Number of Engines Reported in 2016 ICR**	**NOx**	**CO**	**SO2**	**PM_{10}**	**VOC**	**Total HAP**	**GHG (CO_2e)**
2SLB 0-50 hp	52	206.5	25.1	0.0	5.0	7.8	5.2	7,626.4
2SLB 101-200 hp	37	760.0	92.5	0.0	18.4	28.8	19.0	28,073.0
2SLB 201-300 hp	9	281.2	34.2	0.0	6.8	10.6	7.0	10,386.0
2SLB 301-400 hp	59	2,443.4	297.5	0.0	59.2	92.5	61.0	90,258.2
2SLB 501-600 hp	16	999.7	121.7	0.0	24.2	37.8	25.0	36,928.0
4SLB 0-50 hp	24	152.9	11.9	0.0	0.0	4.4	2.7	4,388.6
4SLB 101-200 hp	4	107.2	8.3	0.0	0.0	3.1	1.9	3,077.3
4SLB 401-500 hp	2	134.0	10.4	0.0	0.0	3.9	2.4	3,846.7
4SRB 0-50 hp	600	2,160.7	3,637.0	0.0	18.6	28.9	31.6	114,484.5
4SRB 51-100 hp	217	1564.5	2,633.5	0.0	13.4	20.9	22.9	82,895.9
4SRB 101-200 hp	30	396.1	666.7	0.0	3.4	5.3	5.8	20,987.4
4SRB 201-300 hp	7	152.5	256.6	0.0	1.3	2.1	2.2	8,078.0
4SRB 301-400 hp	1	29.0	48.9	0.0	0.3	0.4	0.4	1,538.7
4SRB 401-500 hp	1	36.3	61.1	0.0	0.3	0.5	0.5	1,923.3
Compression Ignition	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1,059**	**9,424**	**7,905.4**	**0.0**	**150.9**	**247.0**	**187.6**	**414,492**

[1]Engine emissions are only displayed for horsepower and engine configurations reported in the 2016 ICR.

Figure 37 - 2015 Natural Gas-Fired Reciprocating Internal Combustion Engine Counts and Criteria Pollutant, HAP, and GHG Emissions on the Southern Ute Indian Reservation in Tons per Year



Emissions of NOx, VOC, and CO from natural gas-fired RICE at non-registered oil and gas sources on the Reservation in 2015 are displayed below in Figure 38, Figure 39, and Figure 40.

Figure 38 – Oxides of Nitrogen Emissions from Natural Gas-Fired Reciprocating Internal Combustion Engines at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

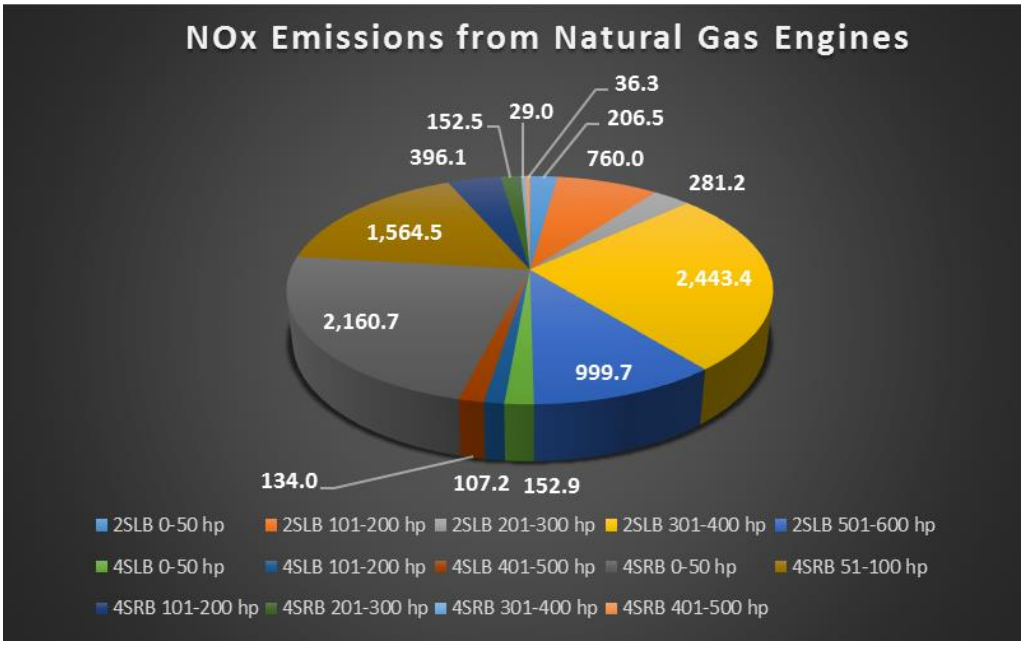


Figure 39 - 2015 Volatile Organic Compound Emissions from Natural Gas-Fired Reciprocating Engines at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

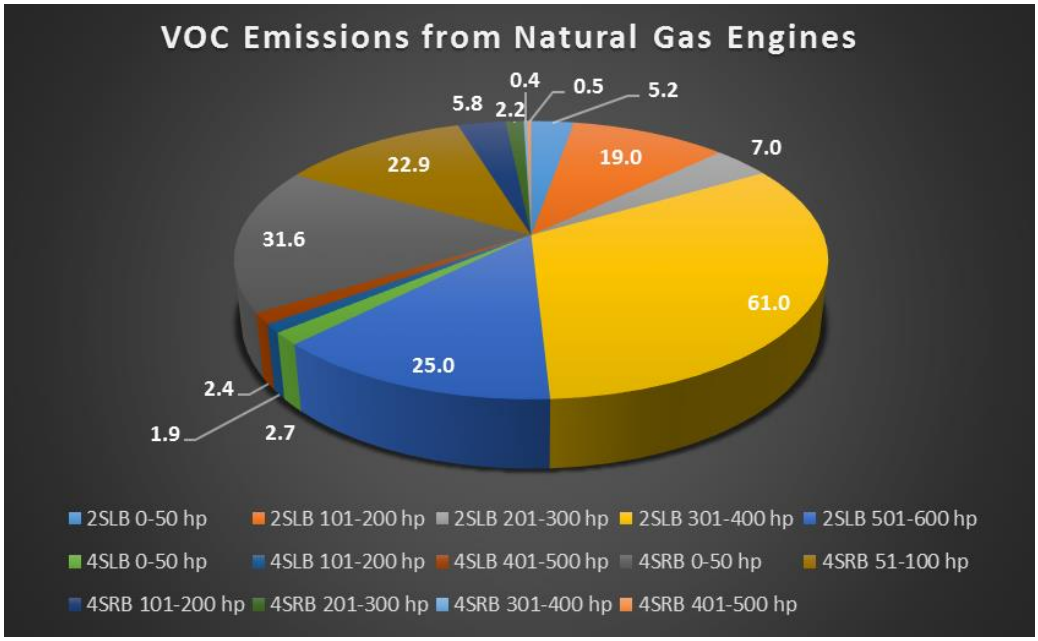
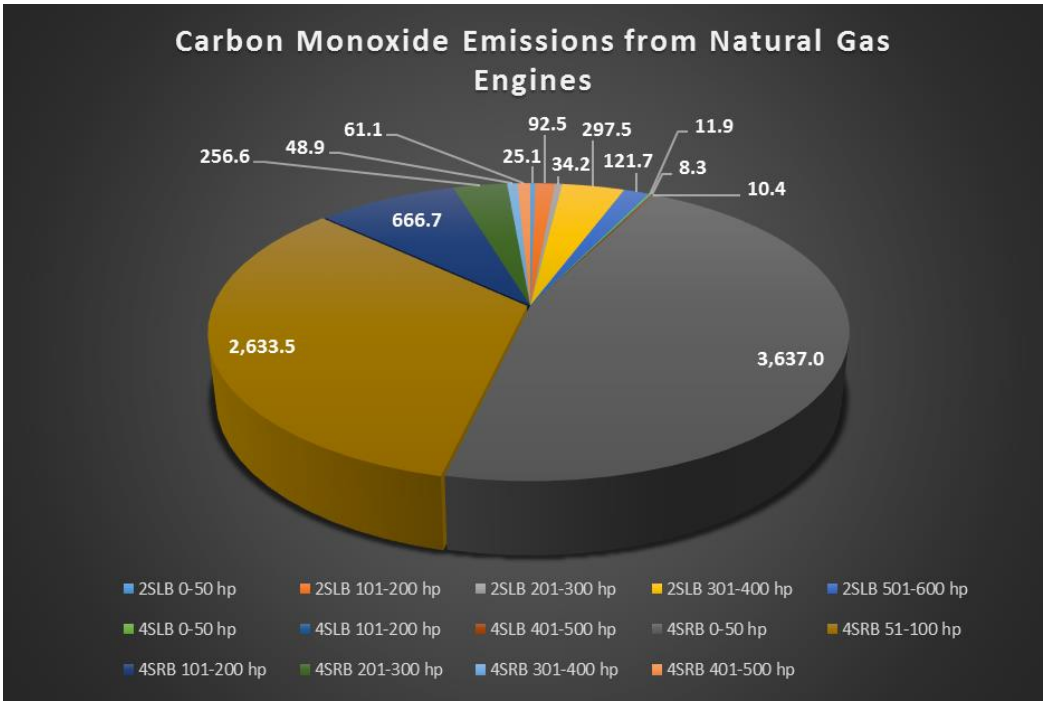


Figure 40 - 2015 Carbon Monoxide Emissions from Natural Gas-Fired Reciprocating Engines at Non-Registered Oil and Gas Sources in Tons per Year



B. Stationary Natural Gas Turbines:

Description of Units

Natural gas-fired stationary turbines are a type of rotary internal combustion engine used by the natural gas industry for natural gas transmission and for electric generation. Turbines operate by introducing compressed air and fuel into a combustion chamber to generate hot gases, which are expanded into the power turbine to rotate the power shaft and create work. Two types of combustion processes are used in turbines, the first being lean-premix staged combustion in which a lean air and fuel mixture is introduced into the combustion chamber, and the second type being diffusion flame combustion where the air and fuel mixing occurs within the combustion chamber. The power shaft is used to run a centrifugal compressor for gas transmission, or to rotate an alternator when used for electric generation.

Data Collection

The ICR required recipients to list the total number of natural gas-fired turbines operated by their company on the Reservation. Turbines were reported according to horsepower or kilowatt range, hours of operation, and turbine configuration. Turbine configurations included uncontrolled, water-steam injection, and lean-premix. The AQP assumed turbines to operate for 8,760 hours per year. Average brake specific fuel consumption (BSFC) was assumed to be 11,000 Btu/hp-hr, as established in the document titled *Stationary Combustion Turbines in the United States*.[16] If an operator specific BSFC was reported in the ICR, this value was used in place of the assumed BSFC value.

Only one turbine was reported at a non-registered source in the ICR. The turbine was a 0-50 hp, lean pre-mix unit, operated 8,760 hours per year, with a BSFC of 10,825 Btu/hp-hr.

Emission Calculation Methodology

Criteria Pollutant and HAP Emissions:

Criteria pollutant and HAP emissions were calculated based on the maximum reported horsepower, emission factors for stationary gas turbines from Chapter 3.1 of EPA AP-42, 100% engine operating load, an operating schedule of 8,760 hours per year and a reported BSFC of 10,825 Btu/hp-hr. The calculation methodology for natural gas turbines is the same methodology used for reciprocating internal combustion engines, and displayed in an example calculation earlier in this section. The natural gas on the Reservation contains negligible amounts of sulfur, therefore SO_2 emissions from turbines are minimal.

[16] McGowin (1973) Stationary Combustion Turbines in the United States.

GHG Emissions:

Greenhouse gas emissions were calculated using the default values from Tables C-1 and C-2 of 40 CFR Part 98, Subpart C and the same methodology as used for criteria pollutants and HAP.

Emissions

Criteria pollutant, HAP, and GHG emissions from natural gas turbines on the Southern Ute Reservation for 2015 are displayed in Figure 41.

Figure 41 - 2015 Turbine Count and Total Emissions of Criteria Pollutant, HAP, and GHG at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

2015 Turbine Count and Total Emissions in Tons per Year								
Turbine Configuration and Horsepower	**Number of Turbines**	**NOx**	**CO**	**SO2**	**PM_{10}**	**VOC**	**Total HAP**	**GHG (CO_2e)**
Lean-Premix 0-50 hp	**1**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**326.0**

C. Tri-Ethylene Glycol Dehydration Units

Description of Units

Tri-ethylene glycol (TEG) dehydration units are commonly used in the natural gas industry to remove entrained water from the natural gas stream to meet pipeline contract water specifications. The dehydration process begins with routing the natural gas stream through TEG in an absorber (or contactor tower) where the entrained water is absorbed by the TEG. During this step, hydrocarbons present in the natural gas stream are also absorbed in the glycol. Following the absorption step, the water saturated (rich) glycol is then distilled to drive off absorbed water before being re-circulated to the absorber. The distillation step results in emissions of VOC and HAP from the reboiler still-vent. The common still-vent HAP emissions are benzene, toluene, ethyl-benzene, and xylene.

Data Collection

The AQP collected dehydration unit counts from the ICR, which required operators to enter the total number of dehydration units operated by their company on the Reservation during calendar year 2015. The ICR included assumed dehydration unit operating parameters and a theoretical extended natural gas analysis, as described later in this section, which could be accepted or overridden with values more representative

of the operators' operations. The theoretical extended gas analysis is displayed below in Figure 42.

Fifty-one dehydration units were reported in the ICR submittals and all submittals accepted the AQP's assumed operation and natural gas composition values.

Emissions Calculation Methodology

Emissions for glycol dehydration units were calculated using the GRI-GLYCalc 4.0 model (GLYCalc), the AQP's theoretical values for dehydration unit operating parameters and natural gas composition, and the methodology outlined in the GLYCalc user's manual.[17] GLYCalc is the EPA's preferred method of quantifying emissions from glycol dehydration units for the development of tribal/state/local emissions inventories.[18]

Product of combustion emissions from dehydration unit reboilers were included in the emission totals for heaters and boilers presented in Section V.1. of this report to avoid double counting.

Figure 42 – Theoretical Extended Natural Gas Analysis – Average of 34 Natural Gas Analyses from the Southern Ute Indian Reservation

Theoretical Extended Natural Gas Analysis	
Component	**Average**
Methane	**92.2564%**
Ethane	**1.1672%**
Propane	**0.3324%**
Isobutane	**0.0548%**
n-Butane	**0.0811%**
Isopentane	**0.0200%**
n-Pentane	**0.0132%**
n-Hexane	**0.0089%**
Carbon Dioxide	**5.9084%**
Nitrogen	**0.1370%**
Hydrogen Sulfide	**0.0000%**
Helium	**0.0000%**
2,2 Dimethylbutane	**0.0002%**
2,3 Dimethylbutane	**0.0007%**
Cyclopentane	**0.0000%**
2-Methylpentane	**0.0018%**
3-Methylpentane	**0.0010%**
2,2 Dimethylpentane	**0.0000%**
Methylcyclopentane	**0.0000%**
2,4-Dimethylpentane	**0.0000%**
2,2,3-Trimethylbutane	**0.0000%**
Benzene	**0.0007%**

[17] Gas Research Institute. (2000). GLYCalc Version 4.0. Retrieved from http://sales.gastechnology.org/000102.html

[18] U.S. EPA. (1995). Glycol Dehydrator Emissions Test Report and Emissions Estimation Methodology. Retrieved from https:www3.epa.gov/ttn/chief/old/efdocs/glycoldehydratortestreport.pdf

3,3-Dimethylpentane	**0.0000%**
Cyclohexane	**0.0013%**
2-Methylhexane	**0.0000%**
2,3-Dimethylpentane	**0.0000%**
1,1-Dimethylcyclopentane	**0.0000%**
3-Methylhexane	**0.0000%**
1,t-3-Dimethylcyclopentane	**0.0000%**
1,c-3-Dimethylcyclopentane	**0.0000%**
3-Ethylpentane	**0.0000%**
1,t-2-Dimethylcyclopentane	**0.0000%**
2,2,4 Trimethylpentane	**0.0002%**
n-Heptane	**0.0032%**
Methylcyclohexane	**0.0017%**
Toluene	**0.0012%**
n-Octane	**0.0018%**
Ethylbenzene	**0.0001%**
2,3-Dimethylheptane	**0.0000%**
m-Xylene	**0.0003%**
p-Xylene	**0.0002%**
o-Xylene	**0.0001%**
n-Nonane	**0.0006%**
n-Decane	**0.0005%**
n-Undecane	**0.0001%**
n-Dodecane	**0.0000%**
n-Tridecane	**0.0000%**
Total:	**100.00%**
Total VOC:	**0.53%**

GRI-GLYCalc Model Input Parameters

The AQP developed assumed dehydration unit operational values for natural gas temperature, pressure, and flowrate by averaging operational information from dehydration units at non-registered oil and gas sources provided by two of the largest operators on the Reservation. An assumed extended natural gas analysis was prepared by averaging 34 individual extended gas analysis from natural gas production sector compressor stations that were reported to the AQP in Title V operating permit applications between 2012 and 2014.

The AQP's assumed values were input into the GLYCalc emissions model using a pipeline water content specification of seven pounds of water per MMscf of natural gas, 1.5% H_2O lean glycol, and assuming uncontrolled operation with no flash tank.

The assumed GLYCalc input parameter values are provided below in Figure 43.

Figure 43 – 2015 GRI-GLYCalc Model Input Parameters for TEG Dehydration Units at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation

2015 GRI-GLYCalc Model Input Parameters					
Wet Gas Temperature (°F)	**Wet Gas Pressure (psig)**	**Dry Gas Flowrate/ Throughput (MMscf/day)**	**Lean Glycol Water Content (weight % H2O)**	**Glycol Pump Type**	**Pipeline Water Content Specification (lb H2O/MMscf)**
68.5	**353.5**	**0.9**	**1.5**	**Electric/ Pneumatic**	**7.0**

GRI-GLYCalc Model Emissions Output:

Fifty-one dehydration units were reported in the ICR submittals and all dehydration unit emissions were calculated using the AQP's default GRI-GLYCalc emissions report. The GRI-GLYCalc report was applied once to each of the 51 dehydration units reported in the ICR, and then summed to derive a Reservation-wide emissions estimate for glycol dehydration units located at non-registered oil and gas sources.

No operator specific GLYCalc reports or dehydration unit emission estimations were provided in the ICR submittals.

Modeled GRI-GLYCalc emissions for a single TEG dehydration unit and using the AQP's assumed model inputs are provided in Figure 44.

Figure 44 – 2015 GRI-GLYCalc Model Emissions Output for TEG Glycol Dehydration Units on the Southern Ute Indian Reservation in Tons per Year

2015 GRI-GLYCalc Model Emissions Output in Tons per Year	
Pollutant	**Uncontrolled Emissions**
Methane	0.2341
Ethane	0.0226
Propane	0.0211
Isobutane	0.0076
n-Butane	0.0156
Isopentane	0.0057
n-Pentane	0.0050
Cyclopentane	0.0000
n-Hexane	0.0080
Cyclohexane	0.0048
Other Hexanes	0.0000
Heptanes	0.0000

Methylcyclohexane	0.0097
2,2,4-Trimethylpentane	0.0002
Benzene	0.0237
Toluene	0.0796
Ethylbenzene	0.0122
Xylenes	0.0998
C8+ Heavies	0.1469
Total HC Emissions	**0.6966**
Total VOC Emissions	**0.4399**
Total HAP Emissions	**0.3849**
Total BTEX Emissions	**0.2153**

Example Calculation

Example calculation for VOC emissions from ICR Reported dehydration units:

VOC Emissions (tpy) = AQP Generated GRI-GLYCalc Emissions Output x Number of 2016 ICR Reported Dehydration Units

Example:

22.4 tpy annual VOC emissions = 0.4399 tpy VOC x 51 reported dehydration units

Emissions

Volatile organic compound and HAP emissions from 51 TEG Glycol Dehydration Units at non-registered oil and gas sources on the Reservation are provided in Figure 45.

Figure 45 – 2015 HAP and VOC Emissions from 51 TEG Dehydration Units at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation

2015 HAP and VOC Emissions from 51 TEG Dehydration in Tons per Year				
Unit Count and Pollutants	**Number of Dehydration Units**	**VOC**	**HAP**	**CO2*e***
Totals	51	22.4	11.4	70,493.4

D. Liquid Storage Tanks

Description of Equipment and Emissions Categories

The oil and gas industry utilizes liquid storage tanks for the storage of produced water, condensate, oil, coolants, and lubricants. The primary emissions from liquid storage tanks are methane, VOC and HAPs. Emission categories include breathing and working losses, flash emissions, and tank loadout.

Breathing and Working Losses:

Breathing losses occur when vapor expansion generated during temperature fluctuations increases the vapor pressure within a tank and cause fugitive emissions to escape from the roof vent. Light colored tanks and tank heaters can help maintain more consistent tank temperatures and reduce breathing losses by reducing vapor pressure variations. Full tanks also produce lower breathing losses due to less space for vapors to expand and escape from roof vents. Working losses occur when liquids are pumped into and out of storage tanks. The displacement of vapors within the tank and the turbulence caused by the movement of the liquid create airborne vapors. Submerged fill tanks can be effective for reducing turbulence and the creation of airborne vapors.

Flash Emissions:

Flash emissions are emissions that occur when liquid dumped from the separator into the liquid storage tank goes from higher pressure to lower pressure, resulting in the entrained gas being released as a vapor from the liquid. The gas to liquid ratio, pressure and temperature of the liquids in the separator and the temperature and pressure of the liquid storage tank influence the amount of flashing losses.

Tank Loadout Emissions:

Tank loadout emissions are vapor loss from transport tanks that occur during the transfer of liquids from a storage tank to a transport tank. Loadout emissions occur due to the generation of vapors in transport tanks during liquid loading, the transfer of vapors from the liquid storage tank to the transport tank, and the displacement of vapors trapped in transport tanks from previous loads during loading.

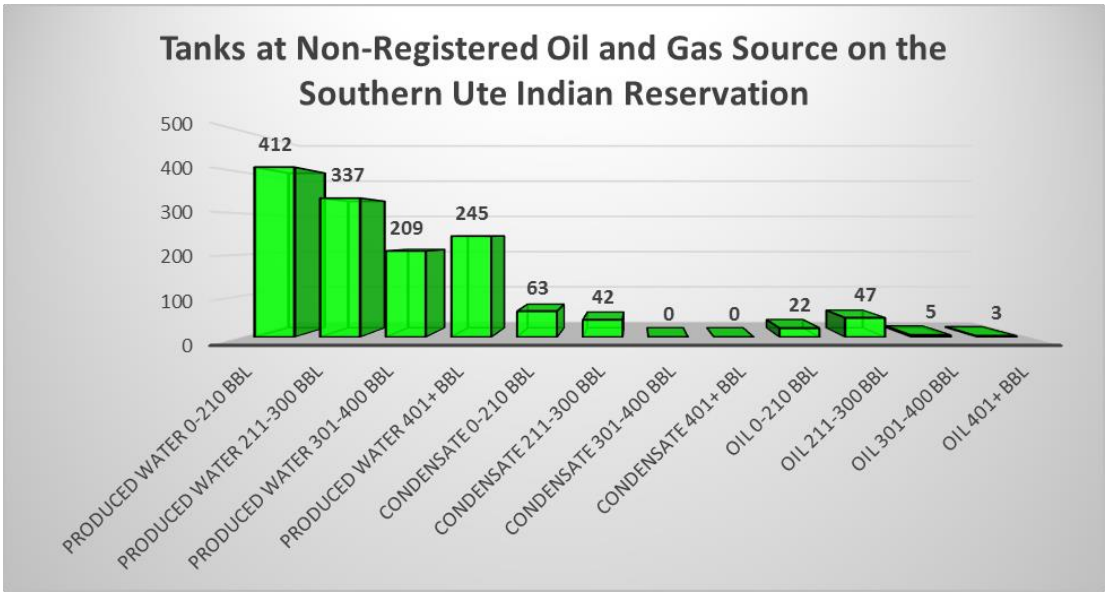
Data Collection

Tank Counts and Data for Calculating Breathing and Working Losses:

The ICR required each operator to provide the total number of produced water, condensate, and oil tanks located at their non-registered sources on the Reservation. Reported tank counts were based on tank contents and capacity in barrels (bbl).

A summary of tanks reported in the ICR, by tank capacity and contents, is displayed below in Figure 46.

Figure 46 – 2015 Liquid Storage Tanks at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation by Tank Contents and Capacity in Barrels



The ICR also provided operators with the opportunity to override assumed data values for annual liquid throughput, Reid Vapor Pressure, and general tank characteristics with values more representative of their operations. Tank characteristics include roof type, color, condition, and presence of a tank heater. Development of liquid throughput values is discussed later in this section. Emissions from lubricant oil and glycol storage tanks were assumed to be negligible and no data was requested for these sources.

Methodology for Deriving Average Liquid Throughput Values:

The AQP developed two types of annual liquid throughput values, based on the availability of data in the COGCC database for sources in La Plata County, Colorado for CY2015. If data were available from COGCC, the AQP developed specific operator throughput values and if the data was not available, the AQP developed assumed annual average liquid throughput values. The operator specific annual average liquid throughput values were derived by dividing their total reported produced water and condensate/oil production numbers by the total number of sources that reported production for CY2015.

Assumed average annual liquid throughput values were developed for operators that reported active sources to the COGCC in 2015, but did not report production. The assumed annual throughput value for produced water was derived by dividing the total CY2015 produced water production values reported to the COGCC database by the total number of reported sources. A combined condensate and oil assumed annual average tank throughput value was derived by dividing the total CY2015 combined condensate and oil production value reported to the COGCC database by the number of non-

registered sources that reported condensate or oil production. Not all companies reported condensate or oil production to COGCC and two companies reported much larger condensate and oil production numbers than other companies producing condensate and oil. Companies that did not produce any condensate or oil and the few companies with large production numbers were dropped from the calculations to avoid skewed production numbers. Assumed annual average liquid throughput values for the produced water, oil and condensate at non-registered oil and gas sources on the Reservation are displayed below in Figure 47.

Figure 47 – 2015 Assumed Annual Average Liquid Throughput Values for Produced Water, Oil and Condensate Tanks at Non-Registered Sources on the Southern Ute Indian Reservation[1]

2015 Assumed Annual Average Liquid Storage Tank Throughput Values				
Number of Sources Operating in 2015	**2015 Oil/Condensate Produced (bbl)**	**2015 Water Produced (bbl)**	**Average Oil/Condensate per source per year (bbl)**	**Average Water per source per year (bbl)**
3,477	13,662	18,956,811	29.97	10,935

[1]Throughput numbers were derived from averaging production numbers from COGCC, (2015). Production Data. Retrieved from http://cogcc.state.co.us/data2.html#/downloads

Emission Calculation Methodology

Liquid storage tank emissions are calculated based on three separate emission event categories that occur during the course of normal tank operation at atmospheric pressures, as described earlier in this section. The emissions categories include: standing and working losses, flash emissions, and loadout emissions. Discussions are provided below of the methodologies used to calculate emissions for each tank emissions category.

Standing and Working Losses

Data Collection and Assumptions:

Emission totals for the Reservation were developed for each individual operator by running the EPA TANKS 4.09d Emissions Estimation Software (TANKS) model once for each tank size and production type category reported in the ICR and then multiplying each modeled emissions total by the number of corresponding tanks reported.[19] Reported liquid throughput values were used when provided and assumed throughput values were used when data was not provided.

[19] U.S. EPA. (2006). TANKS 4.09d Emissions Estimation Software. Retrieved from https://www3.epa.gov/ttnchie1/software/tanks

Emission Calculations:

Standing, and working losses were calculated using the TANKS model and reported or assumed input data values for liquid throughput, Reid vapor pressure, and tank characteristics. A produced water tank was assumed to consist of a mixture of 99% water and 1% condensate and the TANKS model default values were used for condensate and oil. The model was ran for tanks operating at atmospheric pressure and the TANKS model meteorological conditions for Albuquerque, New Mexico. Emission estimates using this geographic location may be biased slightly higher, as temperatures in Albuquerque are warmer in summer and less cold in winter than within the Reservation. All tanks were assumed to have a cone shaped roof, to be gray in color, and equipped with a tank heater.

Liquid Storage Tanks Flash Emissions

Data Collection and Assumptions:

The ICR requested flash gas liberation data from produced water, condensate, and oil, to aid in calculating flash emissions. No ICR submittals were returned with flash liberation data, as this type of sampling is not common practice on the Reservation.

In September 2016, the AQP contracted a third party vendor to perform flash liberation sampling at well-site locations operated by two different companies on the Reservation. Sampling was performed on the separator at each well-site in order to obtain a pressurized sample. In total, seven produced water samples were obtained from coal-bed methane wells of the Fruitland Coal Formation on the east and west sides of the Reservation. Two produced water samples and one condensate sample were obtained from conventional natural gas wells of the Picture Cliffs Sandstone Formation in the south central portion of the Reservation.[20] Due to the very low oil production numbers reported to the COGCC database for La Plata County Colorado in CY2015 and the absence of viable sampling locations, the AQP elected to not obtain oil flash gas samples, but to use the condensate flash sampling results to estimate oil flash emissions

Two additional condensate flash samples were provided by an operator that performed sampling in August 2016 from liquid knockout locations on a well-site gathering pipeline containing natural gas from conventional wells in the southern portion of the Reservation.

All sampling reports included an extended gas analysis, gas to water ratio, gas specific gravity, separator temperature and pressure, and ambient temperature and pressure.

Results from the six valid produced water samples were averaged to obtain assumed gas composition and gas to water ratio values to be used in the Oil to Gas Ratio calculation

[20] Air Pollution Testing, Inc. (2016). Southern Ute Indian Tribe Flash Liberation Analyses.

for estimating storage tank flash emissions. The same methodology was applied for deriving average composition values from the three valid condensate samples.

Averaged extended gas analysis values for produced water and condensate are displayed below in Figure 48 and Figure 49, respectively. Averaged gas to water and gas to condensate values are displayed below in Figure 50.

Figure 48 –Produced Water Flash Gas Analysis from Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Mol Percent – September 2016[1]

Produced Water Flash Gas Analysis from the Southern Ute Indian Reservation in Mol %							
Flash Gas Component	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**	**Sample 6**	**Average Mol %**
Hydrogen Sulfide	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Nitrogen	0.0373	0.0000	1.0883	1.0464	2.6862	0.5921	0.9084
Carbon Dioxide	72.3236	68.4996	36.5680	29.7757	5.8668	16.3515	38.2309
Methane	26.6076	31.0289	62.2021	67.0612	91.4075	76.3697	59.1128
Ethane	0.3200	0.0271	0.1155	0.0138	0.0119	4.0640	0.7587
Propane	0.0359	0.0231	0.0124	0.037	0.0079	1.0078	0.1874
Isobutane	0.0036	0.0035	0.0012	0.0049	0.0007	0.1582	0.0287
N-Butane	0.0100	0.0160	0.0015	0.0163	0.0029	0.1689	0.0359
2,2 Dimethylpropane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Isopentane	0.0028	0.0037	0.0003	0.0071	0.0005	0.1027	0.0195
N-Pentane	0.0039	0.0078	0.0005	0.0117	0.0012	0.0612	0.0144
2,2 Dimethylbutane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclopentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0108	0.0018
2,3 Dimethylbutane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2 Methylpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3 Methylpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N-Hexane	0.4360	0.1881	0.0005	1.8678	0.0035	0.2114	0.4512
Methylcyclopentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0085	0.0000	0.0000	0.0227	0.0000	0.1056	0.0228
Cyclohexane	0.0084	0.0000	0.0000	0.0418	0.0021	0.0481	0.0167
2-Methylhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3-Methylhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2,4 Trimethylpentane	0.0000	0.0000	0.0000	0.0000	0.0003	0.0088	0.0015
Other C7's	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N-Heptane	0.0000	0.0000	0.0006	0.0000	0.0026	0.2092	0.0354
Methylcyclohexane	0.0037	0.0000	0.0000	0.0081	0.0029	0.0865	0.0169
Toluene	0.0108	0.0000	0.0000	0.0514	0.0016	0.1397	0.0339
Other C'8s	0.1872	0.0000	0.0091	0.0196	0.0011	0.2745	0.0819
N-Octane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Ethylbenzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0049	0.0008
M&P Xylenes	0.0008	0.0000	0.0000	0.0141	0.0000	0.0242	0.0065
O-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other C9's	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N-Nonane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other C10's	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N-Decane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Undecanes(11)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Totals:	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Total VOC:	**0.7116%**	**0.2422%**	**0.0261%**	**2.1029%**	**0.0273%**	**2.6225%**	**0.9554%**
Total HAP:	**0.4561%**	**0.1881%**	**0.0005%**	**1.9560%**	**0.0054%**	**0.4946%**	**0.5168%**

[1]Air Pollution Testing, Inc. (2016, September). Southern Ute Indian Reservation Flash Liberation Analyses.

Figure 49 –Condensate Flash Gas Analysis from Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Mol Percent – September 2016[1]

Condensate Flash Gas Analysis from the Southern Ute Indian Reservation				
Flash Gas Component	**Sample 1 Mol%**	**Sample 2 Mol%**	**Sample 3 Mol%**	**Average Mol %**
Hydrogen Sulfide	0.000	0.000	0.0000	0.000
Nitrogen	6.633	5.170	0.5871	4.130
Carbon Dioxide	3.053	2.564	2.8208	2.813
Methane	62.466	62.678	50.2222	58.455
Ethane	14.918	16.162	20.4293	17.170
Propane	6.279	7.028	12.0540	8.454
Isobutane	1.371	1.353	3.2488	1.991
N-Butane	1.738	1.840	3.6206	2.400
2,2 Dimethylpropane	0.000	0.000	0.0000	0.000
Isopentane	0.794	0.769	1.7594	1.107
N-Pentane	0.551	0.560	1.0198	0.710
2,2 Dimethylbutane	0.000	0.000	0.0000	0.000
Cyclopentane	0.000	0.000	0.1844	0.061
2,3 Dimethylbutane	0.000	0.000	0.0000	0.000
2 Methylpentane	0.000	0.000	0.0000	0.000
3 Methylpentane	0.000	0.000	0.0000	0.000
N-Hexane	0.869	0.748	1.4232	1.013
Methylcyclopentane	0.000	0.000	0.0000	0.000
Benzene	0.105	0.076	0.1128	0.098
Cyclohexane	0.000	0.000	0.0000	0.000
2-Methylhexane	0.000	0.000	0.0000	0.000
3-Methylhexane	0.000	0.000	0.0000	0.000
2,2,4 Trimethylpentane	0.003	0.003	0.0291	0.012
Other C7's	0.000	0.000	0.0000	0.000
N-Heptane	0.557	0.461	0.7371	0.585
Methylcyclohexane	0.000	0.000	0.2793	0.093

Toluene	0.166	0.126	0.1768	0.156
Other C'8s	0.000	0.000	0.8700	0.290
N-Octane	0.304	0.247	0.0000	0.184
Ethylbenzene	0.008	0.007	0.0076	0.008
M&P Xylenes	0.071	0.074	0.1086	0.085
O-Xylene	0.000	0.000	0.0000	0.000
Other C9's	0.000	0.000	0.0000	0.000
N-Nonane	0.088	0.088	0.0000	0.059
Other C10's	0.000	0.000	0.0000	0.000
N-Decane	0.027	0.048	0.0000	0.025
Undecanes(11)	0.000	0.000	0.0000	0.000
Totals:	**100%**	**100%**	**100%**	**100%**
Total VOC:	**12.9310%**	**13.4280%**	**25.6315%**	**17.3302%**
Total HAP:	**1.2220%**	**1.0340%**	**1.8581%**	**1.3714%**

[1]Air Pollution Testing, Inc. (2016, September). Southern Ute Indian Reservation Flash Liberation Analyses.

Figure 50 – Average Gas to Water and Gas to Condensate Ratios for Non-Registered Sources on the Southern Ute Indian Reservation – September 2016[1]

Average Gas/Water and Gas/Condensate Ratios for the Southern Ute Reservation – September 2016	
Gas/Water (scf/bbl)	**Gas/Condensate (scf/bbl)**
1.8	10.1
6.1	9.1
1.4	30.3
3.7	-- --
5.9	-- --
1	-- --
3.3	**16.5**

[1]Air Pollution Testing, Inc. (2016, September). Southern Ute Indian Reservation Flash Liberation Analyses.

Flash Emission Calculation Methodology:

Flash emissions from produced water, condensate, and oil tanks were calculated using the Gas Oil Ratio Sampling calculation methodology, and the average gas composition and gas to water and gas to condensate values developed by the AQP from flash liberation sampling data obtained in 2016 from well-sites on the Reservation. Tank throughput values in barrel per day were either reported values or the assumed values developed by AQP, as described previously in this section. Flash emission totals for the Reservation were developed for each individual operator using either reported or assumed liquid throughput values and multiplying emissions by number of corresponding tanks reported.

Example Gas Oil Ratio Calculation for Flash Emissions:

HC Emissions = ((Q)(Rs) x (MWtv) x (lb-mol/379.4 scf) x (365 days/year) x (ton/2000 lb))

Where:

Q = oil, condensate, or water production, bbl/day
Rs = measured gas-oil, gas-condensate or gas-water ratio, scf/bbl
MWtv = stock tank gas Molcular weight, lb/lb-mol

Liquid Storage Tank Loadout Emissions

Data Collection and Assumptions:

Tank loadout emissions were calculated by conservatively assuming that all liquid storage tanks are unloaded manually by truck, and not sent through pipeline. Emission factors and emission calculations were derived from Section 5.2 of EPA AP-42 for Transportation and Marketing of Petroleum Liquids. Loading was assumed to be submerged fill and the saturation emission factor for submerged dedicated normal service was selected for calculating loading losses. Truck tank capacity was assumed to be 100 bbl per loadout event and reported or assumed liquid production numbers were used for calculating the number or loadout events per year. Each loadout event was assumed to be one-hour in duration and the assumed annual hours of unloading operations for each operator were directly correlated to the reported or assumed annual liquid production. Molecular weight and true vapor pressure values were derived from TANKS model runs for produced water and condensate.

Example Tank Loadout Emissions Calculation Methodology:

Tank loadout emissions are calculated using two separate calculations, a first equation is used to estimate the total molecular weight of loading emissions losses and then a second equation is used to estimate the total emission rate on a pollutant basis. Both calculations are displayed below:

Loading Losses Calculation:

L = 12.46 x (S) x (P) x ((MW)/T) x (1-eff)

Where:

L=Loading Losses (lb/1000 gallons)
S = Saturation Factor
P = True Vapor Pressure (Pva @ T)
MW = Molecular Weight (lb/lb-mol)
T = Temperature

E = Control Efficiency of Loading
Total Emission Rate Calculation

Tons Per Year = (TE x WT%) x (OH)/2000

Where:

TE = Total Emission Rate (lb/hr)
WT% = Component Weight Percentage from Flash Gas Analysis
OH = Annual hour of operation

Liquid Storage Tank Greenhouse Gas Emissions

Produced Water Tank Greenhouse Gas Emissions:

Greenhouse gas (GHG) emissions for produced water storage tanks were calculated using the emission factors and methodology from the American Petroleum Institute document titled *Compendium of Greenhouse Gas Emissions for the Oil and Gas Industry*.[21] API emission factors are based on inlet separator pressures and an assumed inlet pressure of 71.67 psi was developed for this emission inventory by averaging pressures measured during the AQP's 2016 flash gas sampling conducted on the Reservation.

Example Calculation for Produced Water Tank GHG Emission

CH4 = (PR) x (O) x (EF)

Where:

CH4 = annual CH4 emissions (ton/yr)
PR = production rate (bbl/day)
O = operation (days/yr)
EF = emission factor (ton/1000 bbl)

Condensate and Oil GHG Emissions:

GHG emissions from condensate and oil tanks were calculated using the methodology for atmospheric pressure fixed roof storage tanks receiving hydrocarbon produced liquids from onshore petroleum and natural gas production outlined in §98.233(j) of 40 CFR Part 98 Subpart W (Subpart W). Annual volumetric GHG emissions were calculated using the emission factors and equations W-15 from §98.233(j)(3) of Subpart

[21] American Petroleum Institute. (2009). *Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry*. Retrieved from http://www.api.org/~media/files/ehs/climate-change/2009_ghg_compendium.ashx.

W. Volumetric GHG emissions were converted to mass emissions using equation W-36 from §98.233(u)(2)(v) of Subpart W.

Example Condensate and Oil GHG Calculations:

Annual Volumetric GHG Emissions - Equation W-15 of 40 CFR 63, Subpart W

Es,i = EFi x Count x 1000

Where:

Es,i = Annual total volumetric GHG emissions (either CO2 or CH4) at standard conditions in cubic feet
EFi = Population emission factor for separators, wells, or non-separator equipment in thousand standard cubic feet per separator, well, or non-separator equipment per year, for crude oil use 4.2 for CH4 and 2.8 for CO2 at 60 °F and 14.7 psia, and for gas condensate use 17.6 for CH4 and 2.8 for CO2 at 60 °F and 14.7 psia.
Count = Total number of separators, wells, or non-separator equipment with annual average daily throughput less than 10 barrels per day. Count only separators, wells, or non-separator equipment that feed oil directly to the storage tank.
1,000 = Conversion from thousand standard cubic feet to standard cubic feet.

Annual Mass Based GHG Emissions – Equation W-36 of 40 CFR 63, Subpart W:

Mass,i = (Es,i) x (pi)

Where:

Mass,i = GHG mass emissions kg/yr
Es,i = GHG volumetric emissions in scf
pi = Density of GHG
Calculation to convert kg/yr from kg/yr to tons/yr

tpy = (Mass,I x 2.20462)/2000

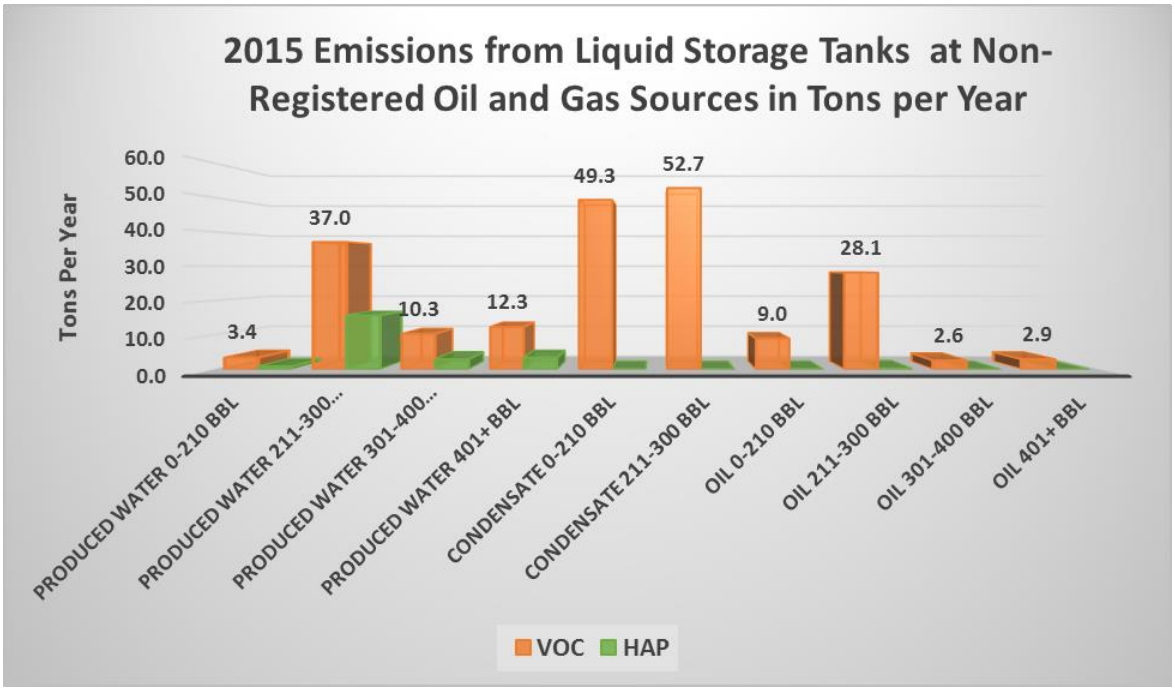
Total Liquid Storage Tank Emissions

Total liquid storage tank emissions from working and breathing losses, flash emissions, tank loadout, and GHG emissions on the Reservation are displayed in below in Figure 51 and Figure 52. Emissions are displayed by tank contents and capacity.

Figure 51 – 2015 VOC, HAP, and GHG Emission Totals on the Southern Ute Indian Reservation in Tons per from Liquid Storage Tanks by Tank Count, Content and Capacity

2015 Liquid Storage Tank Counts and Emission Totals on the Southern Ute Indian Reservation in Tons per Year				
Tank Contents and Capacity	**Tank Count**	**VOC**	**HAP**	**GHG (CO_2e)**
Produced Water 0-210 bbl	412	3.4	0.8	16.8
Produced Water 221-300 bbl	337	37.0	15.7	328.7
Produced Water 301-400 bbl	209	10.3	3.0	61.8
Produced Water 401+ bbl	245	12.3	3.4	71.5
Condensate 0-210 bbl	63	49.3	0.0	596.9
Condensate 211-300 bbl	42	52.7	0.0	397.9
Oil 0-210 bbl	22	9.0	0.1	52.5
Oil 221-300 bbl	47	28.1	0.2	112.1
Oil 301-400 bbl	5	2.6	0.0	11.9
Oil 400+ bbl	3	2.9	0.0	7.2
Total Tank Count and Total Emissions	**1,385**	**207.7**	**23.2**	**1,657.3**

Figure 52 - 2015 VOC, HAP, and GHG Emission Totals on the Southern Ute Indian Reservation in Tons per from Liquid Storage Tanks by Tank Count, Content and Capacity



E. External Combustion Sources

Description of Sources

Natural gas-fired external combustion sources are widely used by the natural gas industry as tank heaters, heated separators, reboilers, and boilers.

Data Collection

The ICR required each operator to report the total number of heaters and boilers operated by their company on the Reservation. Heater and boiler counts were reported according to heat rate range in MMBTU/hr. Operators were also given the option to report average heater and boiler operating hours to override the AQP's assumed operating hours. A description the AQP's assumed values is included in the emission calculation discussion.

Assumptions

If no hours of operation were reported in the ICR, AQP assumed heaters to operate 24 hours per day for half of the year (183 days per year) which equates to 4,392 hours per year. Boilers were assumed to operate for 24 hours per day, 365 days a year, which equates to 8,760 hours per year.

Emission Calculation Methodology

Criteria pollutant and HAP emissions for external combustion sources were calculated using the emission factors from EPA AP-42 Chapter 1.4 for uncontrolled natural gas-fired external combustion sources, the maximum heat rating from each heat rating category reported in the ICR, a default natural gas heating value of 1,020 Btu/scf, and assumed or reported operating hours.

As explained in EPA AP-42 Chapter 1.4, a default natural gas heating value of 1,020 Btu/scf shall be used to convert the emission factor from lbs/MMscf to lbs/MMBtu.

GHG emissions were calculated using the Tier 1 calculation methodology, the natural gas emission factors from Tables C-1 and C-2 of 40 CFR Part 98, and assumed or reported operating hours.

Example Calculations

Criteria and HAP Example Calculations:

lb/hr = (EF/HV) x (HR)

Where:

EF = Emission Factor (lb/MMscf)
HV = Default Heat Value of Natural Gas fuel (Btu/scf)
HR = Heat Rate of Boiler (MMBtu/hr)

Example NOx lb/hr calculation for 0.5 MMBtu/hr natural gas-fired boiler:

lb/hr = (0.06/1,020) x 0.5 = 2.94 E-5

tpy = (lb/hr) x OH/2000

Where:

(lb/hr) = Emission Rate
OH = Annual Operating Hours
2000 = Pounds per ton

Example NOx tpy calculation for 0.5 MMBtu/hr natural gas-fired boiler operating 4392 hours per year:

tpy = (2.94E-5) x (4392/2000)= 6.46E-5

GHG Example Calculation:

Tier 1 Calculation Methodology:

= (1 x 10-3) x (Fuel) x (EF)

Where:

Fuel = volume of fuel combusted per year (MMbtu/yr)
EF = fuel specific default emission factor, from tables C-1 and C-2 of Part 98 (kg/MMBtu)
1 x 10-3 = conversion factor from kilograms to metric tons

Emissions

Criteria pollutant, HAP and GHG emissions from external combustion sources located at non-registered oil and gas sources on the Reservation for calendar year 2015 are displayed below in Figure 53. Emissions are displayed by unit count and heat rating in MMBtu/hr.

Figure 53 - Criteria Pollutant, HAP, and GHG Emissions from Heaters and Boilers at Non-registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year, Displayed by Unit Count and Heat Rating in MMBtu/hr

2015 Emissions from Heaters and Boilers at Non-registered Oil and Gas Sources in Tons per Year, Displayed by Unit Count and Heat Rating in MMBtu/hr								
Equipment Type and Heat Rating	**Unit Count**	**NOx**	**VOC**	**SO2**	**PM_{10}**	**CO**	**HAP**	**CO2*e***
Heaters 0-3 MMBtu/hr	742	470.4	25.9	0.0	35.5	395.1	8.9	561,830
Boilers 11-25 MMBtu/hr	6	64.4	3.5	0.0	4.9	54.1	1.2	76,933
Total	**748**	**534.8**	**29.4**	**0.0**	**40.4**	**449.2**	**10.1**	**638,763**

F. Equipment Leaks and Fugitive Emissions

Description of Sources

Natural gas leaks from components commonly used in the natural gas industry result in emissions of methane, CO2, VOC, and HAP. Components include: valves, pumps, pressure relief valves, connectors, flanges, and, open-ended lines. These components are ancillary equipment to many larger equipment source types including: headers, separators, heaters, filters, engines, compressors, dehydration units, and storage tanks.

Data Collection

The ICR provided operators with the option to report average fugitive component counts for single and co-located well-sites. In the absence of ICR provided component counts, the AQP relied on assumed component counts, as detailed below.

Assumptions

Fugitive component counts were assumed based on component counts for natural gas production contained in the Canadian Association of Petroleum Producers (CAPP) document titled *Guide to Calculating Greenhouse Gas Emissions*.[22] Component counts for single and co-located well-site locations are displayed below in Figure 54.

[22] Canadian Association of Petroleum Producers. (2003). *Guide to Calculating Greenhouse Gas Emissions.* Retrieved from http://www.capp.ca/publications-and-statistics/publications/241974

Figure 54 – Assumed Fugitive Emission Component Counts at Single and Co-Located Natural Gas Well-Sites on the Southern Ute Indian Reservation

Assumed Component Counts for Well-Site Locations on the Southern Ute Indian Reservation				
Component Type-Service	**Component count for a Single well**	**Component count for Two co-located wells**	**Component count for Three Co-located wells**	**Component count for Four Co-located wells**
Valves-Gas/Vapor	16	32	48	64
Connectors-Gas/Vapor	60	120	180	240
Open-Ended Lines-Gas/Vapor	3	6	9	12

Emission Calculation Methodology

VOC and HAP Emission Calculations:

VOC and HAP emissions from equipment leaks and fugitive emissions were calculated using the average emission factor approach and the gas/vapor total organic compound (TOC) emission factors for oil and gas production from Table 2-4 of Chapter 2.3 of EPA AP-42. The TOC emission factor for gas/vapor was chosen as the most representative of production on the Reservation in CY2015 and is the most conservative emission factor available. TOC emissions were calculated by multiplying the gas/vapor emission factor by component counts from Tab 1 of the *CAPP*, the component count that corresponds to the number of wells and typical well-site equipment configurations reported by each recipient of the ICR, and an assumed 8,760 hours of annual operation. VOC and HAP emissions were then derived by multiplying the TOC emissions by the VOC and HAP molecular weight fraction percentages of an assumed extended natural gas analysis for the Reservation. If component counts were provided by operators in the ICR, emissions for their company's productions were calculated using their reported counts in place of the CAPP component counts.

GHG Emission Calculations:

GHG emissions from equipment leaks and fugitive emissions were calculated using the equipment leak by population count methodology and equation W-32A of Subpart W of 40 CFR Part 98 (Subpart W). Input values for the W-32A equation included the emission factors for gas leakage from western U.S. gas service from Table W-1A of Subpart W, the component counts provided in the ICR, the population emission factors listed for equipment types in Tables W-1A and W-4 through W-7 of Subpart W, an assumed 8,760 hours of annual operation, and the methane and CO_2 molecular weight percentage rates from an assumed extended natural gas analysis. Final GHG values were converted from volume to mass using equation W-36 of Subpart W and the gas densities from §98.233(u)(2)(v) of Subpart W.

Example Calculations

VOC and HAP Emission Calculation Methodology:

VOC or HAP Emissions = AP-42 Average Emission Factor for Gas Valves x API Compendium Generic Valve Count x VOC or HAP Percent Weight= lb/hr VOC or HAP emissions

VOC Emissions (lb/hr) = (0.0099 lb/hr/gas valve) x (400 valves) x (0.06% VOC) = 0.0026lb/hr

VOC Emissions (tpy) = (0.0026 lb/hr) x (8760 hr/yr) x (Ton/2000 lb) = 0.0112 tons/year

GHG Emission Calculation Methodology – Equation W-32A of 40 CFR 98 Subpart W:

GHG Emissions (scf/yr) = (Count) x (Efs,e) x (GHGi) x (Te)

Where:

Count = Total number of the emission source type at the facility.
EFs,e = Population emission factor for the specific emission source type, as listed in Tables W-1A and W-4 through W-7
GHGi = Concentration of GHG (CH4 or CO2) in produced natural gas
Te = Average estimated time that each emission source type associated with the equipment leak emission was operational in the calendar year, in hours

Example Methane Calculation for Valves:

scf/yr = (50 x 0.121) x (0.922564147) x (8760) = 48,894.05scf/yr

To convert from scf/yr to scf/hour divide by 8760

Scf/hr = 48,894.05/8760 =5.58

To derive an scf/hr amount, divide scf/yr by annual hours of operation

Volume to Mass Equation - Equation W-36 of 40 CFR 98 Subpart W

Massi = (Es,i) x (pi) x 10^-3

Where:

Massi = Mass emissions in metric tons
Es,I = Volumetric emissions at standard conditions, in cubic feet
Pi = Density of GHG

Equation altered to give answer in lb/hr

Mass I = (Es,I) x (pi) x (lb/kg)

Example:

lb/hr = *5.58 x 0.0192 x 2.20462 = 0.23 lb/hr*

To calculate annual emissions in ton per year, multiply lb/hr rate by 8760 hours and divide by 2,000 lb/ton

tpy Methane = (0.23 x 8760)/2,000 = 1.03

Emissions

Volatile organic compound, HAP and GHG emissions from equipment leak and fugitive emission sources located at non-registered oil and gas sources on the Reservation for calendar year 2015 are displayed below in Figure 55.

Figure 55 – 2015 Emissions of VOC, HAP, and GHG from Equipment Leaks and Fugitive Emission Sources at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

2015 Emissions from Equipment Leaks and Fugitive Emission Sources at Non-registered Oil and Gas Sources in Tons per Year			
Pollutant	**VOC**	**HAP**	**CO2*e***
Emission Totals	**252.9**	**15.1**	**209,593**

G. Natural Gas Driven Pneumatic Devices

Description of Sources

Natural gas-driven pneumatic controllers and pumps are used in the oil and natural gas industry for maintaining liquid levels, pressures, pressure differentials, and temperature. Many devices are designed to leak, or "bleed", natural gas and in doing so emit natural gas containing methane, CO_2, VOC, and HAP. Pneumatic devices are classified as high or low continuous bleed controllers, intermittent bleed controls, or zero bleed controllers.

Data Collection

The AQP assigned an assumed value for the average number of pneumatic devices located at a single wellsite from the 2014 Environmental Science and Technology report titled *Methane Emissions from Process Equipment at Natural Gas Production Sites in*

the United States.[23] The assumed pneumatic device count value was provided in the ICR and operators were provided the opportunity to override the assumed value with values more representative of their operations.

Emission Calculation Methodology

Pneumatic device emissions were calculated by applying the generic natural gas emission factors and supply pressure coefficients found in EPA's April 2014 Report for Oil and Natural Gas Sector Pneumatic Devices to the AQP's assumed average device count or average device counts reported in the ICR.

Example Emission Calculation:

lb/hr = Count x Bleed Rate x R x MW x Y

Where:

Count = total number of devices

Bleed Rate = bleed rate from device (scf/hr/device)

R = Universal gas constant (lb-mol/379.3scf)

MW = molecular weight of the component

Y = volume fraction of component in the vented gas

Example for Methane

lb/hr = 2695 x 58.5 x 1/379.3 x 16.01 x 92% = 577.2 lb/hr

tpy = lb/hr x OH/2000

Where:

lb/hr = emission rate in pounds per hour

OH = annual operating hours

2000 = pounds per ton

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[23] Allen, D. (2014). Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Pneumatic Controllers. *Environmental Science & Technology, 49*, 633-640. Retrieved from http://pubs.acs.org/doi/pdf/10.1021/es5040156

tpy methane = 577.2 x 8760/2000 = 2528.1 tpy

Emissions

Volatile organic compound, HAP, and GHG emissions from natural gas driven pneumatic devices on the Reservation during 2015 are displayed below in Figure 56.

Figure 56 - 2015 Volatile Organic Compound, HAP, and GHG Emissions from Natural Gas Driven Pneumatic Devices at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

2015 Emissions from Natural Gas Driven Pneumatic Devices in Tons per Year			
Pollutant	**VOC**	**HAP**	**CO2*e***
Emission Totals	129.5	7.8	150,493.2

H. Natural Gas Blowdowns

Description of Sources

Natural gas blowdowns are intentional and unintentional gas releases during maintenance, routine operations, and emergencies. Blowdowns occur from gas compressors, compressor startups, gas wellbores, vessels, pipelines, and various equipment.

Data Collection

The ICR requested emissions resultant from maintenance and emergency natural gas blowdowns. Due to the burden of capturing actual emissions for each blown down event at a large number of non-registered sources, emissions from such events are based on assumptions on the amount of gas released from certain types of blowdowns, the AQP's assumed extended gas analysis, and an assumed number of events anticipated during a calendar year. The ICR provided operators with the opportunity to override the AQP's assumed values with values more representative of their operations.

Assumptions

The AQP developed assumed values for the number and time duration of annual compressor and pipeline blowdowns that occur per year and the volume of natural gas vented per event. Assumed values were based on information provided by two operators with a large number of sources on the Reservation. The values assumed for 2015 are displayed below in Figure 57.

Figure 57 – Assumed Values for Annual Natural Gas Blowdown Events Occurring at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in 2015

Assumed Values for Annual Blowdown Events on the Southern Ute Indian Reservation for 2015	
Compressors	
Annual compressor blowdowns per compressor	2
Estimated amount of gas lost per blowdown (Mscf/event)	10
Duration of event (hr/event)	1
Pipelines	
Number of pipeline blowdowns per year	10
Estimated amount of gas lost per blowdown (Mscf/event)	1.92
Duration of event (hr/event)	1

Emissions Calculation Methodology

Emissions from natural gas blowdowns were calculated using either the AQP's assumed extended gas analysis or reported natural gas analysis, and assumed or reported event frequencies, duration, and gas loss values.

Example Calculations:

lb/hr = (Totalvented x % vol) x (MW/(R x T))/OH

Where:

Totalvented = total volume of gas vented (scf/yr)

%vol = volume percent of gas component

MW = molecular weight of the component
R = universal gas constant (scf/lb-mol)
T = temperature (60 °F converted to 519.67 °R)

*tpy = lb/hr*OH/2000*

Where:

lb/hr = emission rate in pounds per hour

OH = annual operating hours

2000 = pounds per ton

Emissions

Emissions from natural gas blowdown activities occurring on the Reservation during 2015 are displayed below in Figure 58.

Figure 58 – 2015 Volatile Organic Compound, HAP, and GHG Emissions from Natural Gas Blowdowns at Non-Registered Oil and Gas Sources on the Reservation in Tons per Year

2015 Emissions from Natural Gas Blowdowns on the Southern Ute Indian Reservation in Tons per Year			
Pollutant	**VOC**	**Total HAP**	**CO2*e***
Emission Totals	3.3	0.1	4,086.1

I. Well Completion and Re-completion Venting

Description of Sources

Well completions and recompletions, when not employing closed vent system techniques, also known as "green completions", release natural gas during the "flow back" back stage of the process. Flow back is the stage in which drilling fluid and hydrocarbon reservoir fluids return to the surface prior to well production. Green completion techniques capture flow back materials, including natural gas.

Data Collection

The number of well completions that occurred in calendar year 2015 were obtained from the COGCC database, and are displayed below in Figure 59. No data were available for well recompletions in the COGCC database and an assumed recompletion value of 1% of all operating wells per year was obtained from the 2015 Colorado Air Resources Management Modeling Study (CARMMS).[24]

The ICR also provided the opportunity for operators to report the number of events that occurred in calendar year 2015, including natural gas lost per event, and completion by type (conventional or green completion).

[24] ENVIRON International Corp.; Carter Lake Consulting; Environmental Management and Planning Solutions. (2015). *Colorado Air Resources Management Modeling Study.* Retrieved from https://www.blm.gov/co/st/en/BLM_Information/nepa/air_quality/carmms.html

Figure 59 – Wells Completed at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in 2015[1]

Well Completions on the Southern Ute Indian Reservation in 2015	
Total	24

[1]Well completion totals were obtained from the COGCC Database.

Assumptions

Fifty percent of all well completions and recompletions were assumed to utilize green completion technology with no natural gas vented to atmosphere. Conventional well completions and recompletions were assumed to vent 1,000 Mscf of natural gas per event. These assumptions were derived by averaging information provided by two operators with a large number of sources on the Reservation.

For well recompletions, the assumed well recompletion value of 1% of all operating wells per year was obtained from the CARMMS study and assumed to be accurate and representative of operations on the Reservation.

All completion and re-completion activities were assumed to be either conventional or green completions, based on information provided by two large natural gas operators on the Reservation. Therefore, the AQP did not estimate emissions from flaring events that may occur during well completion or re-completion activities. Assumed well completion and recompletion values for 2015 are displayed below in Figure 60.

Figure 60 – 2015 Assumed Values for Well Completion and Recompletion Activities at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation[1]

Assumed Values for Well Completion and Recompletion Activities on the Southern Ute Indian Reservation -2015		
Assumed Values for Well Completion and Re-completion Venting	**Completion Type**	
	Conventional	**Green Technology**
Percent of completions by type	50%	50%
Estimated amount of gas vented to atmosphere per event (Mscf/event)	1000	0
Estimated amount of gas controlled via closed loop system per event (Mscf/event)	0	0

[1]Assumed values are based on information provided by two large natural gas operators on the Reservation.

Emission Calculation Methodology

Emissions from well completion and recompletions were calculated using an assumed extended gas analysis, and reported or assumed event frequencies and gas loss values.

Emissions from drilling engines that are employed during well completion and re-completion activities were not calculated.

Emissions

Emissions from well completion and recompletion venting on the Reservation in calendar year 2015 are displayed below in Figure 61.

Figure 61 – 2015 Volatile Organic Compound, HAP, and GHG Emissions from Well Completion and Recompletion Activities at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation

2015 Well Completion and Recompletion Emissions from Non-registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year			
Pollutant	**VOC**	**Total HAPs**	**CO2*e***
Emission Totals	12.1	0.6	15,706.9

J. Typical Well-Site Configuration

Description

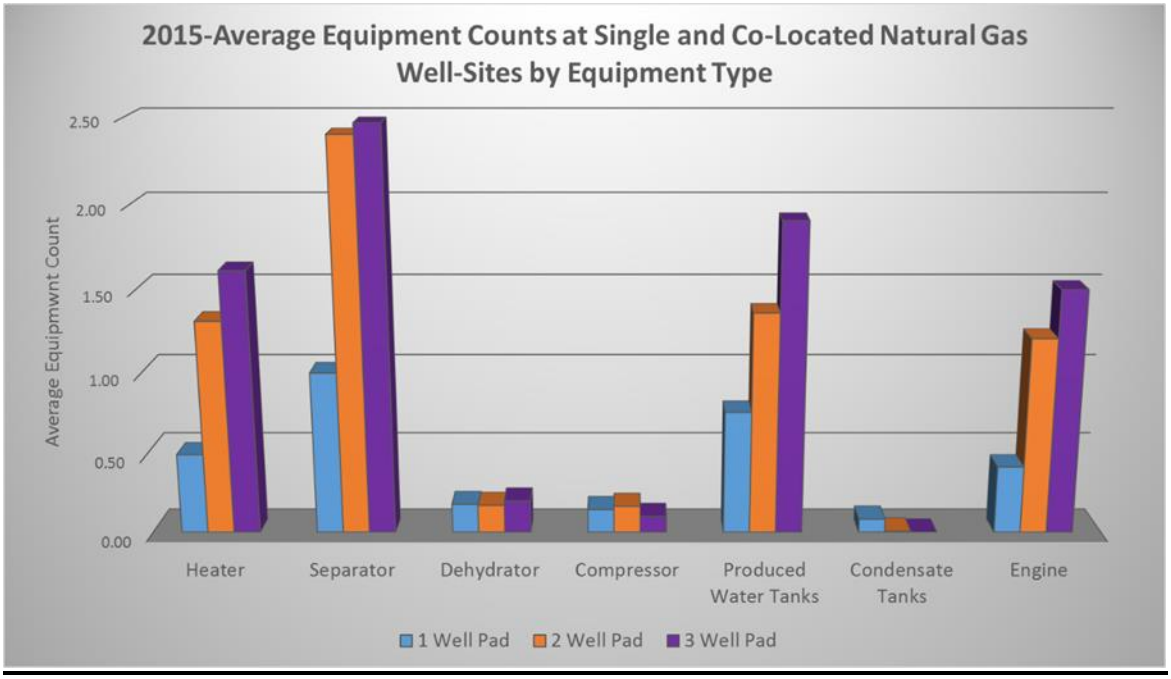
The AQP compiled equipment count information collected in the ICR to prepare average equipment type counts based on the number of natural gas wells located on a single well-pad. This information can be used to gain a better understanding of typical well-site configurations on the Reservation and to assist with estimating emissions from any proposed natural gas development schedules.

Average equipment counts at non-registered oil and gas sources on the Reservation are displayed below in Figure 62 and Figure 63.

Figure 62 – 2015 Average Equipment Counts at Single and Co-Located Well-Sites Located at Non-Registered Oil and Gas Sources on the Southern Ute Indian Reservation in Tons per Year

2015 - Average Equipment Counts at Single and Co-Located Natural Gas Well-Sites by Equipment Type							
Number of Wells per Pad	**Heater**	**Separator**	**Dehydrators**	**Compressors**	**Produced Water Tanks**	**Condensate Tanks**	**Engine**
1	0.5	1.0	0.2	0.1	0.8	0.1	0.4
2	1.3	2.4	0.2	0.2	1.4	0.0	1.2
3	1.6	2.5	0.2	0.1	1.9	0.0	1.5
4	1.0	3.0	0.0	0.0	1.5	0.0	2.5

Figure 63 – Average Equipment Counts at Non-Registered Oil and Gas Wells by Equipment Type



2. Fruitland Formation Outcrop Natural Gas Seeps

Description of Sources

Naturally occurring methane and CO2 seepage from outcrops of the Cretaceous Fruitland Formation (Fruitland Outcrop) contribute a significant quantity of the GHG emissions on the Reservation.

Data Collection

The data used to quantify emissions from the Fruitland Outcrop were provided to the AQP from the SUIT Department of Energy (SUIT DOE). SUIT DOE collected outcrop seepage data on an annual basis since 2007 using an independent contractor between 2007. The goal of the study is identification, mapping, and quantification of methane seeps on the Fruitland Outcrop. A backpack mounted, hand-held gas flux meter manufactured by WEST Systems is used to measure methane and CO2 soil gas flux concentrations in moles per meters squared per day (mol/m² day) at thirty-five seep areas, totaling 53,352,338 square feet (1.9 miles) of ground. The flux concentrations were then used by the contractor to calculate volumetric methane and CO2 concentrations for 2015 in MCFD.

Emission Calculation Methodology

The AQP calculated ton per year emission rates for methane and CO2 by converting the volumetric methane and CO2 flux concentrations from MSCF to SCFD and then dividing the flux concentrations by the ideal gas law constant and multiplying the constants by the molecular weight of each gas. GHG emissions in CO2 equivalence (CO2*e)* were calculated by multiplying methane emissions by the EPA's global warming potential factor of 25 for methane.

Example Calculations

Calculation to Convert Flux Rate in SCFD to lb/day

*lb/day = Flux/Ideal Gas Law Conversion Factor*molar mass*

Where:

Flux = Volumetric gas flux in SCFD
Ideal Gas Law Conversion Factor = 379.3 SCF/mol
*Molar Mass = g*Mol⁻¹ (CH4 = 16.04; CO2 = 44.01)*

*lb/day Methane = 3,097,000/379.3*16.04 = 1,053,658 lb/day Methane*

Calculation to convert lb/day to tpy

*tpy = lb/day/2000/ton*365 days*

Emissions

Emission calculations for methane, CO2 and total GHG in CO2*e* are displayed below in Figure 64:

Figure 64 - 2015 Emissions of Methane, CO2, and total GHG in CO2 Equivalence

2015 Fruitland Outcrop Methane, CO2, and Total GHG (CO2e) Emissions in Tons per Year	
Methane	192,293
CO2	229,097
Total GHG (CO2e)	5,036,413

3. Gas Stations

Description of Sources

There are five gasoline service stations that operated on the Reservation during calendar year 2015.

Data Collection

2015 gasoline throughput values were provided to the AQP by representatives of each gas station, and the throughput are displayed below in gallons per year in Figure 65.

Figure 65 – 2015 Annual Gasoline Throughput at Gasoline Stations Located on the Southern Ute Indian Reservation in Gallon per Year[1]

2015 Annual Gasoline Throughput in Gallons per Year	
Total Gasoline Throughput	**1,785,476**

[1]Reported throughput totals for one gasoline station included both diesel and gasoline and were corrected to include only gasoline. The method used for correcting this value is explained below in the Assumptions section.

Assumptions

AQP assumed that gasoline throughput values reported by gas station representatives are valid. One gasoline station provided an aggregate throughput value for diesel and gasoline fuel. The AQP corrected this throughput value to only include gasoline based on the average of gasoline to diesel fuel dispensing rates contained in three information sources assumed to be accurate for estimating the amount fuel dispensed in Colorado and the U.S. in 2015[25,26,27]

Due to the absence of emission factors for diesel fuel dispensing in EPA AP-42 Section 5.22, the AQP assumed emissions from diesel fuel dispensing to be negligible and did not calculate emissions for this activity. EPA AP-42 Section 5.2.2, also assumes a

[25] U.S. Energy Information Administration. (2016). Petroleum & Other Liquids. Retrieved from http://www.eia.gov/petroleum/

[26] Statista: The Statistics Portal. (2016). *U.S. motor gasoline and distillate fuel oil consumption by the transportation sector from 1992 to 2015 (in 1,000 barrels per day)*. Retrieved from https://www.statista.com/statistics/189410/us-gasoline-and-diesel-consumption-for-highway-vehicles-since-1992/

[27] American Fuels: Alternative Fuels News and Commentary. (2014). *2013 Gasoline Consumption*. Retrieved from http://www.americanfuels.net/2014/03/2013-gasoline-consumption.html

negligible methane content from gasoline evaporative emissions; therefore, AQP did not calculate GHG emissions for gas stations.

Emission Calculation Methodology

Gas station emissions were calculated using the Tribal Emissions Inventory Software Solutions (TEISS) emissions calculator for gasoline service stations.[28] The calculator employs emission factors from EPA AP-42 Section 5.2.2. Total reported fuel throughputs were input into the TEISS emissions calculator for two stages of gasoline service station emissions. Stage 1 includes underground tank filling and submerged filling. Stage 2 includes underground tank breathing and emptying, vehicle refueling displacement losses (uncontrolled), and spillage.

Emissions

Total VOC emissions from gas stations on the Reservation during 2015 are displayed below in Figure 66.

Figure 66 - 2015 Volatile Organic Compound Emissions from Gasoline Dispensing Stations on the Southern Ute Indian Reservation

2015 Gas Station Emissions on the Southern Ute Indian Reservation in Tons per Year			
Annual Reservation Gasoline Throughput (gallons)	**Station Operation Type**	**Pollutant**	**Emissions**
1,785,476	Stage 1: Underground Tank Filling, Submerged Filling	VOC	6.5
1,785,476	Stage 2: Underground Tank Breathing & Emptying, Vehicle refueling displacement losses (uncontrolled), and Spillage	VOC	11.3
Total:		**VOC**	**17.8**

[28] Institute for Tribal Environmental Professionals. (2016). Tribal Emissions Inventory Software Solution Version 3.6.26. Retrieved from http://www7.nau.edu/itep/main/air/air_aqt_teiss.

4. Aviation Gasoline

Description of Sources

Emission estimates for aviation gasoline and the amount of lead in the leaded gasoline for counties were last developed by EPA for calendar year 2014. Lead is an additive in aviation gasoline used for piston-engine aircrafts (either general aviation or air taxi) to increase the fuel octane and prevent valve seat decline, which is a safety concern.

Data Collection

Data was obtained from the EPA NEI for calendar year 2014. EPA's data collection methodology is described in EPA's 2008 Technical Support Document titled *Lead Emissions from the Use of Leaded Aviation Gasoline in the United States*.[29]

Assumptions

The AQP assumed EPA's calendar year 2014 EPA's aviation gasoline emission estimates for La Plata County and Animas Air Parks would be the most representative emission estimates available for calendar year 2015.

Emissions

Volatile Organic Compound and HAP emissions from aviation gasoline usage on the Reservation in 2015 is displayed below in Figure 67.

Figure 67 – 2015 Volatile Organic Compound and HAP Emissions from Aviation Gasoline on the Southern Ute Indian Reservation in Tons per Year[1]

2015 Aviation Gasoline Emissions for the Southern Ute Indian Reservation in Tons per Year	
Aviation Gasoline Stage	**Emissions**
Stage 1 Fueling Pollutants	
VOC	13.2
HAP	0.7
Stage 2 Fueling Pollutants	
VOC	0.4
HAP	0.0
Combined Stage 1 and Stage 2 Fueling Emissions	**Total Aviation Fueling Emissions**
Total VOC Emissions	**13.6**
Total HAP Emissions	**0.7**

[29] U.S. EPA. (2008, October). Lead Emissions from the Use of Leaded Aviation Gasoline in the United States.

[1]Emissions for aviation gasoline fueling are estimated from data sourced from the 2014 EPA National Emission Inventory Database and assumed to be realistic estimations of aviation gasoline fueling emissions for 2015.

5. Gravel Pits

Description of Sources

Ten sand and gravel pits operated within the exterior boundaries of the Reservation during calendar year 2015. Data was collected from the Colorado Division of Reclamation Mining and Safety (DRMS) database[30]. The emissions from pits on the Reservation were estimated by scaling down the emissions estimates reported to the 2014 EPA NEI for La Plata, Archuleta, and Montezuma counties for calendar year 2014.

Data Collection

The AQP researched active gravel pits located within the exterior boundaries of the Reservation through the DRMS ArcGIS data set. AQP used ArcGIS and the "select by attribute" feature to select the gravel, sand, and combined sand and gravel permits located within the exterior boundaries of the Reservation in La Plata, Archuleta, and Montezuma counties. Permits with an active status for 2015 were then cross-referenced with the DRMS Imaged Document data to determine if there was production in 2015. This methodology determined ten active gravel pits in La Plata County and no active gravel pits in Archuleta and Montezuma counties during 2015.

Emissions

Gravel pit emissions for La Plata County were obtained from the EPA's calendar year 2014 Nonpoint Emission Inventory for gravel pits. Emission totals were reported to NEI for La Plata and Archuleta counties as a whole and not for individual gravel pits. To derive emission estimates for the Reservation, the reported emission totals for La Plata County were multiplied by the percentage of active gravel pits that are located within the exterior boundaries of the Reservation. For example 25.64% of active gravel pits in La Plata County are within the Reservation boundaries, therefore, gravel pits on the Reservation account for 25.64% percent of emissions in La Plata County. Emission totals for 2015 are displayed below in Figure 68.

[30] Colorado Division of Reclamation Mining and Safety. (2016). *Active Hardrock Permits.* Department of Natural Resources. Retrieved from http://mining.state.co.us/Reports/Pages/GISData.aspx.

Figure 68 – Emissions of PM_{10} from Active Gravel Pits on the Southern Ute Reservation in 2015

2015 Gravel Pit Emissions on the Southern Ute Indian Reservation in Tons per Year				
County	**Pollutant Description**	**County Emissions**	**Percent(%) of Active Permitted Pits within SUIR**	**Emissions**
La Plata	**PM_{10}**	**175.3**	**25.6%**	**50.5**
Archuleta	**PM_{10}**	**29.2**	**0.0%**	**0.0**

6. Residential Heating

A. Description of Sources: Fireplaces and Wood Burning Stoves

Fireplaces and wood burning stoves are a significant source of residential heating within the exterior boundaries of the Reservation. The predominant types of solid fuel available are pinyon-juniper, pine, and aspen.

Data Collection

The U.S. Census 2010-2014 American Community Survey 5-Year Estimate (survey) was used to determine the number of households on the Reservation that use fireplaces or wood burning stoves for residential heating.[31] The survey estimates the total number of households on the Reservation that used wood as a heating source during the five-year survey period.

The U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics' 2005 Residential Energy Consumption Survey (EIA) was used to obtain the average number of cords used within a year at an average household.[32] Table US8 of the EIA lists that an average household uses an average of 1.6 cords per year. The U.S. Census reported 894 households on the Reservation use fireplaces or woodstoves as the primary heating source.

Fireplace and wood burning residential heating data for the Southern Ute Indian Reservation in 2015 is displayed below in Figure 69.

[31] U.S. Census Bureau. (2016). American Community Survey. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

[32] U.S. Energy Information Administration. (2005) Table US8 Average Consumption by Fuels Used, 2005 Physical Units per Household

Figure 69 – 2015 Fireplace and Wood Burning Stove Residential Heating Data for the Southern Ute Indian Reservation

2015 – Fireplace and Wood Burning Residential Heating Data for the Southern Ute Indian Reservation			
Homes Heated with Wood	**Average Fuel Use per Household/Year**	**Unit of Measurement**	**Total Number of Cords used in 2015**
894	1.6	Cords	1,430.4

Emission Calculation Methodology

Emissions for residential fireplace and wood burning stoves were calculated using the Tribal Emissions Inventory Software Solutions (TEISS) emission calculator. The calculator employed emission factors from EPA AP-42 Section 1.10.2, which may be adjusted based on the units of data input.

Example Calculation

894 households x 1.6 cord / household = 1,430.4 cords (input into TEISS)

Assumptions

The U.S. Census surveyed 5,159 households with an estimated uncertainty of ± 96 households using fireplaces or woodstoves for home heating. The stove type entered into TEISS was conventional pre-phase I.

Emissions

Total criteria pollutant and GHG emissions from residential fireplace and wood-burning stoves on the Reservation in 2015 are displayed below in Figure 70.

Figure 70 – 2015 Criteria Pollutant and GHG Emissions from Fireplaces and Wood Burning Stoves on Southern Ute Indian Reservation in Tons per Year

2015 Fireplace and Wood Burning Stoves Emissions for the Southern Ute Indian Reservation in Tons per Year						
Pollutant	**NOx**	**SO_2**	**PM_{10}**	**CO**	**VOC**	**CO2*e***
Total	1.9	0.3	20.5	154.5	35.5	2,851.9

B. Description of Sources: Propane Heating

Liquid propane (LP) is the dominant source of residential heating on the Reservation and in Southwest Colorado.

Data Collection

The U.S. Census 2010-2014 American Community Survey 5-Year Estimate was used to determine the number of households on the Reservation that use LP gas as a source of heating.

The U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics' 2009 Residential Energy Consumption Survey (EIA) was used to obtain the average of LP used per household. The survey estimated the average number of gallons of LP used within a year for an average household.[33] The U.S. Census reported 2,405 or 46.6% of households on the Reservation use LP gas as the primary heat source and the EIA estimated 768 gallons of LP gas are burned per year in households in Colorado.

Liquid Propane residential heating data for the Southern Ute Indian Reservation in 2015 is displayed below in Figure 71.

Figure 71 - 2015 Liquid Propane Residential Heating Data for the Southern Ute Indian Reservation

2015 – Liquid Propane Residential Heating Data for the Southern Ute Indian Reservation			
Homes Heated with Liquid Propane	**Average Fuel Use per Household/Year**	**Unit of Measurement**	**Total Gallons used in 2015**
2,405	768	Gallons	1,847,040

Emission Calculation Methodology

Emissions for residential LP gas heating were calculated using the TEISS emission calculator. The calculator employed emission factors from AP-42 Section 1.5.

Example Calculation

$$2{,}405 \text{ households} \times \frac{768 \text{ gallons}}{\text{household}} = 1{,}847{,}040 \text{ gallons *(input into TEISS)}$$

[33] U.S. Energy Information Administration. (2009). Table CE2.5 Household Site Fuel Consumption in the West Region, Totals and Average, 2009 Physical Units. Retrieved from https://www.eia.gov/consumption/

Assumptions

The U.S. Census surveyed 5,159 households with an estimated uncertainty of ± 122 households that use LP gas for home heating. The actual sulfur content of LP gas on the Reservation is unknown and the default sulfur content of 0.54 grains/100 ft^3 was used in the TEISS emission calculator.

Emissions

Total criteria pollutant and GHG emissions from residential LP gas usage on the Reservation in 2015 is displayed below in Figure 72.

Figure 72 – 2015 Criteria Pollutant and GHG Emissions from Liquid Propane Gas Heating at Residential Sources on Southern Ute Indian Reservation in Tons per Year

2015 Liquid Propane Gas Heating Emissions for the Southern Ute Indian Reservation in Tons per Year						
Pollutant	**NOx**	**SO_2**	**PM_{10}**	**CO**	**VOC**	**CO2*e***
Total	12.4	0.1	0.0	3.5	0.5	10,609.9

C. Description of Sources: Natural Gas Heating

Natural gas is a prevalent residential heating fuel on the Reservation.

Data Collection

The U.S. Census 2010-2014 American Community Survey 5-Year Estimate (survey) was used to determine the amount of households on the Reservation that use natural gas for residential heating. The survey estimates the total number of households on the Reservation that used natural gas as a heating source during the five-year survey period.

The U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics' 2009 Residential Energy Consumption Survey (EIA) was used to obtain the average of natural gas used per household. The survey estimated the average cubic feet of natural gas used within a year for an average household. The U.S. Census reported 1,031 or 20% of households on the Reservation use natural gas as the primary heat source and the EIA estimated 80 thousand cubic feet (80MMcf) of natural gas are burned per year in households in Colorado.

Natural Gas residential heating data for the Southern Ute Indian Reservation in 2015 is displayed below in Figure 73.

Figure 73 - 2015 Natural Gas Residential Heating Data for the Southern Ute Indian Reservation

2015 – Natural Gas Residential Heating Data for the Southern Ute Indian Reservation			
Homes Heated with Natural Gas	**Average Fuel Use per Household/Year**	**Unit of Measurement**	**Total MMcf used in 2015**
1,031	80	MMcf	82,480

Emission Calculation Methodology

Emissions for residential natural gas heating were calculated using the TEISS emission calculator. The calculator employed emission factors from EPA AP-42.

Example Calculation

1,031 household x 80,000 cf gas / household = 82,480 thousand cf gas (input into TEISS)

Assumptions

The U.S. Census surveyed 5,159 households with an estimated uncertainty of ± 120 households that use natural gas for home heating.

Emissions

Total criteria pollutant and GHG emissions from residential natural gas heating sources on the Reservation in 2015 are displayed below in Figure 74.

Figure 74 – 2015 Criteria Pollutant and GHG Emissions from Natural Gas Heating at Residential Sources on Southern Ute Indian Reservation in Tons per Year

2015 Natural Gas Heating Emissions for the Southern Ute Indian Reservation in Tons per Year						
Pollutant	**NOx**	**SO_2**	**PM_{10}**	**CO**	**VOC**	**CO2*e***
Total	3.9	0.0	0.0	1.6	0.2	4,494.8

7. Wildland Fires and Prescribed Burns

Description of Activity

The forest on the Reservation is predominantly comprised of pinyon-juniper woodlands with ponderosa, gambel oak, aspen and sub-alpine forest at higher elevation areas. The

forest is prone to wildfire and prescribed burns are utilized as a forest management strategy to help prevent catastrophic fires, improve wildlife habitat and improve overall forest health. Wildfires and prescribed burns can be significant sources of air pollution on the Reservation and the Four Corners area.

Data Collection

Wildland and prescribed burn fire (forest fire) data for calendar year 2015 were obtained from the Bureau of Indian Affairs (BIA) and the Southern Ute Agency Fire Management Division.[34] The initial data identified 23 fires (21 wildfires and 2 prescribed fires). To ensure accuracy, AQP accessed another data set from the U.S. Department of Agriculture Federal Fire Occurrence Website.[35] The U.S. Department of Agriculture data set identified four additional wildfires reported by the U.S. Forest Service (USFS) and the National Park Service (NPS). Data sets included type of fire, latitude and longitude of fire perimeter, and acres burned.

Emission Calculation Methodology

Forest fire emission estimates were calculated using the USFS BlueSky Playground web tool (BlueSky).[36] BlueSky is comprised of several internal USFS datasets and modeling programs, including the Fuels Characteristic Classification System fuel information dataset (FCCS), the CONSUME3 fuel consumption model, and the FEPS emission factors model.

Forest fire data including latitude and longitude and acres burned are input into BlueSky and BlueSky selects the correct default model input values based on the fire location. Input values include available fuel load, fuel consumed, emission factors, and meteorological forecast data. "Dry" was selected for the fuel moisture value. Forest fire event by FCCS fuel bed type are displayed below in Figure 75.

Figure 75 – 2015 Forest Fire Occurrence on the Southern Ute Indian Reservation by Fuels Characteristic Classification System Fuel Bed Type and Acres Burned

2015 Forest Fires on the Southern Ute Reservation according to FCCS Fuelbed Type and Acres Bured		
FCCS Fuel Bed Description	**Number of Fires**	**Acres Burned**
Bare Ground	1	0.5

[34] Bureau of Indian Affairs Fire Management. (2015). *Southern Ute 2015 Fire Occurrence*

[35] U.S. Department of Interior and U.S. Department of Agriculture. (2016). *Federal Wildland Fire Occurrence Data*. Retrieved from Federal Fire Occurrence: http://wildfire.cr.usgs.gov/firehistory/index.html.

[36] U.S. Forest Service AirFire Research Team. (2016). *BlueSky Playground (Version 2.0 beta)*. Retrieved from http://playground.airfire.org/home.php

Ponderosa Pine Savanna	4	1.6
Interior Douglas-Fir-Interior Ponderosa Pine/Gamble Oak Forest	1	0.1
Quaking Aspen / Engelmann Spruce Forest	18	77.0
Pinyon-Utah Juniper Woodland	1	0.8
Totals	**25**	**80.1**

Emission Equations

Emissions = (Area burned) x (Fuel Load Available) x (Fuel Consumed (Burn Efficiency)) x (Emission Factors)

Mass of Emissions =
Area burned (input from AQP datasets)
Fuel Load Available (updated FCCS map) *Bluesky Playground Framework*
Fuel Consumed (CONSUME3)
Emission Factors (FEPS plus HAPs)

Assumptions

Collected and reported fire related data is assumed to be accurate and to be the best data available. BlueSky is assumed to function as intended and to select the proper fuel characteristics from the USFS FCCS map when latitude and longitude coordinates are input into the model.

Emissions

Total criteria pollutant, NH3 and GHG from prescribed burns and wildland fires that occurred within the exterior boundaries of Reservation boundaries in 2015 are displayed below in Figure 76.

Figure 76 - 2015 Criteria Pollutant, NH_3, and GHG Emissions from Prescribed Burns and Wildland Fires within the Exterior Boundaries of the Southern Ute Indian Reservation in Tons per Year

2015 Prescribed Burn and Forest Fire Emissions on the Southern Ute Indian Reservation in Tons per Year							
Pollutant	**PM_{10}**	**CO**	**NOx**	**NH_3**	**SO_2**	**VOC**	**CO_2e**
TOTAL	**9.6**	**48.1**	**0.9**	**0.78**	**0.4**	**11.3**	**833.7**

8. Agricultural Burning

Description of Activity

Agricultural burning is performed on the Reservation to clear irrigation ditches of vegetation and to clear pastures of weeds and vegetation prior to crop cultivation.

Data Collection

Emissions from agricultural burning on the Reservation were obtained from the 2014 NEI for La Plata County and Archuleta County. EPA reported two types of agricultural burning: Agricultural Burning Grasses, and Agricultural Burning Unspecified Crop Type. EPA did not report emissions for Agricultural Burning Unspecified Crop Type for Archuleta County. Emissions were not included in this emissions inventory for Montezuma County due to only 0.2% of the county falling within the Reservation boundaries.

Emission Calculation Methodology

Emissions obtained from the NEI for La Plata and Archuleta County were scaled down proportionally to the percentage of land in La Plata and Archuleta counties that fall within the exterior boundaries of the Reservation.

Assumptions

AQP assumes the methods and calculations used to develop emissions from agricultural burning are valid and acknowledges that the process used to reduce emissions for the Reservation could result in a slight under or overestimation of emissions. It is also assumed that emissions from agricultural burning from the 2014 NEI are realistic estimations that occurred in 2015.

Emissions

Criteria pollutants, NH3 and HAP emission estimates from agricultural burning that occurred within the exterior boundaries of the Reservation in 2015 are displayed below in Figure 77.

Figure 77 – 2015 Criteria Pollutant, NH_3, and HAP Emissions from Agricultural Burning on the Southern Ute Indian Reservation in Tons per Year

2015 Agricultural Burning Emissions for the Southern Ute Indian Reservation in Tons per Year[1]							
Pollutant	**PM_{10}**	**CO**	**NOx**	**NH_3**	**SO2**	**VOC**	**Total HAP**
TOTAL	**2.2**	**12.6**	**0.3**	**0.7**	**0.0**	**0.7**	**0.0**

[1]Emissions for agricultural burning were estimated from data retrieved from the 2014 EPA National Emission Inventory Database and are assumed to be realistic estimations of agricultural burning emissions that occurred in 2015.

VI. Mobile Sources

Description of Sources

Mobile source emissions are generated from on-road vehicles and non-road engines including lawn equipment, recreational vehicles, agricultural equipment, construction equipment, etc.

1. On-Road Mobile Sources

AQP estimated emissions from gasoline, diesel, compressed natural gas (CNG), and ethanol fueled on-road mobile sources, such as motorcycles, passenger cars, passenger trucks, light commercial trucks, transit buses, school buses, refuse trucks, single unit land and short-haul trucks, motorhomes, and combination short-haul trucks.

Data Collection

Hourly humidity and temperature data were obtained from the two SUIT Ambient Air Monitoring stations, Ute 1 and Ute 3. The humidity and temperature data were used to calculate hourly averages for each month of the year. The hourly average values for each month were then used as meteorology data inputs into the EPA MOVES2014a (MOVES) emission modeling software. [37]

Vehicle miles traveled (VMT) data (by vehicle type) were obtained from the 2014 NEI County Database (CDB). Data adjustments were made to the VMTs based on the percentage of road miles in La Plata and Archuleta County that fall within the exterior boundaries of the Reservation, as determined from GIS shapefiles obtained from the La Plata and Archuleta County GIS departments.[38,39] The data adjustment resulted in a reduction of the VMT data to 48.05% and 18.2% for La Plata and Archuleta counties, respectively. No significant roads on the Reservation are located in Montezuma County, and therefore AQP assumed VMT for Montezuma County to be negligible. The AQP determined that 1,427.4 miles of roads are within the Reservation boundaries. Fuel type data for on-road vehicles was obtained from the 2014 NEI National Database (NDB)

[37] U.S. EPA Moves 2014. (2016). Retrieved from https://www.epa.gov/catc/clean-air-technology-center-products#software

[38] La Plata County. (2016). *Roads.* GIS/Mapping. Retrieved from ftp://ftp.laplata.co.us/shapefiles/

[39] Archuleta County. (2016). *Roads - Archuleta County.* GIS. Retrieved from http://www.archuletacounty.org/504/Download-GIS-Data

and no adjustments to the data set were necessary, since fuel type usage was assumed to be the same across the Reservation.

Emission Calculation Methodology

Data values were input into the MOVES model to calculate mobile source emissions individually for both La Plata and Archuleta counties. The AQP later combined the two model output data sets to obtain Reservation emission totals. MOVES calculated emissions for running exhaust, engine start exhaust, brake wear and tire wear from mobile sources fueled by gasoline, diesel, CNG and ethanol. Data outputs were organized by source type, fuel type, and pollutant using the MySQL™ online open source database.[40]

Assumptions

AQP assumed data from the 2014 NEI to be the best available data for 2015 and the emissions estimations from MOVES to be correctly calculated and realistic.

Emissions

Criteria pollutant emissions from on-road mobile sources on the Reservation in 2015 are displayed below in Figure 78.

Figure 78 – 2015 Criteria Pollutant Emissions from On-Road Mobile Sources on the Southern Ute Indian Reservation in Tons per Year

2015 On-road Mobile Source Emissions on the Southern Ute Indian Reservation in Tons per Year				
Pollutant	**CO**	**NOx**	**VOC**	**PM_{10}**
Emissions	**250.5**	**55.7**	**19.1**	**8.0**

2. Non-Road Mobile Sources

Non-road mobile sources contribute a significant portion of the NOx and CO emissions from mobile sources. Non-road mobile sources on the Reservation include agricultural equipment, construction and mining equipment, lawn and garden equipment, and recreational equipment.

[40]Oracle. (2016). MySQLWorkbench Version 6.3.7. Retrieved from https://www.mysql.com/

Data Collection

Hourly humidity and temperature data were obtained from the two SUIT Ambient Air Monitoring stations, Ute 1 and Ute 3. The humidity and temperature data were used to calculate hourly averages for each month of the year. The hourly average values for each month were then used as data inputs into MOVES emission modeling software.

Fuel type data for non-road sources were obtained from the 2014 NEI NDB and used as the fuel data inputs in MOVES.

Assumptions

AQP assumed data from the 2014 NEI to be the best available data and the emissions estimations from MOVES to be correctly calculated and realistic.

Emission Calculation Methodology

AQP performed a single MOVES model run for non-road sources, which concurrently estimated emissions for both La Plata and Archuleta counties. The MySQL database was used to organize the model outputs by sector, source classification code and pollutant. Emissions were calculated on a county level and AQP reduced emissions totals for La Plata and Archuleta County to 38.9 % and 29.5% respectively, based on the portion of the counties that are within the exterior boundaries of the Reservation.

Emissions

Criteria pollutant emissions from non-road mobile sources on the Reservation in 2015 are displayed below in Figure 79.

Figure 79 – 2015 Criteria Pollutant Emissions from Non-Road Mobile Sources on the Southern Ute Indian Reservation in Tons per Year

2015 Mobile Non-Road Emissions on the Southern Ute Indian Reservation in Tons per Year				
Pollutant	**CO**	**NOx**	**VOC**	**PM_{10}**
Emissions	**1252.8**	**123.5**	**177.7**	**15.2**

VII. Biogenic

Biogenic processes of trees, vegetation, soil, and microbial activities generate VOC, NOx, CO, and HAP emissions. EPA estimates biogenic emissions for triennial inventory years, with the last estimation performed for calendar year 2014.

Assumptions

The AQP assumed the emission estimations prepared by EPA to be performed correctly and to be the best available emissions estimates for 2015.

Emission Calculation Methodology

Biogenic emissions estimated for La Plata and Archuleta County were prepared by EPA using the EPA's Biogenic Emission Inventory System and Biogenic Emissions Landuse Database.[41] AQP obtained the 2014 emission estimates for La Plata and Archuleta counties from the 2014 NEI. Emissions estimates for Montezuma County were not included in this emissions inventory due to only 0.2% of the county falling within the Reservation boundaries.

County wide emissions were reduced for La Plata and Archuleta County to 38.9% and 29.5% respectively, based on the area of each county that is located within the exterior boundaries of the Reservation.

Emissions

Criteria pollutant and HAP emissions from biogenic sources on the Reservation in 2015 are displayed below in Figure 80.

Figure 80 – 2015 Criteria Pollutant and HAP Emissions from Biogenic Sources on the Southern Ute Indian Reservation in Tons per Year[1]

2015 Biogenic Source Emissions on the Southern Ute Indian Reservation in Tons per Year				
Pollutant	**CO**	**NOx**	**VOC**	**HAP**
Emissions	**2,018.4**	**146.1**	**11,932.2**	**1,532.3**

[1]Emissions for biogenic sources were estimated from data retrieved from the 2014 EPA National Emission Inventory data and are assumed to be realistic estimations of biogenic source emissions for 2015.

VIII. Summary

1. Emissions Sources

Reservation emissions presented in this inventory are distributed between point, non-point, mobile and biogenic sources.

[41] U.S. Environmental Protection Agency. (2009). Biogenic Emission Inventory System. Retrieved from https://www.epa.gov/air-emissions-modeling/biogenic-emission-inventory-system-beis

A. Point Sources

There are four categories of point sources including:

1) Title V permitted oil and gas sources,
2) TMNSR permitted and registered minor oil and gas sources,
3) Municipal solid waste landfills, and
4) Airports.

B. Non-Point Sources

There are seven categories of non-point sources including:

1) Non-registered minor oil and natural gas sources,
2) Fruitland Formation Outcrop natural gas seeps
3) Gasoline stations,
4) Aviation gasoline dispensing,
5) Gravel pits,
6) Residential heating,
7) Fire events (wildland fires and prescribed burns), and
8) Agricultural burning.

C. Mobile Sources

Mobile sources are divided into two categories:

1) On-road, and
2) Non-road.

D. Biogenic Emissions

Biogenic emissions encompass all non-man made emission sources.

2. Emission Inventory Findings

Oil and natural gas production and mid-stream transmission is the predominant industry on the Reservation. Of all the quantified emission categories, this sector contributed the most significant quantities of NOx, CO, SO2 and PM_{10} to the airshed during 2015. Oxides of nitrogen emissions from oil and gas production and transmission accounted for 17,795.2 tpy, or 98% of the total NOx emissions quantified in the emission inventory, CO emissions at 15,264.1 tpy represent 80% of the total quantified CO emissions, SO_2 emissions are 81.3 tpy, or 94% of the total quantified SO_2 emissions, and PM_{10} emissions from this sector are 70% of the total reservation emissions at 321.2 tpy.

A summary of 2015 criteria pollutant, HAP, and GHG emissions by source category is displayed below in Figure 81.

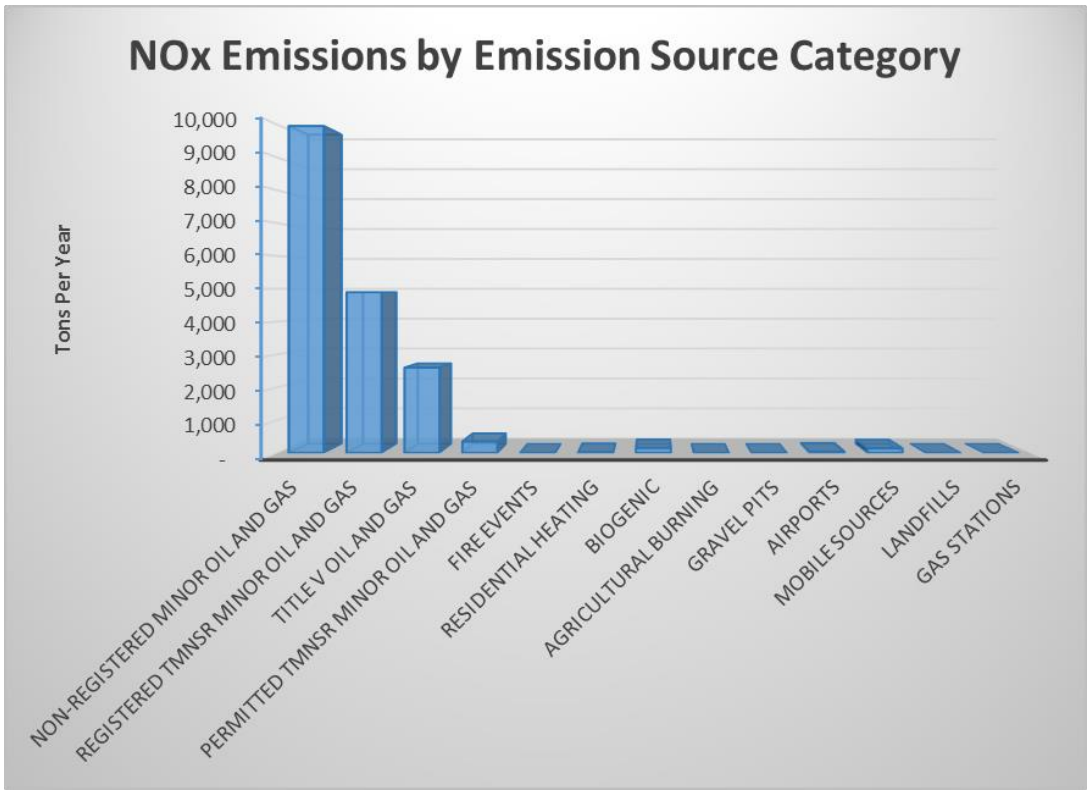
Figure 81 – 2015 Criteria Pollutants, HAP and GHG Emissions on the Southern Ute Indian Reservation in Tons per Year[1]

2015 Emissions on the Southern Ute Indian Reservation in Tons per Year							
Source Category	**NOx**	**VOC**	**SO2**	**PM_{10}**	**CO**	**Total HAP**	**GHG (CO_2e)**
Point Sources							
Title V Oil and Gas	2,598.2	1,155.0	52.3	68.8	2,817.3	283.1	2,012,320
Permitted TMNSR Minor Oil and Gas	342.7	173.0	5.1	9.1	187.5	16.2	120,490
Registered TMNSR Minor Oil and Gas	4,895.3	964.2	23.9	51.7	3,904.8	312.5	631,332
Municipal Solid Waste Landfills	--	5.3	--	2.0	--	2.8	61,993
Airports	34.9	17.5	4.3	12.2	198.4	5.1	--
Total Point Source Emissions	**7,871.1**	**2,3515.0**	**85.6**	**143.8**	**7,108.0**	**619.7**	**2,826,135**
Non- Point Sources							
Non-Registered Minor Oil and Gas	9,959.0	902.7	--	191.6	8,354.8	255.9	1,505,611
Fruitland Formation Outcrop Natural Gas Seeps	--	--	--	--	--	--	5,036,413
Gas Stations	--	17.9	--	--	--	--	--
Aviation Gasoline	--	13.6	--	--	--	0.7	--
Gravel Pits	--	--	--	50.6	--	--	--
Residential Heating	18.1	36.2	0.3	41.0	159.7	2.4	5,480
Fire Events	0.9	11.3	0.4	9.6	48.1	--	834
Agricultural Burning	0.3	0.7	0.1	3.8	12.6	0.0	--
Total Non-Point Source Emissions	**9,978.3**	**982.4**	**0.8**	**296.6**	**8,575.2**	**259.0**	**6,548,338**
Mobile Sources							
Mobile Sources	141.1	184.0	--	17.7	1,334.2	--	--
Biogenic							
Biogenic	146.1	11,932.2	--	--	2,018.4	1,532.3	--
Reservation-Wide Emissions Totals							
Total:	**18,136.4**	**15,413.6**	**86.4**	**454.2**	**19,035.9**	**2,411.0**	**9,357,473**

[1]Emissions not calculated for blank cells due to un-availability of data or negligible emissions

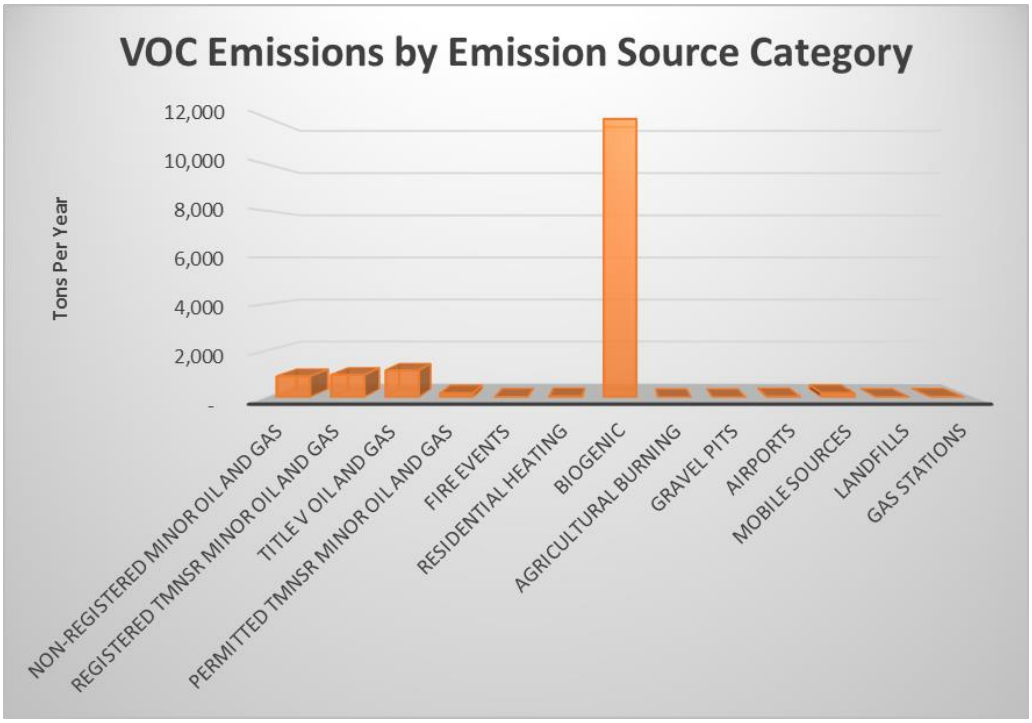
NOx emissions by source category on the Reservation in 2015 is displayed below in Figure 82.

Figure 82- 2015 NOx Emissions on the Southern Ute Indian Reservation by Source Category in Tons per Year



VOC emissions by source category on the Reservation in 2015 is displayed below in Figure 83.

Figure 83- 2015 VOC Emissions on the Southern Ute Indian Reservation by Source Category in Tons per Year



Biogenic sources are the most significant source of volatile organic compounds and HAPs emissions to the airshed. Volatile organic compound emissions from this category account for 77% of the total VOC emissions to the airshed at 11,932.2 tpy. Hazardous Air Pollutant emissions were 64% of emissions to the airshed at 1,532.3 tpy.

Due to the lack of accurate emission factors and reliable data, GHG emissions were not estimated for every category presented in this inventory. Several categories that were not evaluated or quantified, such as mobile sources and biogenic sources, would be expected to contribute significant emissions of GHG. However, of the total GHG quantified, oil and natural gas production and midstream transmission accounts for 46% of the total GHG at 4,269,753 tpy in CO2*e* and the natural gas seeps from the Fruitland Formation Outcrop account for 54% of the total GHG at 5,036,413 tpy in CO2*e*.

3. Oil and Gas Emissions Summary

The bulk of the emission sources within the point source category are larger emission sources such as natural gas compressor stations, central delivery points, treating plants, and processing plants. When you combine the Title V, synthetic minor and registered minor oil and gas source categories, this represents the bulk of non-biogenic VOC and HAP

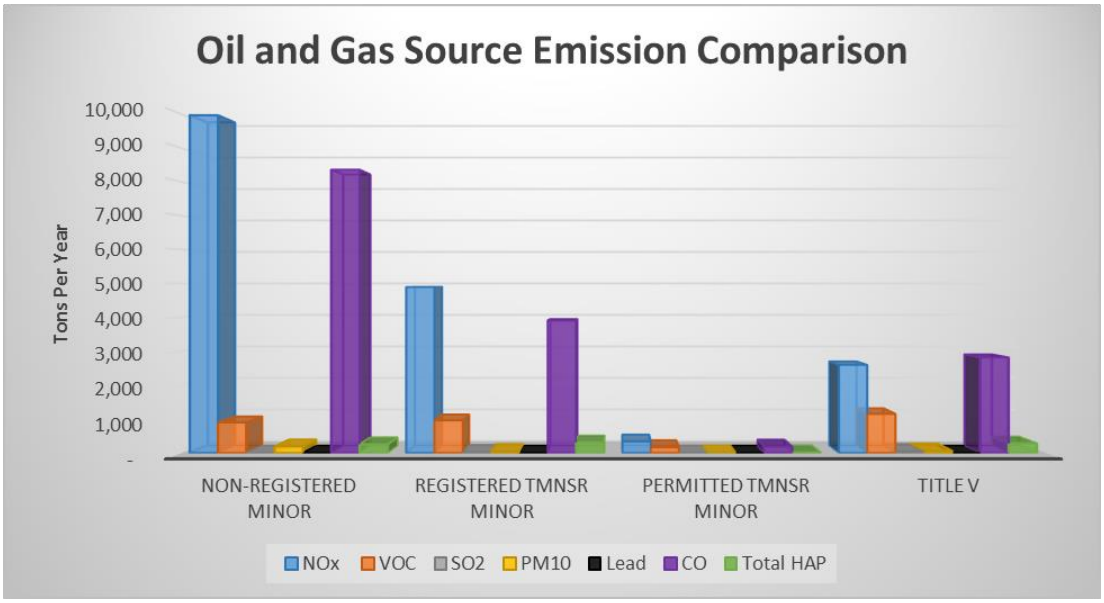
emissions. Volatile Organic Compound emissions from oil and gas point sources account for 66% of the total airshed, non-biogenic VOC emissions at 2,292.2 tpy and 69% of total non-biogenic emissions to the airshed at 611.8 tpy. These source categories also contribute 94 % of the total SO2 emissions to the airshed at 81.3 tpy.

Within the oil and gas sector, non-point source, non-registered sources such as production well sites, contribute the most NOx, CO, and PM_{10} emissions to the airshed in contrast to the larger point source Title V and TMNSR permitted and registered minor oil and gas sources. This is due to the large total number of non-registered oil and gas sources, 2,588 sites, operating within the Reservation. This category alone accounts for 55% of the total airshed, NOx emissions at 9,959.0 tpy and 44% of the total CO emissions at 8,354.8 tpy. Particulate matter less than 10 microns emissions were 191.6 tpy, or about 42% of the total airshed emissions. Emissions totals from oil and gas sector sources are displayed below in Figure 84 and Figure 85.

Figure 84 – 2015 Table of Emissions from Oil and Gas Sector Sources on the Southern Ute Indian Reservation in Tons per year

2015 – Oil and Gas Sector Emissions by Category in Tons Per Year							
Category	**NOx**	**VOC**	**SO2**	**PM10**	**CO**	**HAP**	**CO2e**
Title V	2,598.2	1,155.0	52.3	68.8	2,817.3	283.1	2,012,320
Permitted TMNSR Minor	342.7	173.0	5.1	9.1	187.5	16.2	120,489
Registered TMNSR Minor	4,895.3	964.2	23.9	51.7	3,904.8	312.5	631,332
Non-Registered Minor	9,959.0	902.7	-	191.6	8,354.8	255.9	1,505,611
Total	**17,795.2**	**3,194.9**	**81.3**	**321.2**	**15,264.4**	**867.7**	**4,269,752**

Figure 85 – 2015 Chart of Emissions from Oil and Gas Sector Sources on the Southern Ute Indian Reservation in Tons per year



Non-registered minor sources contributed the most significant emissions of NOx and CO within the oil and gas sector at 9,959.0 tpy of NOx and 8,354.8 tpy of CO. Title V sources contributed the most significant emissions of VOC in the oil and gas sector, at 1,155.0 tpy. Registered minor oil and gas sources contributed the most significant emissions of HAP at 312.5 tpy. Comparisons of NOx, CO, VOC, HAP and GHG emissions at oil and gas sector sources are displayed below in Figure 86 and Figure 87, Figure 88, Figure 89, and Figure 90, respectively.

Figure 86– 2015 Chart of NOx Emissions from Oil and Gas Sector Sources on the Southern Ute Indian Reservation in Tons per year

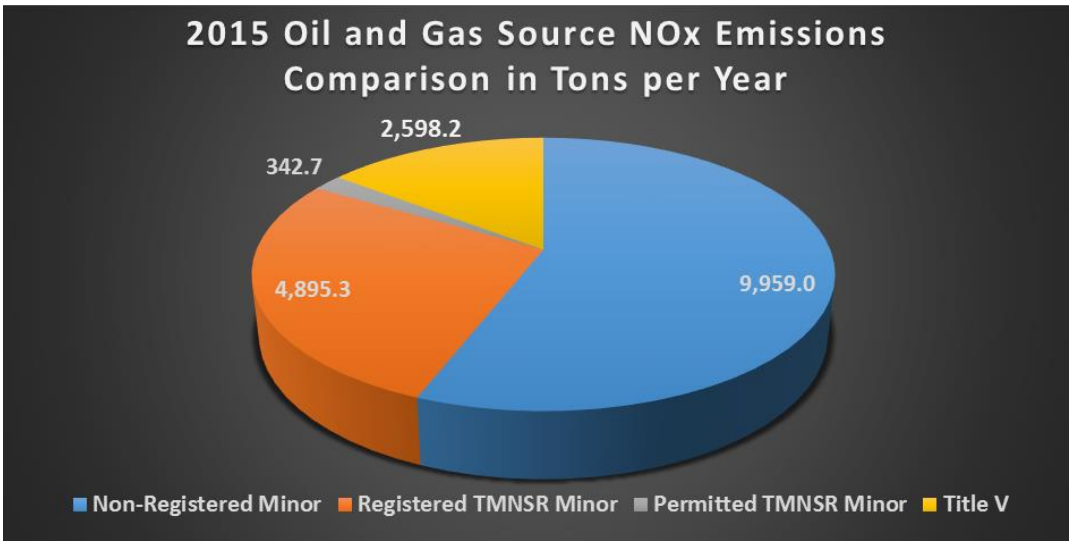


Figure 87– 2015 Chart of CO Emissions from Oil and Gas Sector Sources on the Southern Ute Indian Reservation in Tons per year

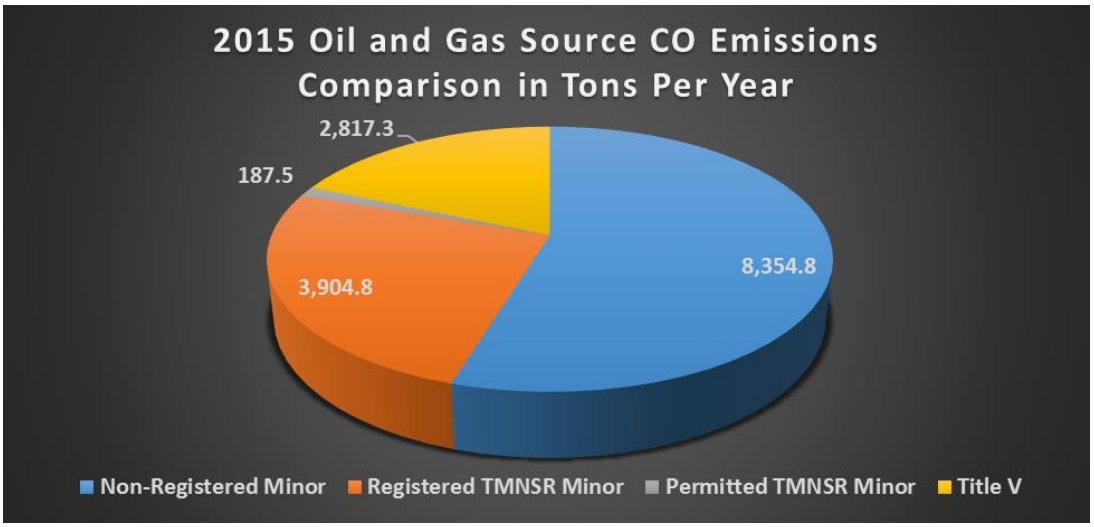


Figure 88– 2015 Chart of VOC Emissions from Oil and Gas Sector Sources on the Southern Ute Indian Reservation in Tons per year

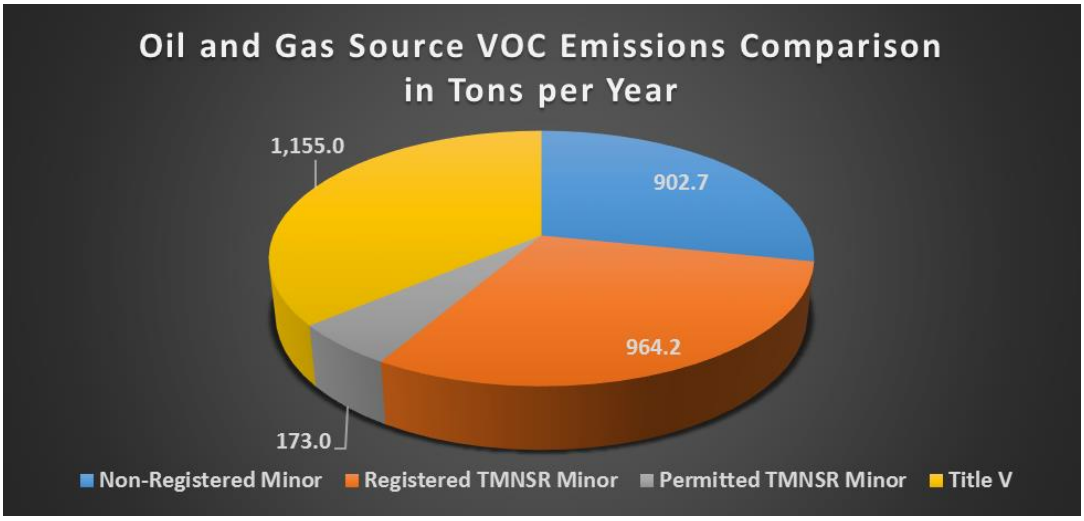


Figure 89– 2015 Chart of HAP Emissions from Oil and Gas Sector Sources on the Southern Ute Indian Reservation in Tons per year

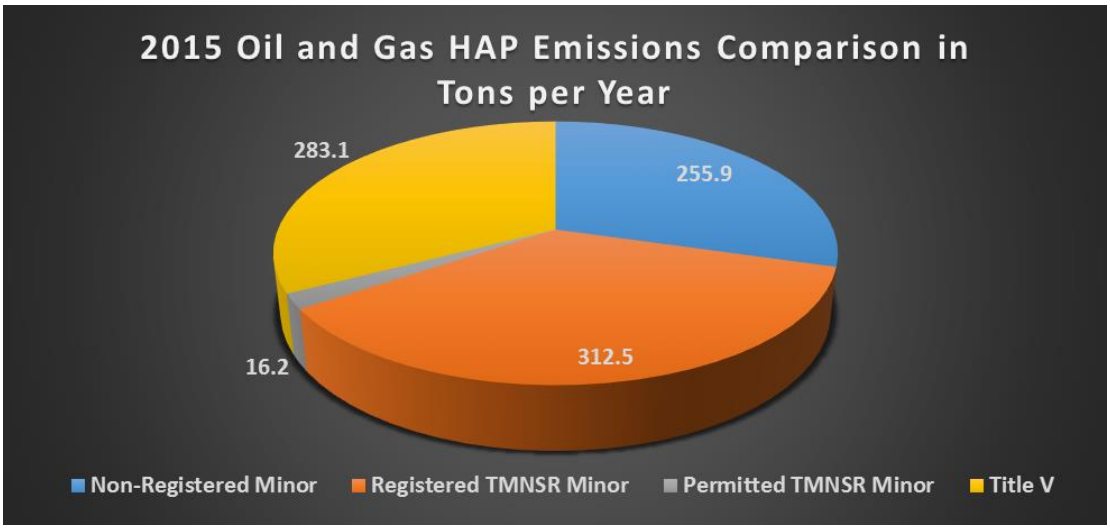
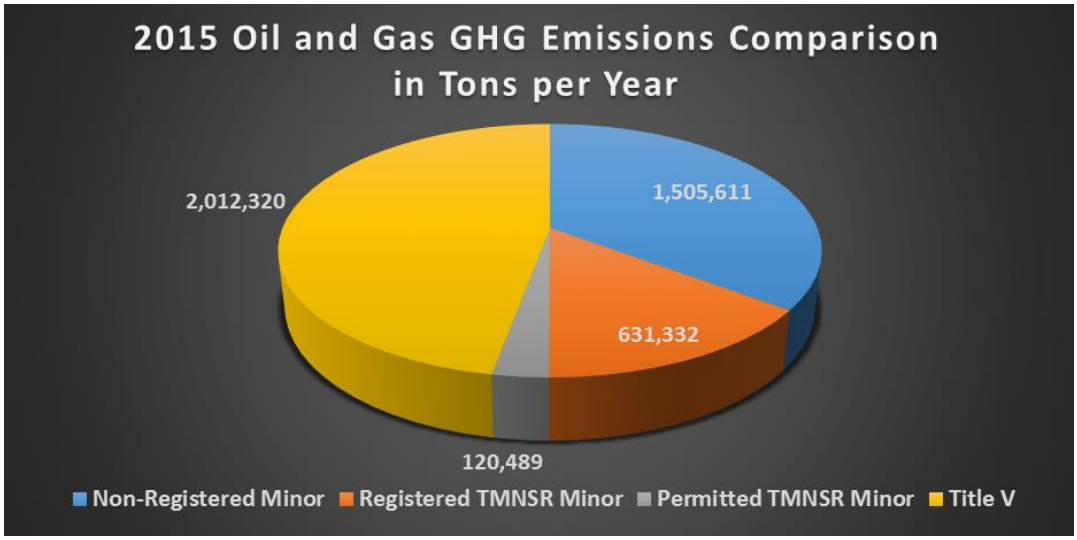


Figure 90– 2015 Chart of GHG Emissions from Oil and Gas Sector Sources on the Southern Ute Indian Reservation in Tons per year



Within the non-registered oil and gas sources, the emission unit type that contributed the most NOx emissions was natural gas-fired reciprocating internal combustion engines. Two stroke lean burn RICE between 301-400 hp and 4SRB engines between 0-50 hp were the largest emitting subcategories. The largest contributor of CO emissions from non-registered oil and gas sources were 4SRB engines between 0-50 hp and 4SRB engines between 51-100 hp. Please reference Figure 91, below for additional information on specific criteria, VOC, HAP and GHG emissions from non-registered oil and gas RICE.

Figure 91 - 2015 Natural Gas-Fired Reciprocating Internal Combustion Engine Counts and Emissions in Tons per Year on the Southern Ute Indian Reservation[1]

2015 Natural Gas-Fired RICE Counts and Emissions in Tons per Year on the Southern Ute Indian Reservation[1]								
Engine Configuration and Horsepower (hp)	**Number of Engines Reported in 2016 ICR**	**NOx**	**CO**	**SO2**	**PM_{10}**	**VOC**	**Total HAP**	**GHG ($CO2e$)**
2SLB 0-50 hp	52	206.5	25.1	0.0	5.0	7.8	5.2	7,626.4
2SLB 101-200 hp	37	760.0	92.5	0.0	18.4	28.8	19.0	28,073.0
2SLB 201-300 hp	9	281.2	34.2	0.0	6.8	10.6	7.0	10,386.0
2SLB 301-400 hp	59	2,443.4	297.5	0.0	59.2	92.5	61.0	90,258.2
2SLB 501-600 hp	16	999.7	121.7	0.0	24.2	37.8	25.0	36,928.0
4SLB 0-50 hp	24	152.9	11.9	0.0	0.0	4.4	2.7	4,388.6
4SLB 101-200 hp	4	107.2	8.3	0.0	0.0	3.1	1.9	3,077.3
4SLB 401-500 hp	2	134.0	10.4	0.0	0.0	3.9	2.4	3,846.7
4SRB 0-50 hp	600	2,160.7	3,637.0	0.0	18.6	28.9	31.6	114,484.5
4SRB 51-100 hp	217	1564.5	2,633.5	0.0	13.4	20.9	22.9	82,895.9
4SRB 101-200 hp	30	396.1	666.7	0.0	3.4	5.3	5.8	20,987.4
4SRB 201-300 hp	7	152.5	256.6	0.0	1.3	2.1	2.2	8,078.0
4SRB 301-400 hp	1	29.0	48.9	0.0	0.3	0.4	0.4	1,538.7
4SRB 401-500 hp	1	36.3	61.1	0.0	0.3	0.5	0.5	1,923.3
Compression Ignition	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1,059**	**9,424**	**7,905.4**	**0.0**	**150.9**	**247.0**	**187.6**	**414,492**

[1]Engine emissions are only displayed for horsepower and engine configurations reported in the 2016 ICR.

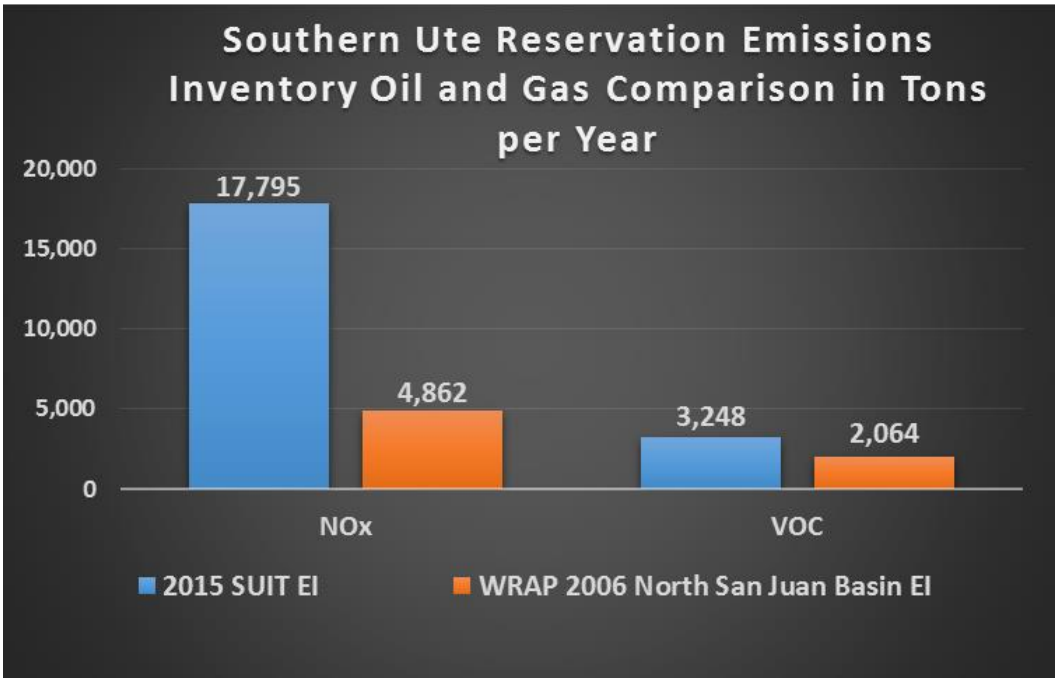
4. Comparison of Oil and Gas Emission Estimates in 2015 Southern Ute Indian Reservation Emissions Inventory and 2006 Western Regional Air Partnership Emissions Inventory

To evaluate the representativeness of oil and gas emission estimations from this 2015 SUIT emissions inventory, the AQP has compared the results with oil and gas emission estimates for the Reservation from the Western Regional Air Partnership (WRAP) emissions inventory titled *Development of Baseline 2006 and 2012 Midterm 2012 Emissions from Oil and Gas Activity in the North San Juan Basin.*[42] The AQP considers this WRAP emissions inventory as the most accurate and representative emission inventory previously prepared for the Reservation to date.

[42] Bar-Ilan A., J. G. (2009, September 1). Development of Baseline 2006 and Midterm 2012 Emisions from Oil and Gas Activity in the North San Juan Basin. Prepared by Environ for Western Regional Air Partnership. Retrieved from https://www.wrapair.org//forums/ogwg/documents/NSanJuanBasin/2009-09_06_Baseline_and_12_Midterm_Emissions_N_San_Juan_Basin

The WRAP EI was largely based on information sourced from the August 2009 environmental assessment titled *Programmatic Environmental Assessment for 80 Acre Infill Oil and Gas Development for the Southern Ute Indian Reservation*, referred to hereafter as the 2009 PEA.[43] The 2009 PEA was developed by the Tribe in 2007 for CY2005 and was compiled in part by using results from a voluntary survey sent to twelve oil and gas operators. The survey requested the operators provide source locations, equipment types, site rating capacities, emission factors, air pollution controls, potential NOx and VOC emissions and actual NOx and VOC emissions. A comparison of actual NOx and VOC emissions on the Reservation from this 2015 SUIT emissions inventory and the 2006 WRAP emissions inventory is displayed below in Figure 92.

Figure 92– Comparison of NOx and VOC Emission Estimations for the Southern Ute Indian Reservation from the 2015 SUIT EI and the 2006 WRAP EI in Tons per year



In comparison, estimated NOx emissions under the 2006 WRAP EI are 4,862 tpy, which is considerably less than the 17,795 tpy of NOx emission estimated in this 2015 SUIT EI. The AQP attributes the difference in NOx emission estimates as being due to the 2006 WRAP EI having a less complete data set for engines and external combustion sources at minor and non-registered oil and gas sources. For example the data set for the 2006 WRAP EI (data from the 2009 PEA) only included emission estimations for 321 engines across the entire oil and gas sector, whereas this 2015 SUIT EI included NOx emissions for 1,632 engines, based on actual equipment counts from Title V permits, minor sources, and non-registered sources.

[43] Southern Ute Indian Tribe. (2009, August). *Programmatic Environmental Assesment for 80 Acre Infill Oil and Gas Development on the Southern Ute Indian Reservation*

NOx emissions from this 2015 SUIT EI may also be higher since the AQP assumed there were no emission controls on engines at non-registered oil and gas sources. The rationale for this assumption was that a majority of these engines are below the 500 hp threshold in which it is typically considered economical to install control equipment, and many of these engines are located at older well-site locations and are therefore less likely to be newer model NSPS JJJJ compliant engines.

The 2006 WRAP EI data set may also have under estimated NOx emissions due to the assumption that all 4SRB engines greater than 500 hp located within the Reservation were equipped with non-selective catalytic reduction. Conversely, the AQP found in preparation of this inventory that very few of these engines utilized any control technology. Higher NOx estimates in this 2015 SUIT EI may also be attributable to the universal assumption by AQP that all heater and external combustion sources at non-registered minor sources were equipped with burners having a 3 MMBtu/hr firing rate capacity, when in fact many of these burners may have substantially lower firing rates.

The VOC emission estimates from the 2006 WRAP EI are 2,064 tpy, which is lower than the 3,248 tpy VOC emission estimates from this 2015 SUIT EI. AQP attributes the lower VOC emissions in the 2006 WRAP EI as being due to a less complete data set for minor and non-registered oil and gas sources than the data set used in this 2015 SUIT EI. The 2006 WRAP EI also did not quantify emissions for several emission categories included in this 2015 SUIT EI, such as emissions from produced water tanks, truck loading, well completion and recompletion venting, and amine units.

HAP and GHG emissions were not calculated in the 2006 WRAP EI, therefore no comparisons can be made with the 2015 SUIT EI.

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X. Appendix – Quality Assurance Review

Description of Quality Assurance Review

To meet the EPA emissions inventory level II data quality objective of conducting a third party quality assurance (QA) review, the AQP contracted with ES Engineering Services. The QA review included the review of the data collection methodology, data, assumptions, emission factors, calculation methodologies, and emission totals. An abridged version of the final QA report is attached as an Appendix. A full version of the QA report, which contains all of the QA review forms can be requested from the AQP.

QUALITY ASSURANCE REVIEW

SOUTHERN UTE INDIAN TRIBE
2015 EMISSION INVENTORY

PREPARED FOR:

Southern Ute Indian Tribe
Environmental Programs Division
Air Quality Program
P.O. Box 737, MS #4
Ignacio, Colorado 81137

PREPARED BY:

ES ENGINEERING
SERVICES

1036 W. Taft Avenue
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December 2016

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SECTION 1.0

INTRODUCTION

1.1 Project Summary

Southern Ute Indian Tribe (SUIT) Air Quality Program (AQP) is developing the 2015 emission inventory (EI) to obtain baseline emission data for all quantifiable air emission sources located within exterior boundaries of the SUIT. The baseline emission will be used to support air quality plans and regulations targeted at ozone precursors for maintaining attainment with National Ambient Air Quality Standards, emission modeling, and Title V permitting fee analysis.

The EI includes criteria pollutants, such as oxides of nitrogen (NO_X), carbon monoxide (CO), particulate matter ten micrometers in diameter or smaller (PM10), volatile organic compounds (VOC), hazardous air pollutants (HAP), and greenhouse gases (GHGs). The inventory includes emissions from point, non-point, mobile, and biogenic emission sources.

SUIT AQP has requested ES Engineering Services, LLC (ES) to perform a quality assurance (QA) review of the EI. The QA review includes emission calculation method verification, emission factors validation, and the assessment of the supporting text.

1.2 Technical Project Contacts

For the purpose of this QA review, the ES contact are as follow:

A. Edward Krisnadi
Project Manager

ES Engineering Services, LLC
Air Quality
Regulatory Compliance Services
1036 W. Taft Avenue
Orange, CA 92865

Phone: (714) 919-6557
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Karl Lany
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1036 W. Taft Avenue
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SECTION 2.0

QUALITY ASSURANCE PLAN

In accordance with the guidance described in EPA Emission Inventory Improvement Program (EIIP) Volume VI Chapter 2: Planning and Documentation dated January 1997, a Quality Assurance Plan (QAP) was prepared to provide written instructions for the technical and quality aspects associated with the development of the 2015 SUIT EI. The main purpose of QAP is to ensure the developed EI is complete, accurate, comparable, and representative of the emissions occur on the SUIT Reservation during the calendar year of 2015. The quality review was conducted in accordance with the QAP. The complete QAP is included in Appendix A.

SECTION 3.0

SUMMARY OF FINDINGS

The 2015 SUIT EI includes criteria air pollutant, HAP, and GHGs emissions from the following sources:

- 37 oil and gas sources permitted under Title V program
- 5 oil and gas sources permitted as synthetic minor permitted facilities
- 241 registered tribal minor new source review (TMNSR) oil and gas facilities
- 2 municipal solid waste landfills
- 3 airports and the usage of aviation gasoline
- 2,569 non registered TMNSR oil and gas facilities
- 5 gasoline service stations
- 10 sand and gravel pits
- Residential heating from wood burning, propane, and natural gas combustions
- Wildfires and prescribed burns
- Agricultural burning
- Mobile sources
- Biogenic sources

Each emission source type was reviewed in accordance with the QAP. Table 3-1 summarizes the type of review activities, the findings, and recommended corrective mechanisms. The detail of these findings are included in QA/QC forms provided in Appendix B of this report.

TABLE 3-1
SUMMARY OF FINDINGS

Type of Emission Sources	Type of Review Activities	Findings & Recommended Corrective Mechanisms
Title V Oil and Gas Facilities	Data Entry	The accuracy of data transferred from the submitted annual emission reports to the emission summary spreadsheet was reviewed. Several incorrect data entries were found and revisions on these mistakes were recommended. SUIT AQP will make the revisions accordingly.
Synthetic Minor Oil and Gas Facilities	Data Entry	The accuracy of data transferred from the submitted annual emission reports to the emission summary spreadsheet was reviewed. Several incorrect data entries were found and revisions on these mistakes were recommended. SUIT AQP will make the revisions accordingly.

Type of Emission Sources	Type of Review Activities	Findings & Recommended Corrective Mechanisms
Registered TMNSR Oil and Gas Facilities	Data Entry	The accuracy of data transferred from the information collection request (ICR) provided by the facility owners or operators to the emission summary spreadsheet was reviewed. Data entry from a random sample of 76 of the 241 registered oil and gas facilities were reviewed and no incorrect data entry was found.
Landfill	Data Entry, Data Input and Output Associated with Emission Software	Total HAP emissions, rather than individual HAP, were reported in the emission summary spreadsheet. Since individual HAP emission is available in the annual Title V fee report, SUIT AQP will add each HAP emission to the summary table for the landfill. GHG emissions were not included in the working spreadsheet. SUIT AQP will further review if GHG emissions from the landfill is required for 2015 EI and incorporate if required.
Airport and the usage of aviation gasoline	Data Entry	The accuracy of data transferred from the EPA National Emission Inventory Database (NEI) to the emission summary spreadsheet was reviewed. No incorrect data entry was found. GHG emissions were not included in the working spreadsheet. SUIT AQP will further review if GHG emissions from the usage of aviation gasoline is required for 2015 EI and incorporate if required.

Type of Emission Sources	Type of Review Activities	Findings & Recommended Corrective Mechanisms
Non Registered TMNSR Oil and Gas Facilities	Data Entry, Calculation Methods, Emission Factors, Data Input and Output Associated with Emission Software	GHG emissions from combustion equipment type, such as engines, heaters, etc., were incorrectly calculated by using lower heating value, rather than the higher heating value, of natural gas. Since the emission factors are provided in kilograms per MMBtu, the GHG emissions shall be calculated using the heat input of the equipment (MMBtu/hour). Criteria air pollutant and HAP emissions from heaters and boilers were incorrectly calculated by using lower heating value of field natural gas in converting the AP-42 emission factors from lb/MMscf into lb/MMbtu. As noted in AP-42 emission factor table, 1,020 Btu/scf shall be used in converting these emission factors. SO_2 emissions from heaters and boilers were incorrectly calculated based on the AP-42 emission factors. SO_2 emissions are not expected, based upon gas analyses demonstrating that the field natural gas does not contain any sulfur content. GHG emissions were not calculated from Tri-ethylene glycol dehydration equipment. SUIT AQP will further review if GHG emissions from dehydration equipment is required for 2015 EI. HAP emissions were not included in the pneumatic equipment emission calculation. Since natural gas contains HAP, such as n-hexane, HAP emissions will be included in the calculation. There are other minor errors found during ES review; however, these findings are either site-specific or result in negligible impacts to the overall emissions, such as incorrect or incomplete text on the data source, incorrect text on the column header, etc.
Gas Stations	Data Entry, Calculation Methods, Emission Factors	An incorrect cell formula was found in the working spreadsheet. As a result, the VOC emissions were slightly under estimated. Incorrect reference text in regards to the operation was also found. SUIT AQP will make these corrections.

Type of Emission Sources	Type of Review Activities	Findings & Recommended Corrective Mechanisms
Sand and Gravel Pits	Data Entry	The accuracy of data transferred from EPA National Emission Inventory database (NEI) to the emission summary spreadsheet was reviewed. No mistakes were found in this review.
Residential Heating	Data Entry, Calculation Methods, Emission Factors, Data Input and Output Associated with Emission Software	The accuracy of data transferred from the Tribal Emissions Inventory Software Solutions (TEISS) to the emission summary spreadsheet, the used of AP-42 emission factors, and the calculation methodology were reviewed. No mistakes were found in this review. GHG emissions were not included in the working spreadsheet. SUIT AQP will further review if GHG emissions from residential heating is required for 2015 EI.
Wildfires and Prescribed Burns	Data Entry, Data Input and Output Associated with Emission Software	The accuracy of data transferred from the data output of BlueSky emission software to the emission summary spreadsheet was reviewed. Incorrect data entry of VOC and GHG emissions was found in this review. SUIT AQP will revise the values on these emissions.
Agricultural Burning	Data Entry	The accuracy of data transferred from EPA National Emission Inventory database (NEI) to the emission summary spreadsheet was reviewed. No mistakes were found in this review.
Mobile Source	Data Entry, Data Input and Output Associated with Emission Software	The accuracy of data transferred from the data output of EPA Moves2014a emission software to the emission summary spreadsheet was reviewed. No mistakes were found in this review. GHG emissions were not included in the working spreadsheet. SUIT AQP will further review if GHG emissions from residential heating is required for 2015 EI

Type of Emission Sources	Type of Review Activities	Findings & Recommended Corrective Mechanisms
Biogenic Source	Data Entry	The accuracy of data transferred from EPA National Emission Inventory database (NEI) to the emission summary spreadsheet was reviewed. No mistakes were found in this review. GHG emissions were not included in the working spreadsheet. SUIT AQP will further review if GHG emissions from residential heating is required for 2015 EI

All the corrective actions recommended by ES to revise the findings are being accepted and implemented by SUIT AQP. Findings, which do not impact the overall emissions, will be revised in the template worksheet. The letter of project completion included in the Appendix C contains a more detailed discussion on this matter.

APPENDIX A

QUALITY ASSURANCE PLAN

QUALITY ASSURANCE PLAN

SOUTHERN UTE INDIAN TRIBE
2015 EMISSION INVENTORY

PREPARED FOR:

Southern Ute Indian Tribe
Environmental Programs Division
Air Quality Program
P.O. Box 737, MS #4
Ignacio, Colorado 81137

PREPARED BY:

1036 W. Taft Avenue
Orange, California 92865

December 2016

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SECTION 1.0

INTRODUCTION

1.1 Emission Inventory Purpose

The 2015 emission inventory (EI) for the Southern Ute Indian Tribe (SUIT) Reservation is being developed to obtain baseline emissions data for the 2015 calendar year for all quantifiable air emission sources located within exterior boundaries of the SUIT. Using this baseline emission data, SUIT will develop air quality plans and air quality regulations targeted at ozone precursors for maintaining attainment with the Ozone National Ambient Air Quality Standards, emission modeling, and Title V permitting fee analysis.

The EI addresses air pollutants, such as oxides of nitrogen (NO_X), carbon monoxide (CO), particulate matter ten micrometers in diameter or smaller (PM10), volatile organic compounds (VOC), hazardous air pollutants (HAP), and greenhouse gases (GHGs), from point, non-point, mobile, and biogenic emission sources.

The SUIT Reservation is located in southwestern Colorado, covers 1,066 square miles in three counties (La Plata, Archuleta, and Montezuma), and borders New Mexico to the south. The total area covered by the EI is approximately 682,590 acres, which encompasses all land within the external boundaries of the SUIT Reservation. The primary land use is agricultural, and the predominant industry is oil and gas production. As of January 2015, oil and gas production facilities include thirty-seven (37) Title V sources, five (5) permitted Tribal Minor New Source Review (TMNSR) sources, 241 registered TMNSR, and 2,569 non-registered sources.

1.2 Data Quality Objectives and Indicators

Because the EI will provide supportive data for strategic decision making, it is considered a Level II inventory, based on guidance provided by the USEPA Emission Inventory Improvement Program (EIIP) dated January 1997. The end use of this inventory will drive the minimum QA and work plan requirements.

Table 1-1 shows the established data quality objectives (DQOs) to ensure the accuracy, completeness, representativeness, and comparability of the inventory, in keeping with the EIIP's guidance for Level II inventories.

Table 1-2 presents the data quality indicators (DQIs) that will be used to measure the progress of each DQO.

Table 1-1
Data Quality Objectives (DQOs)

DQO	Procedure for Achieving Objective
Accuracy	For the purpose of this inventory, emissions from certain sources, such as Title V facilities, TMSNR facilities, etc., were obtained and transmitted directly from existing inventory reports that were provided by facility operators. Therefore, only the accuracy of data entry will be reviewed by a third party contractor, ES Engineering Services, LLC (ES). For all other emission sources, such as non-point sources, mobile sources, etc., a comprehensive review, which includes emission factors, engineering assumptions, and other parameters, will be conducted by ES to ensure accuracy. A QA/QC report will be developed by ES to record the findings and the corrective actions taken. The report will also include this Quality Assurance Plan (QAP) and will be available to be included in the overall inventory report.
Completeness	For Title V and permitted TMNSR oil and gas facilities, and landfills, the collection data was based on the required 2015 annual emission fee report. SUIT AQP issued Clean Air Act (CAA) Section 114 information collection requests (ICR) in June 2016 to collect data from registered TMNSR oil and gas facilities and non-registered oil and gas sources. Various reputable sources, such as EPA, the Colorado Oil and Gas Conservation Commission (COGCC), and professional organizations were used to collect data from mobile sources, biogenic sources, and non-point sources other than oil and gas facilities.
Representativeness	The data will be reviewed and compared to emission inventories from comparable regions to determine the reasonableness of the emissions estimates and representativeness of the data.
Comparability	To ensure the data are comparable, standard procedures will be followed, and results will be presented in the same units that were used in the 2006 and 2014 Western Regional Air Partnership (WRAP) Greater San Juan Basin (GSJB) oil and gas emission inventories. Emission factors and assumptions will be compared with methodologies used in similar emission calculation applications.

Table 1-2
Data Quality Indicators (DQIs)

DQO	Inventory DQI Target Values
Accuracy	• Sources of all data used, including emission factors, assumptions, and calculation methodologies will be thoroughly documented to allow an outside reviewer to replicate all calculations. • Emission calculation models, such as GRI-GLY Calc 4.0, Tanks 4.09d, etc., were utilized to calculate emissions whenever it was applicable.
Completeness	• Capture 100% of point source emissions reported in annual emission fee report for 2015 calendar year. • Capture 95% of non-point oil and gas source emissions data, which was collected through CAA Section 114 ICR issued by SUIT AQP in June 2016. • Capture 80% of non-point sources other than oil and gas, mobile sources, and biogenic sources. Data for these sources were collected from various reputable sources, such as facility surveys, US census, and etc.
Representativeness	• 100% of emission estimates will be within an order of magnitude of the value of estimates from emission inventories from comparable regions. If this DQI can't be met, an explanation will be provided.
Comparability	• Results to be compared with 2006 and 2014 WRAP GSJB oil and gas emission inventories • Emission factors and assumptions will be compared with methodologies used in similar emission calculation applications.

1.3 Summary of Quality Assurance Plan Organization

The remaining of this QAP is organized as follows:

Section 2.0	Contains the programs summary that describes the major components of the inventory development and QA/QC program
Section 3.0	Presents the purpose and policy statement
Section 4.0	Contains the emission inventory preparation plan, which includes details the organizational structure, roles, and training of inventory development, and QA/QC team members
Section 5.0	Discusses QA/QC procedures that will be implemented throughout this project
Section 6.0	Describes the corrective action mechanism that will be implemented as needed
Section 7.0 through 10.0	Discuss the methods used to prepare the point, non-point, mobile, and biogenic source inventories, as well as planned QA/QC activities for each source category.
Section 11.0	Presents the data reporting procedures that will be followed
Section 12.0	Presents reference citations for all data sources discussed in this QAP

SECTION 2.0

PROGRAM SUMMARY

This QAP provides written instructions for the technical and quality aspects associated with development of the 2015 SUIT Reservation EI. It is designed so that QA/QC procedures are implemented throughout the entire inventory development process. This will ensure that the inventory is complete, accurate, comparable, and representative of the SUIT Reservation.

2.1 Program Components

Inventory tasks and QC procedures will include data checking by the SUIT AQP staff and ES throughout the development of the inventory and the final EI report. These procedures include, but are not limited to, the following:

- The development and implementation of written procedures for data gathering, data assessment, data handling, calculation of emissions, and reporting;
- Adequate management and supervision of work;
- Review of all calculations for technical soundness and accuracy, including verification that the appropriate emission factors were used and impact of controls were correctly addressed;
- Documentation of data in a manner that will allow reconstruction of all inventory development activities; and
- Maintenance of an orderly master file of all the data gathered and a copy-ready version of the final inventory submitted to the USEPA National Emission Inventory database.

QA activities are distinguished from QC activities in that they provide a more objective assessment of data quality because QA personnel are not directly involved in the development of the inventory. QA activities are usually more comprehensive because they include assessments of the effectiveness and appropriateness of the systems established by management to control data quality

For this inventory, the review on the data collection will be conducted by SUIT AQP staff. The QA review of data entry to the final EI spreadsheet, emission totals, assumptions, emission factors, and calculation methodologies will be conducted by ES.

ES will develop a QA/QC report which includes all the review activities and corrective actions taken to finalize the 2015 SUIT Reservation EI.

2.2 Inventory Constraints

Several constraints may impact the inventory development process. The intent of this inventory is to develop emissions estimates for various emission sources on the reservation that are accurate and representative of reservation emissions. To fulfill that intention, data specific to the reservation will be collected for as many sources as possible.

It is expected that for some sources, measured data will not be available due to unreturned or insufficient information collection request responses. There may also be time and funding limitations on how much measured data can be collected.

The effects of these constrains will be minimized by:

- Prioritization of categories so that resources will be allocated preferentially to critical data and sources;
- In measured data are not available, data from reputable sources, such as federal, state, and local government agencies and professional organizations, will be used; and
- Any engineering assumptions made to develop this EI will be validated by a third party contractor, which is ES.

SECTION 3.0

PURPOSE AND POLICY STATEMENT FOR THE 2015 SOUTHERN UTE INDIAN TRIBE FOR CRITERIA POLLUTANTS, HAP, AND GREENHOUSE GASES EMISSIONS INVENTORY

The point, non-point, mobile, and biogenic EI is being developed to provide general assessment of air pollutant sources within the exterior boundaries of the SUIT Reservation. The EI will be used to determine baseline emissions data that will help the SUIT AQP to develop future air quality planning, such as development of air quality regulations, emissions modeling, and Title V permitting fee analysis.

In order to provide data of sufficient quality, SUIT AQP with ES assistance has developed this QAP. It includes all of the critical elements recommended in the EPA EIIP guidance documents (EIIP, 1997).

Implementation of the QA and QC procedures described in this QAP is fully supported by the SUIT AQP Manager, the AQP Technical Manager, the AQP Scientist, and the AQP Air Quality Analyst who were involved in the development of this 2015 EI. This support is evidenced by their commitment to implement the procedures as described in this QAP and to generate data of known quality.

QC procedures described in this document were developed by ES with the approval of SUIT AQP staff. These procedures were developed to provide a comprehensive program that includes QC measures that are implemented by ES.

It is the responsibility of ES to report any deviations on the inventory immediately to the SUIT AQP technical manager and program manager. The impact of deviations on the inventory will be evaluated and the appropriate corrective actions will be taken to ensure that the technical and DQOs are met.

Mark Hutson, Air Quality Program Manager, SUIT AQP — Date: 12/1/2016

Danny Powers, Air Quality Technical Manager, SUIT AQP — Date: 12/1/2016

Karl Lany, Vice President, ES Engineering Services, LLC — Date: 12/1/2016

A. Edward Krisnadi, Project Manager, ES Engineering Services, LLC — Date: 12/1/2016

SECTION 4.0

EMISSION INVENTORY PREPARATION PLAN

All the inventory development activities will be managed by SUIT AQP staff. The oil and gas facilities, which consist of Title V, permitted TMNSR, registered TMSNR, and non-registered TMSNR, will be prepared by the SUIT AQP Air Quality Scientist, Oakley Hayes. The non-oil and gas facilities, which consist of non-point, mobile, and biogenic sources, will be prepared by SUIT AQP Air Quality Analyst, Matt Wampler. The comprehensive EI report will be prepared by SUIT AQP Air Quality Technical Manager, Danny Powers. The overall management of this EI development will be supervised by SUIT AQP Manager, Mark Hutson.

Once the calculation of the EI is complete, ES, a third party contractor will conduct the QA/QC activities on the workbooks. ES will also review the text of the final EI report developed by SUIT AQP staff.

SECTION 5.0

GENERAL QA/QC PROCEDURE

QA/QC procedures described in this QAP were developed to help ensure data accuracy, completeness, representativeness, and comparability. These procedures will be implemented by SUIT AQP staff throughout the planning, data collection, emission estimation, and reporting phases of the inventory development program.

5.1 QC Activities

QC procedures will be implemented during inventory development to meet technical and DQOs. These activities will be conducted at critical steps in the inventory development process where the successful outcome of inventory development could be compromised. These critical steps are presented below and discussed in the following subsections of this QAP:

- Data collection;
- Data documentation;
- Calculating emissions;
- Data checking;
- Reporting; and
- Maintenance of the master files.

5.1.1 Data Collection

Data for this EI will be collected according to EPA level II EI guidelines utilizing measured data when available and reputable sources when measured data is not available. The approach and supporting documents or references will be thoroughly documented and included in the emission report. Table 5-1 shows guidance documents and suggested data sources in collecting the data:

Table 5-1
Data Collection Guidance Documents

Source Type	Guidance Document	Suggested Data Sources
Point Source	USEPA AP-42 – Compilation of Air Emission Factors USEPA EIIP Volume II 40 CFR Part 98	Existing emission inventories, state permit files, ICR, facility surveys, engineering documentation.
Non-point Source	USEPA AP-42 – Compilation of Air Emission Factors Emission estimation software	Existing emission inventories, state permit files, ICR, facility surveys, US Census, engineering documentation, case study.
Mobile Source (On-Road and Non-Road Mobile Source)	Guidance and emission factors used in USEPA emission models (MOVES2014a) EIIP Volume IV	Existing emission inventories.
Biogenic	EIIP Volume V	Existing emission inventories.

5.1.2 Data Documentation

Good data documentation procedures are essential when developing an emissions inventory. Therefore, the following data documentation requirements have been developed to facilitate the validation of the final emission results.

- Data sources will be included as references in the final inventory report. Units of measurement will be provided with each data value;
- Calculation methodologies with example calculations will be provided in the final inventory report;
- The approach used to determine completeness for each source type will be described;
- Documents from which emission factors are taken will be identified and referenced; and
- The source, agency group, or company providing information via telephone will be identified (include contact information and the date information was provided).

In developing the EI, the master files will be saved and maintained in electronic formats. These electronic documents including reports and spreadsheets shall be saved in the electronic folder, established for the 2015 SUIT Reservation EI.

5.1.3 Calculating Emissions

Information on how point, area, mobile, and biogenic emissions will be calculated is provided in Sections 7.0 through 10.0.

5.1.4 Data Checking

Data checking will be conducted by ES, which was not involved in the development of the EI. The following review activities will be performed by ES:

- Validate data transmission from existing emission inventories to the EI spreadsheets.
- Validate the cell functions and formulas in the EI spreadsheets.
- Validate the emission factors, calculation methodologies, and engineering assumptions for calculating the emissions.
- Validate the data input values and results generated from emission estimation software, such as EPA MOVES2014a, EPA TANKs 4.09d, GRI-GLYCalc, EPA LandGEM, etc.
- Validate the text of the emission inventory report including emission factors, assumptions, citations, and emission estimations.

Throughout the review process, ES will advise the SUIT AQP of deficiencies and recommended corrective mechanisms to improve the accuracy of the inventory. These findings and corrective actions will be recorded on the QA/QC form included in Appendix A of this QAP.

Additionally, ES will prepare a QA/QC report, which summarizes the results from all review activities conducted to validate the accuracy of this EI.

5.1.5 Reporting

Prior to finalizing the report, all of actions taken in response to the recommendations for corrective actions will be evaluated to determine whether the report accurately reflects the corrections made. The final emission report will be reviewed for technical soundness, completeness, accuracy, comparability, and representatives by SUIT AQP technical manager and program manager, and ES.

It is the responsibility of SUIT AQP program manager to ensure that the report accurately reflects the data and that the master file provides sufficient data to verify the results reported. A copy-ready master of the report will be retained in the master file and made available to all project personnel.

5.1.6 Maintenance of the Master File

The master file is a compilation of all data gathered and produced during development of the inventory. It should include sufficient supporting data to verify the accuracy of the emission results reported. Indexing procedures must facilitate data retrieval.

Maintenance of the master file will begin with retention of this QAP. All correspondence data and data received concerning development of the inventory will be filed by source. References will be maintained along with applicable data contained within each reference.

The master file will be maintained in an electronic project file. Access to these electronic files will be limited to SUIT AQP staff and controlled so that the master file is maintained in an orderly manner and is complete.

5.2 QA Activities

QA activities are distinguished from QC activities in that they provide a more objective assessment of data quality because QA personnel are not directly involved in development of the inventory. QA activities are usually more comprehensive because they include assessments of the effectiveness and appropriateness of the systems established by management to control data quality.

QA activities of the EI will be conducted by a third party contractor, ES. These activities will provide assessments on the quality of calculation methodologies, emission factors, and engineering assumptions in developing the EI. Findings will be recorded on the QA/QC form included in Appendix A and be included in the final QA/QC report.

SECTION 6.0

CORRECTIVE ACTION MECHANISMS

Recommendations for corrective actions will be made and undertaken as soon as quality concerns are identified. All changes or corrections made to the EI will be documented in the QA/QC form and summarized in the final QA/QC report prepared by the third party contractor, ES.

SECTION 7.0

POINT SOURCE INVENTORY PREPARATION AND QA/QC ACTIVITIES

For the purposes of this emission inventory, SUIT AQP identifies the following category of point sources located within the exterior boundary of the reservation:

- Title V Oil and Gas Sources
- TMNSR Oil and Gas Sources
- Municipal Solid Waste (MSW) Landfills
- Airports

Each of these sources will be assessed for inclusion in the 2015 EI.

7.1 Title V Oil and Gas Sources

A Title V emission source is a source that emits or has the potential to emit (PTE) 100 tons per year or more of any criteria pollutants, 10 tons per year or more of any one hazardous air pollutants (HAP), or 25 tons per year or more of any combination of HAP. In 2015, there were 36 Title V oil and gas sources operated on the SUIT Reservation.

Title V sources are required to report emissions annually and pay emission fees based on the type and quantity of pollutants emitted. For this EI, the data will be collected directly from the most recent annual emission fee report. If there are no data available from the annual emission fee report, Title V permit applications will be utilized as the data source to complete the EI.

7.2 Minor Point Sources

7.2.1 Permitted Tribal Minor New Source Review Oil and Gas Sources

If a source has the PTE equal to or greater than the thresholds that require a permit under the Title V operating permit program or prevention of significant deterioration (PSD) program, a source can obtain TMNSR permits to create enforceable emission limitations to reduce PTE to below the Title V or PSD emission thresholds. These permits are often referred to as “synthetic minor permits”.

For the TMNSR portion of this inventory, emissions from five TMNSR oil and gas facilities, which are not subject to Title V, will be included. Similar to Title V sources, permitted TMNSR sources are required to submit annual emission inventories to EPA. For this EI, the data will be collected directly from the most recent submitted annual emission inventories. PTE data from the permit applications will also be used in completing this EI.

7.2.2 Registered Tribal Minor New Source Review Oil and Gas Sources

TMSNR sources with PTE equal or greater than the thresholds described in Table 7-1, but below the thresholds that require a Title V operating permit are required to register with EPA Region 8 by no later than March 1, 2013. EPA Region 8 currently has received 241 registrations for oil and gas sources located within the exterior boundary of SUIT Reservation.

Table 7-1
TMNSR Permitting Threshold

Regulated Air Pollutant	Permitting Threshold (TPY)
Carbon monoxide	10
Oxides of nitrogen	10
Sulfur dioxide	10
Volatile Organic Compounds	5
PM	5
PM-10	5
PM-2.5	3
Lead	0.1
Fluorides	1
Sulfuric Acid Mist	2
Hydrogen Sulfide (H2S)	2
Total Reduced Sulfur (including H2S)	2
Reduced Sulfur Compounds	2
Waste Combustor Emissions	2
Solid Waste Landfills Emissions (measured as Non Methane Organic Compounds)	10

SUIT AQP issued a mandatory Clean Air Act Section 114 information collection request (ICR) in June 2016 to reconcile emission data from each of the registered TMNSR oil and gas sources. The ICR specifically requested reconciliation of the operational status of each registered source, equipment located at each source, and the actual emissions for the 2015 calendar year. Additionally, the ICR included emissions and emission sources exempted under the registrations, such as engines less than 50 hp, HAP and GHG emissions.

7.3 Landfills

There are two Class II MSW landfills within the SUIT Reservation boundaries. These landfills are Bondad Landfill and Archuleta County Landfill. The emissions from Bondad Landfill were obtained directly from the 2015 Title V emission fee form package submitted to SUIT AQP.

SUIT AQP worked with Archuleta Solid Waste Department to obtain documentation, such as 2015 greenhouse gas report, air pollution emission notice, permit applications and design capacity report, in compiling the emissions from the Archuleta County Landfill. These reports were submitted by Archuleta County to the Colorado Department of Public Health and Environment (CDPHE). SUIT AQP utilized EPA MSW landfill emission model, LandGEM version 3.02 (LandGEM) to calculate emissions from Archuleta County Landfill. Engineering assumptions and climatic parameters contained in Bondad Landfill Title V emission fee report were used as input values for LandGEM in calculating Archuleta County Landfill emissions.

7.4 Airports

There are three airports located within the SUIT Reservation, the Durango-La Plata County airport, the Animas Air Park, and Animas Air Park Helipark. Emissions from these airports were calculated and submitted to the EPA National Emission Inventory (NEI) database for calendar year 2014. SUIT AQP used these reported values for the 2015 EI.

7.5 QA/QC Activities for Point Sources

All data received from the data sources will be stored and maintained in the project master files. All data sources will be clearly documented in the EI spreadsheets. For Title V oil and gas sources, minor sources consisting of permitted and registered TMNSR oil and gas sources, Bondad landfill, and airports, SUIT AQP did not perform any calculations, since 2015 emissions data from these sources had been calculated and reported directly to SUIT AQP or EPA. Therefore, ES will only review the data entries from the data sources to the EI spreadsheets.

SUIT AQP estimated emissions from Archuleta County Landfill by using LandGEM software. ES will review the input values and data results generated from the software.

SECTION 8.0

NON-POINT SOURCE INVENTORY PREPARATION AND QA/QC ACTIVITIES

For the purposes of this emission inventory, SUIT AQP identified the following categories of non-point sources located within the exterior boundary of the reservation:

- Non-registered Oil and Gas Sources
- Gas Stations
- Aviation Gasoline
- Gravel Pits
- Residential Heating

Each of these sources will be assessed for inclusion in the 2015 EI.

8.1 Non-registered Oil and Gas Sources

For the purpose of this emission inventory, non-registered oil and gas sources are defined as oil and gas sources with emissions below the emission thresholds described in Table 7-1.

The list of non-registered oil and gas sources was obtained from the Colorado Oil and Gas Conservation Commission (COGCC) and Drilling Edge database. Each operator of a non-registered source received a Clean Air Act Section 114 ICR issued by SUIT AQP in June 2016. The ICR required each recipient to provide actual equipment counts, production information, and equipment configuration. 87.5% of the recipients submitted a completed ICR to SUIT AQP. These returned ICRs are accounted for 98% of the known non-registered sources. Ground surveys were utilized to collect data from the remaining recipients.

Table 8-1 shows the type of emission sources, required data, and calculation methodologies needed to develop the EI for non-registered oil and gas facilities.

Table 8-1
Non-Registered Oil and Gas Sources Calculation Method and Required Data

Emission Source	Calculation Method and Required Data
Natural Gas-Fired Reciprocating Internal Combustion Engines	**Method:** EPA AP-42 3.2 – Natural Gas-Fired Reciprocating Engines (August, 2000), 40 CFR Part 98, Subpart C, Table C-1 and C-2 – Mandatory Greenhouse Gas Reporting. **Data:** Engine horsepower rating, engine configurations, operating hours, and brake specific fuel consumption (BSFC).
Tri-Ethylene Glycol Dehydration Unit	**Method:** GRI-GLYCalc emission estimation software. **Data:** Natural gas analysis, wet gas temperature, pressure, dry gas flowrate/throughput, lean glycol water content, glycol pump type, pipeline water content specification.
Liquid Storage Tanks	**Method:** EPA TANKS 4.09d (TANKS), Engineering calculation for flash gas emissions, EPA AP-42 5.2 – Transportation and Marketing Petroleum Liquids (July 2008), American Petroleum Institute Compendium of Greenhouse Gas Emissions for the Oil and Gas Industry, 40 CFR Part 98 Subpart W. **Data:** Tank throughput, tank characteristics, Reid vapor pressure, field sampling data for flash gas composition and gas to water ratio values, truck tank capacity, liquid saturation factor, liquid molecular weight, true vapor pressure, and temperature.
Heaters and Boilers	**Method:** EPA AP-42 1.4 – Natural Gas Combustion (July 1998), 40 CFR Part 98, Subpart C, Table C-1 and C-2 – Mandatory Greenhouse Gas Reporting. **Data:** Equipment heat rating, operating hours, natural gas heating value
Equipment Leaks and Fugitive Emissions	**Method:** Canadian Association of Petroleum Producers Guide for Calculating Greenhouse Emissions, publication number 2003-0003 (April 2003), EPA Protocol for Equipment Leak Emission Estimates Chapter 2.3 (November 1995), 40 CFR Part 98, Subpart W – Mandatory Greenhouse Gas Reporting. **Data:** Fugitive component counts (valves, connectors, open ended lines).
Natural Gas Driven Pneumatic Devices	**Method:** EPA Report for Oil and Natural Gas Sector Pneumatic Devices (April 2014). **Data:** Equipment bleed rate.

Emission Source	Calculation Method and Required Data
Natural Gas Blowdown and Purges	**Method:** Facility Surveys **Data:** Number and time duration of annual compressor and pipeline blowdowns, the amount of natural gas vented.
Well Completion and Recompletions	**Method:** Facility Surveys **Data:** Number of well completions and recompletions.

8.2 Gasoline Service Stations

Five gasoline service stations were operated on the SUIT Reservation during calendar year 2015. Fuel throughput was provided by each gas station representative. Emission factors from EPA AP-42 Chapter 5.2, Table 5.2-7 – Evaporative Emissions from Gasoline Service Station Operations were utilized to estimate the emissions. SUIT AQP did not calculate emissions from diesel service stations since diesel fuel dispensing emissions are assumed to be negligible.

8.3 Aviation Gasoline

Emission estimates for aviation gasoline and the amount of lead (Pb) in the leaded gasoline were developed by EPA for calendar year 2014. This data was obtained from the EPA National Emission Inventory (NEI). SUIT AQP utilized the 2014 data for the 2015 EI.

8.4 Gravel Pits

Ten sand and gravel pits operated in SUIT Reservation during the 2015 calendar year. The number of active pits within the exterior boundaries of SUIT Reservation was determined based on the data from the Colorado Division of Reclamation Mining and Safety (DRMS) database and the current active permits. Emissions of sand and gravel pits in SUIT Reservation were estimated using total emissions from all gravel pits located in La Plata and Archuleta counties.

8.5 Residential Heating

There are three types of fuel used for residential heating: wood used in fireplaces and wood burning stoves, propane, and natural gas. The amount of households using these fuels was determined using the U.S. Census 2010-2014 American Community Survey 5-Year Estimate. The U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics Residential Energy Consumption Survey was used to obtain the average number of cords, propane, and natural gas used within a year at an average household.

Calculation methodologies and emission factors described in EPA AP-42 Section 1.10, 1.5, and 1.4 were used to estimate the emissions from residential heating using wood, propane, and natural gas respectively.

8.6 Wildland Fires and Prescribed Burns

The forest on SUIT Reservation is predominantly comprised of pinyon-juniper woodlands with ponderosa, gambel, oak, aspen, and sub-alpine forest. The forest is prone to wildfire and prescribed burns are utilized as a forest management strategy to help prevent catastrophic fires, improve wildlife habitat, and improve overall forest health. Wildfires and prescribed burns can be significant sources of air pollution.

The acres of wildfires and prescribed burns was obtained from the Bureau of Indian Affairs (BIA) and the Southern Ute Agency Fire Management Division, and Federal Fire Occurrence Website. Emission estimation software called BlueSky was utilized to calculate the emissions from wildland fires and prescribed burns.

8.7 Agricultural Burning

The emissions from agricultural burning activities occurred within the SUIT Reservation were estimated based on the total agricultural burning emissions in La Plata County reported in The 2014 EPA National Emission Inventory (NEI) database.

8.8 QA/QC Activities for Non-point Sources

All data received from the data sources will be stored and maintained in the project master files. All data sources will be clearly documented in the EI spreadsheets. In addition to data entries from the data sources to the EI spreadsheets, ES will also review emission factors, calculation methodologies, engineering assumptions, data input values and results generated from various emission estimation softwares, and the text of the report referencing the data sources.

Any findings and corrective actions taken during the review process will be recorded in the QA/QC form and compiled in the final QA/QC report.

SECTION 9.0

MOBILE SOURCES INVENTORY PREPARATION AND QA/QC ACTIVITIES

Mobile source emissions are generated from on-road vehicles and non-road engines, such as lawn equipment, recreational vehicles, agricultural equipment, construction equipment, etc.

9.1 On-Road Mobile Sources

Emissions from on-road mobile sources include emissions from motorcycles, passenger cars and trucks, light commercial trucks, transit buses, school buses, refuse trucks, single unit land and short-haul trucks, motorhomes, and combination short-haul trucks. To calculate the emissions from on-road mobile sources, SUIT AQP utilized emission estimation software, Moves2014a. The data input values for Moves2014a were mainly obtained from the 2014 County Database (CDB) and 2014 National Database (NDB). Hourly humidity and temperature data were obtained from SUIT Ambient Air Monitoring team.

9.2 Non-Road Mobile Sources

Emission from non-road mobiles sources include emissions from mobile source operating off-road, such as agricultural, construction, and recreational equipment. To calculate the emissions from non-road mobile sources, SUIT AQP utilized emission estimation software, Moves2014a. The data input values for Moves2014a were collected from 2014 NDB for La Plata and Archuleta County. The hourly humidity and temperature data were obtained from SUIT Ambient Air Monitoring team.

9.3 QA/QC Activities for Mobile Sources

Since emissions from mobile sources (on-road and non-road mobile sources) were calculated using emission software, Moves2014a, ES will review the data input values and data results generated from the software.

SECTION 10.0

BIOGENIC INVENTORY PREPARATION AND QA/QC ACTIVITIES

Biogenic emissions are generated from trees, vegetation, oil and gas seeps, soil and microbial activities. VOC and NO_X emissions are typical biogenic emissions. EPA estimated biogenic emissions from La Plata and Archuleta County for the 2014 calendar year using the Biogenic Emission Inventory System (BEIS 3.61) with Biogenic Emission Landuse Database (BELD 4.1). The EPA biogenic emissions were scaled down by 38.9% for La Plata County and 29.5% for Archuleta County to represent the area within the exterior boundaries of SUIT Reservation.

Since the biogenic emissions were directly from EPA database, ES will review the data entries from the data source to the EI spreadsheet.

APPENDIX C

LETTER OF PROJECT COMPLETION

December 1, 2016

environmental services

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Mark Hutson
Air Quality Program Manager

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Subject: Project Completion for Quality Assurance Review on 2015 Emission Inventory

Dear Mr. Hutson,

This letter is to inform you that the Quality Assurance (QA) review of the 2015 Emission Inventory (EI) project has been completed on December 1, 2016. ES Engineering Services, LLC (ES) has completed the review of the emission calculation worksheets and draft emission inventory report. All the corrective actions recommended by ES have been discussed with Southern Ute Indian Tribe Air Quality Program (SUIT AQP) staff. During the review, any unclear recommendations were discussed and validated by ES through conference calls. All final recommendations have been or will be incorporated by SUIT AQP staff into the inventory. With these recommended changes, ES believes the EI is complete, accurate and representative pursuant to US EPA inventory

On behalf of ES, I would like to thank the SUIT AQP for the opportunity to participate in this project. Should you or other SUIT AQP staff have any questions or concerns related to this project, please contact me at (714)919-6500 ext. 12908 or ekrisnadi@es-online.com

Sincerely,

ES Engineering Services, LLC

A. Edward Krisnadi
Project Manager
Regulatory Compliance Services
Air Quality Consulting

Enclosed
029-RCS-85774.ltr1.doc