# Appendix G
# Air Quality Technical Support Document

# Greater Natural Buttes
# Air Quality Technical Support Document

Vernal Field Office/Utah

**Bureau of Land Management**

**April 2010**

***BLM Mission Statement***

*The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times.*

*Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife, wilderness, air and scenic, scientific, and cultural values.*

# Executive Summary

The Bureau of Land Management has prepared this Technical Support Document to provide details of the air quality analysis that supports the Environmental Impact Statement for the infill drilling activity proposed within the Greater Natural Buttes Project Area (GNBPA). This document provides an overview of emissions for four modeling scenarios identified as follows:

- 2006 Baseline – 2006 base year actual emissions;
- 2018 Projected Baseline – 2018 projected emissions without the proposed project;
- 2017 Proposed Action – 2018 Projected Baseline with project emissions from the proposed development alternative in 2017 (3,675 wells); and
- 2026 Optimal Recovery Alternative – 2018 Projected Baseline emissions with project emissions from the maximum recovery alternative development scenario in 2026 (13,446 wells).

Several models were used to characterize the air quality impacts from these scenarios, as summarized in the following sections. For the GNBPA, the existing air quality currently is classified as being in attainment or unclassifiable. Until the recent installation of two ozone monitors on tribal land northwest of the GNBPA in December 2008, there were no ambient air quality monitors in the Uinta Basin. Since data from these two new stations is for ozone only and only a few months of data has been collected, it is not of use for this analysis. Therefore, the lack of usable direct measurements of the current air quality conditions in the Uinta Basin is a factor that prevents validation of the ozone model. However, the model does provide a means to compare the relative change in ambient ozone concentration between the project alternatives and baseline air quality.

## ES-1 Emissions Summary

Air emissions inventories for the modeled scenarios were developed from the Western Regional Air Partnership (WRAP) emissions inventories and project-specific data provided by Kerr-McGee Oil & Gas Onshore LP (KMG). The WRAP inventories were compiled using data provided by state and tribal regulatory agencies as well as industry partners for existing as well as projected oil and gas emission sources. These inventories include point, area, non-road mobile, and on-road mobile sources and include identification of these source groups by location (within counties and modeling grid cells). The WRAP emissions inventories include baseline data for nitrogen oxides ($NO_X$), carbon monoxide (CO), sulfur dioxide ($SO_2$), particulate matter less than 10 microns in aerodynamic diameter ($PM_{10}$), fine particulate matter, and volatile organic compounds (VOCs).

All or portions of multiple WRAP inventories were used to develop emissions inventories for the 2006 Baseline and the 2018 Projected Baseline scenarios for this analysis. The WRAP inventories used are identified as follows:

- 2002 Plan2d – original WRAP baseline inventory for all sources (used non oil and gas portion only);
- 2018 PRP18a – original WRAP forecasted inventory for non-road mobile and on-road mobile sources;
- 2018 PRP18b – original WRAP forecasted inventory for point and area sources;
- 2002 Phase II – 2002 base year inventory for oil and gas sources outside the Uinta and Piceance basins only;
- 2018 Phase II – 2018 forecasted inventory for oil and gas sources outside the Uinta and Piceance basins only;

- 2006 Draft Phase III – 2006 base year inventory for oil and gas sources in the Uinta and Piceance basins only; and
- 2012 Draft Phase III – 2012 base year inventory for oil and gas sources in the Uinta and Piceance basins only.

The WRAP III emissions inventory is an update of the WRAP II database based on existing and approved oil and gas emissions sources through 2006 in the Uinta and Piceance basins only. It focused additional effort on accounting for VOC emissions from regional sources, but it updated emissions of other criteria pollutants within these basins as well. The emission source categories and the development of these baseline inventories for 2006 and 2018 are summarized in **Table ES-1**.

**Table ES-1 Summary of Baseline Inventory Development**

| Emissions Source Category | Inventory Used for 2006 Baseline | Inventory Used for 2018 Projected Baseline |
|---|---|---|
| Oil and Gas – Unita Basin | WRAP Oil and Gas Phase III 2006 | Projected from WRAP Phase III Oil and Gas 2006 based on projected cumulative activity in 2018 |
| Oil and Gas – Piceance Basin | WRAP Oil and Gas Phase III 2006 | Projected from WRAP Phase III Oil and Gas 2006 and 2012 |
| Oil and Gas – All Other Basins | Interpolated from WRAP Phase II Oil and Gas 2002 and 2018 | WRAP Oil and Gas Phase II 2018 |
| Point Sources – Non Oil and Gas | Interpolated from WRAP 2002 Plan2d and WRAP 2018 PRP18a | WRAP 2018 PRP18b |
| Area Sources – Non Oil and Gas | Interpolated from WRAP 2002 Plan2d and WRAP 2018 PRP18a | WRAP 2018 PRP18b |
| Non-Road Motor Vehicle | Interpolated from WRAP 2002 Plan2d and WRAP 2018 PRP18a | WRAP 2018 PRP18a |
| On-Road Motor Vehicle | Calculated with 2005/2006 meteorology and 2006 vehicle miles traveled (VMT) interpolated from WRAP 2002 Plan2D and WRAP 2018 PRP18a VMT | Calculated with 2005/2006 Meteorology and WRAP 2018 PRP18a VMT |
| Biogenic | Model of Emissions of Gases and Aerosols from Nature (MEGAN) with 2005/2006 meteorology | MEGAN with 2005/2006 meteorology (held steady from 2005/2006) |
| Wildfire | 2006 Wildfire Inventory | 2006 Wildfire Inventory (held steady from 2006) |

The 2018 Projected Baseline emissions inventory was developed to coincide with the 2018 projected WRAP Phase II inventory and the highest production year for the Proposed Action when planned drilling would still be occurring (2017). Emissions inventories for criteria pollutants and source characteristics for the Proposed Action and Optimal Recovery Alternative scenarios were based on project data provided by KMG. Sources were grouped as necessary to facilitate modeling and analysis.

The oil and gas emissions inventory in the Uinta Basin for the year 2018 was developed in two steps. First, the rate of activity increase in five operating factors (well counts, spud counts, gas production, condensate production, and oil production) was applied to relevant source category emissions for the Uinta Basin 2006

WRAP Phase III inventory. Second, controls from applicant-committed measures, federally enforceable requirements, or binding agreements were applied.

The 2018 Projected Baseline also was used as the baseline for the Optimal Recovery Alternative, though peak production under this alternative is anticipated in 2026. This approach provided a consistent basis of comparison between the alternatives and reduced uncertainty in baseline emissions from projecting development beyond the WRAP inventory time horizon.

## Emissions Data Assumptions

Emissions data for the Proposed Action and the Optimal Recovery Alternative were developed from available emission factors, analytical data, applicable applicant-committed environmental protection measures, applicant-provided equipment specifications, federally required controls or emission standards, and anticipated activity levels. Emission rates were developed for the criteria pollutants and for selected hazardous air pollutants (HAPs). A summary of criteria pollutant emissions from stationary sources in the Uinta Basin is provided in **Table ES-2**, and the project-related increases in the major components of HAPs for the Proposed Action and Optimal Recovery Alternative are provided in **Table ES-3**. Emissions for a full list of HAPs were reviewed, but only those with the greatest emissions in relation to health effects were evaluated.

**Table ES-2 Summary of Criteria Pollutant Emissions for Each Scenario**

| Criteria Pollutant | Emissions (tons per year [tpy]) | | | | | |
|---|---|---|---|---|---|---|
| | 2006 Baseline | 2018 Projected Baseline | 2017 Proposed Action | | 2026 Optimal Recovery Alternative | |
| | | | Project | Total | Project | Total |
| $NO_X$ | 10,754 | 10,138 | 2,071 | 12,209 | 4,946 | 15,084 |
| CO | 7,800 | 9,732 | 1,155 | 10,887 | 2,994 | 12,726 |
| $SO_2$ | 391 | 30 | 25 | 55 | 78 | 108 |
| $PM_{10}$ | 592 | 565 | 973 | 1,538 | 2,658 | 3,223 |
| VOC | 70,226 | 184,262 | 6,654 | 190,916 | 24,976 | 209,238 |

**Table ES-3 Summary of Potential Increases in Emissions of HAPs for Project-related Alternatives**

| Pollutant | Potential HAP Increase (tpy) | |
|---|---|---|
| | Proposed Action | Optimal Recovery Alternative |
| Benzene | 67.3 | 255.2 |
| Toluene | 173.5 | 661.9 |
| Ethyl Benzene | 12.7 | 48.5 |
| Xylenes | 186.9 | 714.1 |
| Formaldehyde | 70.4 | 156.5 |
| n-Hexane | 196.2 | 748.5 |

## ES-2 Model Types

Air quality impacts were assessed for the Proposed Action and Optimal Recovery Alternative using the following air quality models:

- CALPUFF – This United States (U.S). Environmental Protection Agency (USEPA) guideline modeling system was used to determine air quality and visibility impacts at Class I areas (e.g., national parks and wilderness areas) in the region as well as at selected Class II sensitive areas. Further, this model addressed acid deposition in these areas and impacts to acid neutralizing capacity (ANC) in specified lakes of concern.
- CMAQ – The Community Multi-Scale Air Quality Model (CMAQ) was used to determine impacts on regional ozone levels.
- AERMOD – This USEPA guideline model was used to assess impacts of a typical development scenario in the near-field (within 50 kilometers [km]).

The region of study, or modeling domain, for the CALPUFF and CMAQ model systems is depicted in **Figure ES-1**, including the location of the GNBPA and the identified Class I and sensitive Class II areas. The AERMOD model assessed impacts within 50 km of each modeled source within the development scenario for the project. Therefore, there was no specified study domain for the AERMOD analysis. Models generally were run with default values or with model settings that were representative of the region.

## ES-3 Summary of Impacts on Class I and Selected Class II Areas – Air Quality

The guideline CALPUFF modeling system was used to determine impacts on Class I areas and sensitive Class II areas in the region.

### Proposed Action

The greatest impact on ambient air quality from project sources on Class I areas was at Arches National Park, where the maximum impact for all criteria air pollutants occurs. The highest $PM_{10}$ 24-hour impact was 0.10 micrograms per cubic meter (µg/m$^3$) at this site. All other impacts for all criteria pollutants at all Class I areas for the Proposed Action were below 0.01 µg/m$^3$.

The greatest impacts at the identified sensitive Class II areas were at the Flaming Gorge National Recreation Area with the maximum 24-hour $PM_{10}$ impact of 3.23 µg/m$^3$ and the maximum annual $PM_{10}$ impact of 0.58 µg/m$^3$. All other impacts from all other criteria pollutants at Class II areas were less than 0.5 µg/m$^3$.

### Optimal Recovery Alternative

For the Optimal Recovery Alternative at Class I areas, the maximum 24-hour $PM_{10}$ impact was 0.24 µg/m$^3$ at Arches National Park. The maximum annual average $PM_{10}$ impact of 0.02 µg/m$^3$ also occurred at the Arches National Park. All other impacts from all other criteria pollutants in Class I areas were less than 0.13 µg/m$^3$.

At sensitive Class II areas under the Optimal Recovery Alternative, the maximum impacts were at the Flaming Gorge National Recreation Area for all criteria air pollutants. The maximum annual average $NO_2$ impact was 0.94 µg/m$^3$. The $PM_{10}$ impact on a 24-hour average was 7.36 µg/m$^3$, and the annual $PM_{10}$ impact was 1.38 µg/m$^3$. Impacts from all other criteria pollutants at all other Class II areas were less than 1.0 µg/m$^3$.

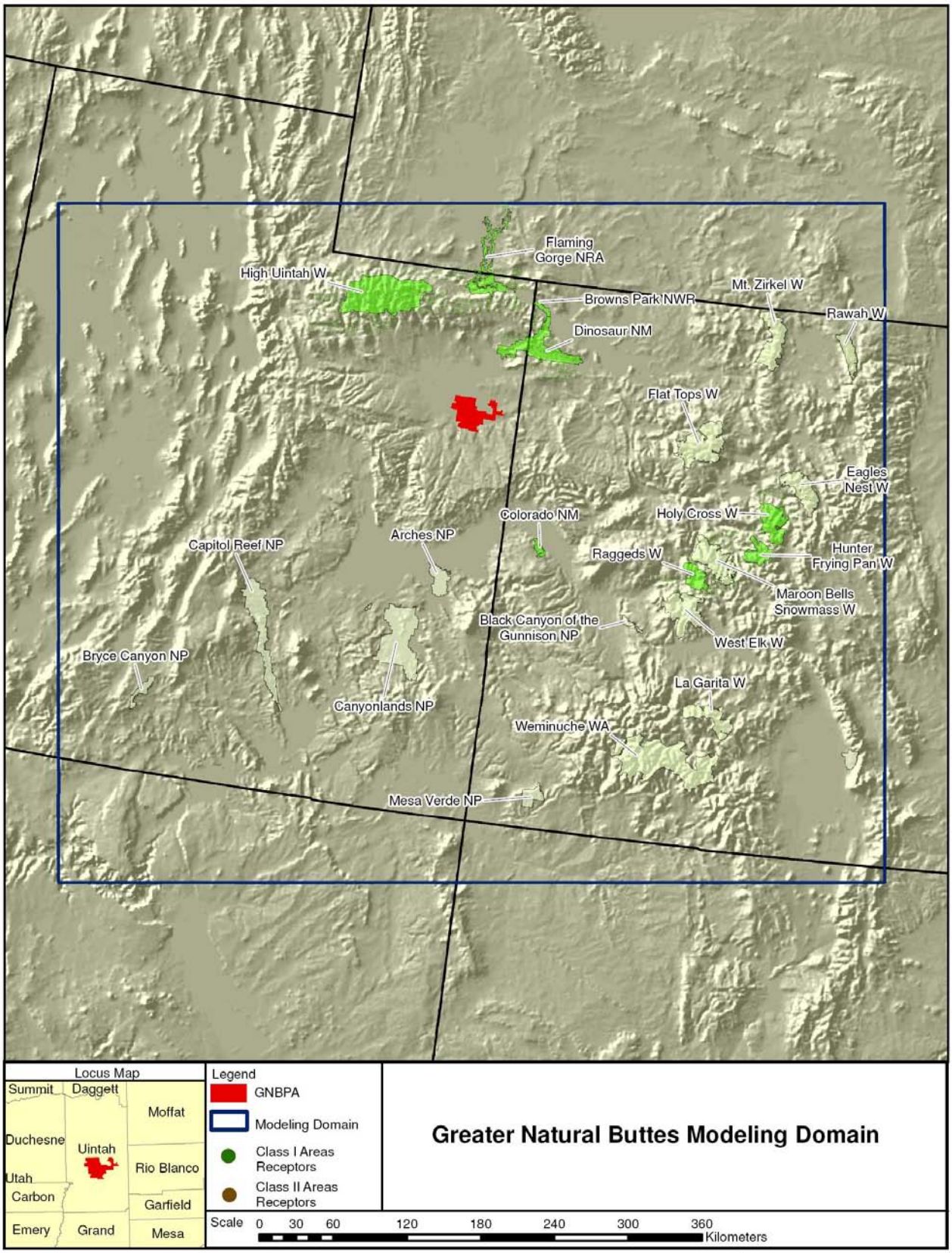


**Figure ES-1 Greater Natural Buttes Modeling Domain**

## ES-4 Cumulative Impacts

When added to the background concentrations, all cumulative impacts from all sources for each of the alternatives, including the modeled non-project sources, were well below the established National Ambient Air Quality Standards (NAAQS) for all criteria air pollutants.

## Summary Impact at Class I/II Areas – Visibility

The CALPUFF model system also was used to evaluate impacts on visibility at the Class I areas and at the listed sensitive Class II areas.

### Proposed Action

The results of the CALPUFF analysis showed that there were no days with a contribution to visibility impacts greater than 10 percent increase in the light extinction coefficient (1.0 deciview) at listed Class I areas. Therefore, the Proposed Action would not contribute to an impact on visibility at the Class I Areas.

The modeling results at the listed sensitive Class II areas showed the highest impacts at Flaming Gorge National Recreation Area and Dinosaur National Monument. The CALPUFF modeling showed that up to 102 days would be impacted with greater than 10 percent increase in light extinction at Flaming Gorge. The same analysis showed the eighth highest increase in extinction for the Proposed Action was 32.6 percent. At Dinosaur National Monument, the model predicted 32 days per year with an impact above 10 percent and an eighth highest increase in light extinction of 16.6 percent. Except at Flaming Gorge National Recreation Area and Dinosaur National Monument, modeled results for all other Class II areas under CALPUFF Method 6 showed that all of the eighth highest impacts are less than a 10 percent increase in light extinction above natural background (expressed as an impact of 1.0 deciviews). Class II areas were included in the analysis as a courtesy to sister federal agencies. Class II areas have no visibility protection under state or federal laws or regulations.

### Optimal Recovery Alternative

For the Optimal Recovery Alternative, all project-related impacts were below 10 percent light extinction at all Class I areas. At Class II areas, the eighth highest impacts using CALPUFF Method 6 were above 10 percent at Flaming Gorge National Recreation Area and Dinosaur National Monument. The Method 6 analysis showed that the eighth highest increase in light extinction for project-related sources was 62.4 percent at Flaming Gorge, with 156 days predicted to be greater than 10 percent. At Dinosaur National Monument, the eighth highest increase was 32.7 percent, with 71 days predicted to be greater than 10 percent.

## ES-5 Summary Impacts at Class I/II areas – Acid Deposition

The CALPUFF model system also provided acid deposition results for nitrate and sulfate ion deposition at Class I and sensitive Class II areas, which were then used to analyze impacts to the ANC of selected sensitive lakes in the modeling domain.

### Acid Deposition

Impacts from project-related sources for both the Proposed Action and the Optimal Recovery Alternative were well below the U.S. Forest Service (USFS) established comparative deposition values (5 and 3 kg/ha-yr for sulfur and nitrogen deposition, respectively). Cumulative deposition from all modeled sources also was below the established comparative deposition values for both alternatives at all Class I and Class II areas except Mesa Verde National Park.

### Acid Neutralization

The model showed project-related impacts at all identified sensitive lakes to be below the USFS screening threshold for ANC established for further analysis. Therefore, no additional analysis was conducted for these impacts.

## ES-6 Summary Impacts on Ambient Ozone Levels

### Ozone Model and Limitations

Impacts on ambient air ozone levels were evaluated using the CMAQ model system. The modeling system met the USEPA-established criteria for acceptable model accuracy and error statistics at the existing monitoring stations within the modeling domain but not in the GNBPA. There were no recent or statistically valid representative monitoring data that could be used to compare baseline modeled impacts to actual levels in the GNBPA. The Greater Natural Buttes project model was run using the 2006 WRAP Phase III emissions data, but there were no concurrent ambient measurements to compare the modeled results to actual monitored concentrations. This lack of concurrent data prevented validation and calibration of the model results; however, the model did provide a means to compare the relative change in ambient ozone concentration between the project alternatives and baseline air quality.

### Ozone Model Results

The model results showed no impacts above the current ozone standard of 75 parts per billion (ppb) for the fourth highest annual level in the Uinta Basin for the Projected Baseline and the project alternatives. The maximum fourth highest impact was 2.4 ppb from the Proposed Action scenario and 4.9 ppb from the Optimal Recovery Alternative. For both scenarios, the impacts were occurring in areas simulated to remain below the 75 ppb ozone standard.

## ES-7 Localized Impacts on Air Quality

### AERMOD Model and Limitations

The AERMOD modeling system was used to evaluate localized impacts on criteria air pollutants at receptors within the GNBPA. A series of source configurations was developed, including well sites, drilling, operation, and compression, and projected air quality impacts on the near-field, which was defined as receptors within 50 km. The model used a 5-year period of meteorological data from the Vernal Airport. Due to the lack of air quality monitoring data in this region, it was difficult to assess background concentrations for determining compliance with ambient air quality standards.

### AERMOD Model Results

Although background concentrations were difficult to assess in this region due to lack of recent monitoring, the localized impacts of single sources plus background were all less than the NAAQS. The impacts of the multi-well scenario and the well drilling operations, as discussed above, also were lower than the NAAQS.

## ES-8 Greenhouse Gas Emissions

The predicted annual increase in greenhouse gas emissions (carbon dioxide [$CO_2$], nitrous oxide, and methane) were tabulated for both the Proposed Action and the Optimal Recovery Alternative. Both direct project-related and indirect (from electric power generation) emissions were included. During the maximum production year for each alternative, a total 2.75 million metric tons of $CO_2$ equivalent gases would be emitted by the Proposed Action, and 5.48 million metric tons of $CO_2$ equivalent gases would be emitted by the Optimal Recovery Alternative.

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# 1.0 Introduction and Background

Kerr-McGee Oil & Gas Onshore LP (KMG), a wholly owned subsidiary of Anadarko Petroleum Corporation, proposes to conduct infill drilling to develop the hydrocarbon resources underlying oil and gas leases owned, at least in part, by KMG within the Greater Natural Buttes Project Area (GNBPA) in Uintah County, Utah. KMG plans to explore and develop all potentially productive subsurface formations underlying the GNBPA. KMG is the designated operator or owns contractual leasehold rights for more than 85 percent of the lands within the GNBPA boundary. The oil and gas leases were issued by the Bureau of Land Management (BLM), State of Utah, Bureau of Indian Affairs (BIA), and private owners.

The BLM is analyzing the environmental impacts of the proposed project by preparing an Environmental Impact Statement (EIS) as required by the National Environmental Policy Act (NEPA). In support of this NEPA analysis, this document presents a technical analysis of air quality issues related to development of the resources within the GNBPA. The purpose of this analysis is to provide the details of the air quality technical data and assumptions that were used to develop the air quality review and evaluation of impacts as required under NEPA.

## 1.1 Project Description

KMG proposes to drill and produce natural gas supplies in the GNBPA shown in **Figure 1-1**. This project area consists of approximately 162,911 acres in an existing gas producing area located in T8S/R20-23E, T9S/R20-24E, T10S/R20-23E, and T11S/R21-22E in Uintah County, Utah. The GNBPA encompasses 88,565 acres of federal land administered by the BLM; 39,399 acres of land owned by the Northern Ute Tribe and administered by the BIA; 32,755 acres of land owned by the State of Utah; and 2,192 acres of privately owned land.

KMG's proposed development plan, referred to in this document as the Proposed Action, is to drill additional wells at an average rate of approximately 358 wells per year over a period of about 10 years or until the resource base is fully developed, with a maximum total of 3,675 wellbores. The total number of wells drilled during the life of the project or during any particular year would depend largely on factors outside of KMG's control such as permit approvals, production success, engineering technology, economic factors, commodity prices, rig availability, and lease stipulations. The productive life of each well is estimated to be 30 to 50 years.

Infill drilling would be performed on 40-acre and 20-acre surface spacing throughout the GNBPA (i.e., 16 to 32 surface well pads per square mile, respectively). KMG defines a 40-acre well pad as the first well pad located in a 40-acre quarter-quarter of a square mile section of land. A 20-acre pad is defined as the second well pad located in a 40-acre quarter-quarter section. Downhole well spacing would be based on reservoir engineering evaluation on an on-going basis and would be site-dependent, potentially ranging from 16 wells per section (40-acre spacing) to 64 wells per section (10-acre spacing). In areas where the gas resources in the reservoirs warrant a downhole spacing of less than 20 acres based on reservoir engineering evaluation, KMG would test and attempt to utilize directional drilling technology to drill from nearby 20-acre or 40-acre pads, if such is technically and economically viable. In general, the surface density of the KMG well pads would not exceed 32 pads per section. This equates to an average spacing between pads of approximately 285 meters (m), a distance that is incorporated into air modeling procedures described in this document.

KMG has committed to several environmental protection measures to reduce emissions of criteria and hazardous air pollutants (HAPs) from the proposed project. These controls are summarized in **Table 1-1**.

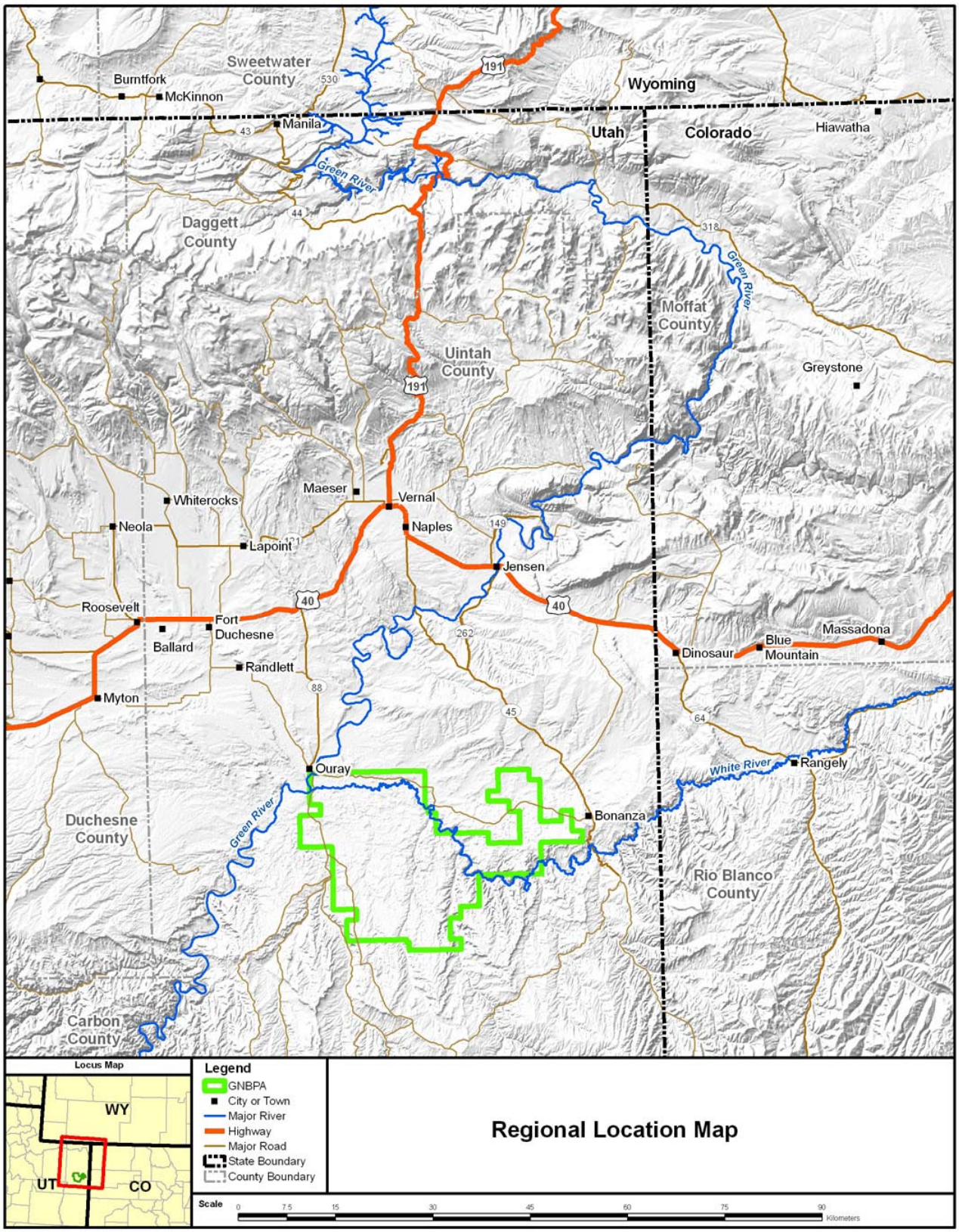



**Figure 1-1 Location of GNBPA**

**Table 1-1 Applicant-committed Environmental Protection Measures**

| Source Type | Proposed Control | Impact to Analysis |
|---|---|---|
| Natural Gas Fired Engines | For all engines, install lean burn engines or engines equipped to achieve comparable emissions reduction | All stationary engines considered for the project are greater than 500 horsepower (hp), and therefore will be considered lean burn. Engines will comply with current New Source Performance Standards or better, if applicable. |
| | Install catalyst on all natural gas fired engines | Since all engines are lean burn, the analysis will consider the use of oxidation catalysts for carbon monoxide (CO) and volatile organic compound (VOC) reduction. Non-selective catalytic reduction is appropriate for rich burn engines only and therefore is not considered. |
| | Install approximately 50 percent electric compression | The analysis considers 57 percent of the compression to be electric based on information on compression to be installed as provided by KMG. |
| Non-road Diesel Engines | Phase in Tier 2 drill rig engines by 2012 | All non-road diesel engines are assumed to be at Tier 4 in 2018, which is the year for analysis. |
| Dehydrators | Install zero emission dehydrators | Emissions from dehydrators are not considered for the project. |
| Pneumatics | Install low-bleed pneumatics | The fugitive emission calculations consider low-bleed pneumatics. |
| Condensate Tanks | Install controls on new condensate tanks with potential to emit VOC greater than 20 tons per year (tpy) | The analysis considers controls on tanks greater than 20 tpy VOC. |
| Completions | Use “green completions” | No VOC from completions and “green completions” assumed for greenhouse gas analysis. |

## 1.2 Overview of Modeling Approach

The focus of the air quality analysis was to assess local and regional air quality impacts from reasonably foreseeable development in the Uinta Basin region, in conjunction with the proposed project. The study area covers large portions of eastern Utah and western Colorado, and is discussed in detail in Chapter 4.0.

The general approach was to develop a sound emissions inventory for a project base year to tabulate emissions, conduct modeling for future year scenarios, and evaluate results from the proposed modeling tools. The modeling efforts included use of the CALPUFF modeling system to investigate impacts on visibility (regional haze), air quality, and acid deposition in areas that are 50 kilometers (km) or more from the GNBPA. The guideline air quality model AERMOD was used to evaluate impacts on air quality in the near field of the GNBPA. The Models-3 Community Multiscale Air Quality (CMAQ) model was used to evaluate impacts on ambient air ozone in the region.

The emissions inventory used for the AERMOD and CALPUFF modeling focused on criteria pollutants using actual emissions for analysis of compliance with the National Ambient Air Quality Standards (NAAQS), for depicting visibility impacts (regional haze only), and sulfur and nitrogen deposition. Comparison of impacts to Prevention of Significant Deterioration (PSD) increment levels are provided, but the study did not include

developing a PSD increment consuming inventory.[1] The inventory for the CMAQ ozone modeling considered project emissions in concert with emissions from other sources (i.e., electric generation, motor vehicles, biogenics, etc.).

The nature of proposed development was based on the KMG proposed project description. The analysis incorporated the planned development and a prepared set of emissions data for project modeling, to include project development alternatives and reasonably foreseeable development as discussed below. Those emissions data were incorporated into the modeling system developed for the project base year, and used to predict impacts on visibility, acid deposition, and air quality, including ozone. Critical impacts on resources evaluated were identified, and the major source or source groups that contribute to those impacts were characterized.

Emissions data for 2006 were used as the basis for comparing emissions and impacts for the base year. This selection was appropriate primarily because of data availability for 2006 from the Western Regional Air Partnership (WRAP). WRAP used 2006 as the base year for their regional haze planning and put significant effort into preparing the meteorological simulation and emissions data that were necessary to carry out a detailed CMAQ simulation.

### 1.2.1 Modeling Systems

#### 1.2.1.1 CALPUFF Modeling

An air quality modeling analysis was being conducted for the current proposed study to assess potential impacts on ambient air quality and Air Quality-Related Values (AQRVs) in the modeling domain from existing and projected sources in the study area. The CALPUFF modeling system (Scire et al. 2000a,b) was promulgated on April 15, 2003, and is the United States (U.S.) Environmental Protection Agency's (USEPA's) preferred/recommended model for long-range transport and for complex winds at short-range distances. As appropriate, the modeling procedure follows recommendations in the Interagency Workgroup on Air Quality Modeling and Federal Land Managers' (FLM) Air Quality Related Values Workgroup (FLAG) documents for the assessment of both near- and far-field impacts (USEPA 1998a; FLAG 2000). This analysis uses the current USEPA-approved version of the CALPUFF modeling suite (Version 5.8) to address the air quality impacts and AQRVs.

#### 1.2.1.2 CMAQ Modeling

For more than a decade, USEPA has been developing the CMAQ modeling system with the overarching aim of producing a 'One-Atmosphere' air quality modeling system capable of addressing ozone, particulate matter (PM), visibility, and acid deposition within a common platform (Byun and Ching 1999; Byun and Schere 2006). The original justification for the Models-3 development emerged from the challenges posed by the 1990 Clean Air Act (CAA) Amendments and USEPA's desire to develop an advanced modeling framework for 'holistic' environmental modeling utilizing state-of-science representations of atmospheric processes in a high performance computing environment. USEPA completed the initial stage of development with Models-3 and released CMAQ in mid-1999 as the initial operating science model under the Models-3 framework. The most recent rendition is CMAQ Version 4.6, publicly released in October 2006.

[1] This analysis does not differentiate between increment-consuming and non-increment-consuming sources, and therefore, the model results cannot be used to demonstrate compliance with PSD increment consumption. However, the results of modeling are compared to applicable Class I or Class II increment levels.

CMAQ consists of a core Chemical Transport Model (CTM) and several preprocessors including the Meteorological-Chemistry Interface Processor (MCIP), initial and boundary conditions processors (ICON and BCON), and a photolysis rates processor (JPROC).

Byun and Schere (2006) described the newest features implemented in CMAQ Version 4.5. In addition to those mentioned above, others pertained to details in the model's chemistry, transport, computer implementation, and model operation. This latest version of CMAQ was used to develop predictions of ground level ozone concentrations in the region. In accord with the nature of the ambient ozone standard, the annual fourth highest daily 8-hour concentrations were provided for comparison to air quality standards. The same grid area that was used for the CALPUFF modeling was used for CMAQ.

#### 1.2.1.3 AERMOD Modeling

AERMOD is a refined dispersion model for simple and complex terrain for receptors within 50 km of a modeled source. The AERMOD (USEPA 2004) model was adopted by USEPA in a final rule (Federal Register November 9, 2005) and replaced the Industrial Source Complex (ISC) model. The rule became effective on December 9, 2005, and the ISC model was phased out as of December 9, 2006. The AERMOD model was developed by the American Meteorological Society/USEPA Regulatory Model Improvement Committee (AERMIC) work group and was intended to incorporate improved understanding of air dispersion calculations. The AERMOD modeling system consists of two preprocessors and the dispersion model. AERMET is the meteorological preprocessor component and AERMAP is the terrain preprocessor component that characterizes the terrain and generates receptor elevations along with critical hill heights for those receptors.

The promulgated version of AERMOD (Version 07026) was used for the near-field modeling for this study and was run with default model options. AERMOD was used to assess air quality impacts from project-related sources in the local area for comparison to applicable air quality standards and PSD Class II increments, but not as a regulatory evaluation. This near-field analysis focused on oil and gas development and operations, and did not directly address impacts from other major sources in the region because it focused on the project-only impacts.

## 1.3 Development of Emissions Inventories and Pollutants of Interest

Emissions inventory scenarios were developed for the base year operating scenario and three forecast year scenarios that include reasonable foreseeable development, the proposed project, and maximum production. These four scenarios are identified as follows:

- 2006 Baseline – 2006 base year actual emissions;
- 2018 Projected Baseline – 2018 projected emissions without the proposed project;
- 2017 Proposed Action – 2018 Projected Baseline emissions with project emissions from the proposed development alternative in 2017; and
- 2026 Optimal Recovery Alternative – 2018 Projected Baseline emissions with project emissions from the maximum recovery development alternative in 2026.

The NEPA analysis also considers a Resource Protection Alternative, which focuses on minimizing land disturbance for the installation and operation of wells and other support facilities. From an air emissions perspective, ambient impacts from the Resource Protection Alternative are well-characterized by the impacts from the Proposed Action; therefore, the Resource Protection Alternative was not modeled as a separate evaluation.

Air emissions inventories were developed from the WRAP emissions inventories and project-specific data provided by KMG. The WRAP inventories were compiled using data provided by state and tribal regulatory agencies, as well as industry partners, and include data for point, area, non-road mobile, and on-road mobile

sources. All or portions of multiple WRAP inventories were used to develop emissions for the 2006 Baseline and 2018 Projected Baseline scenarios. These WRAP inventories include:

- 2002 Plan2d – original WRAP baseline inventory for all sources (used non oil and gas portion only);
- 2018 PRP18a – original WRAP forecasted inventory for non-road mobile and on-road mobile sources;
- 2018 PRP18b – updated WRAP forecasted inventory for point and area sources;
- 2002 Phase II – 2002 base year inventory for oil and gas sources only, updated to address visibility and regional haze (focus on oxides of nitrogen [$NO_X$]);
- 2018 Phase II – 2018 forecasted inventory for oil and gas sources only, updated to address visibility and regional haze (focus on $NO_X$);
- 2006 Draft Phase III – 2006 base year inventory for oil and gas sources only, updated to address ozone (focus on VOCs); and
- 2012 Draft Phase III – 2012 base year inventory for oil and gas sources only, updated to address ozone (focus on VOCs).

The 2006 Baseline and 2018 Projected Baseline scenarios primarily used the 2002 Plan2d, 2018 PRP18a, and 2018 PRP18b inventories for non oil and gas emissions only, supplemented with the Phase II and Draft Phase III inventories for oil and gas emissions as available. Emissions inventories of criteria pollutants and source characteristics for the 2017 Proposed Action and 2026 Optimal Recovery Alternative scenarios were based on project data provided by KMG. Sources were grouped as necessary to facilitate modeling and analysis. See Chapter 3.0 for greater detail regarding inventory development.

## 1.4 Assessment Approach

The outputs from the air quality modeling were used to assess potential impacts on near-field and far-field air quality and far-field AQRVs. Air quality impact assessments were conducted by making the following comparisons:

- Air quality impacts resulting only from the Proposed Action or Optimal Recovery Alternative alone were compared to predicted impacts from the 2018 Projected Baseline.
- Direct cumulative air quality impacts were compared to the applicable NAAQS and State Ambient Air Quality Standards (SAAQS) and applicable PSD increments (Class I or Class II, depending on receptor location). While the impacts were numerically compared to PSD increments for each emissions scenario to determine the change over time of the modeled impacts, there was no formal assessment of increment-consuming emissions or of expected increment consumption.

AQRVs evaluated included visibility and atmospheric deposition. Visibility impacts were assessed at the far-field receptors located in sensitive receptor areas using two different procedures.

1. The primary method for assessing regional haze impacts was based on USEPA's Best Available Retrofit Technology (BART) guideline (also referred to as Method 6). This method also is used for tracking progress under the Regional Haze Rule (USEPA 2003) and is planned as a possible update to FLAG. Method 6 results were presented as consistent with the BART guideline. That is, the $98^{th}$ percentile (or eighth highest day per year) model results were presented in addition to the number of days of impacts above 1.0 change in deciviews (dv) and the maximum change in dv. Data for 0.5 change in dv were provided for information purposes only.
2. The second method was based on the FLAG guidance document (also referred to as Method 2). This method used an assumed natural background visibility reference level and visibility parameter equations recommended by FLAG (FLAG 2000). Under the FLAG method, estimated visibility degradation was compared to the established significance thresholds.

The FLAG recommended background values were used for both Method 2 and Method 6 assessments. Results of both analyses were reported.

Atmospheric deposition impacts were assessed by comparing predicted net change in annual total atmospheric deposition fluxes to sensitive lakes in terms of acid neutralizing capacity (ANC), and with the threshold based on U.S. Forest Service (USFS)-recommended prediction methods (USFS 2000) and the total terrestrial deposition loading method in Fox et al. (1989).

Future 8-hour ozone impacts were estimated from the CMAQ modeling following the USEPA-recommended approach of using the photochemical grid model in a relative sense to scale observed 8-hour design values (USEPA 2007). The analysis focused on the fourth highest daily 8-hour reading using 1 year of meteorological data developed for modeling. Since there were no current complete monitoring data in or representative of the GNBPA, spatial depictions of the differences in future year ozone levels with and without the project emissions were provided. However, without concurrent meteorological data, emissions data, and monitored ozone levels that represent impacts in the area, it was impossible to assess the adequacy of the model simulations in the GNBPA. The focus of the ozone evaluation was on the projected change in ozone levels resulting from the Projected Baseline scenario compared to either the Proposed Action or Optimal Recovery Alternative.

# 2.0 Study Area and Background for Air Quality Analyses

Air quality within the Uinta Basin has the potential to be affected by activities such as emissions from the construction and operation of oil and gas facilities, access roads, and other elements of the proposed project. Regional air quality also is affected by natural events such as windstorms and wildfires. These natural events generally are short lived, lasting from several hours to perhaps several days. The effects during the event may impact human health and the environment, and generally are considered part of the natural environment.

## 2.1 Regional Setting for Air Quality

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, atmospheric stability, and wind (speed and direction). Mixing height is the height above ground within which rising warm air from the surface will mix by convection and turbulence. Local atmospheric conditions, terrain configuration, and source location determine dilution of pollutants in this mixed layer.

The Uinta Basin in eastern Utah is part of a high, broad plateau area that is surrounded by higher terrain on virtually all sides, with rugged and rolling terrain features embedded in the plateau. The GNBPA extends along the White River Valley within Uintah County. South of that valley, the GNBPA extends over a large region that includes terrain with numerous creeks and washes that generally are north-south in orientation. Elevations range from about 4,700 feet above mean sea level along the White River to 5,500 feet along the benches and ridges in the southern part of the GNBPA.

With a dry intermountain climate, the region usually has relatively clear days and nights with wide swings in daily temperature as well as a wide range of seasonal conditions from winter to summer. **Table 2-1** provides a climatological summary for two sites that are located to the west (Ouray 4 NE) and east (Bonanza) of the GNBPA (Western Regional Climate Center 2007); therefore, representing conditions in the region. Precipitation is relatively light across the region (6.77 to 8.85 inches per year), but does occur throughout the year with no clearly defined dry or wet season. Summertime maximum temperatures reach into the 90s (degrees Fahrenheit [°F]) with winter lows near zero (°F).

**Table 2-1 Period of Record Monthly Climate Summary**

**Ouray 4 NE, Utah (426568) – Period of Record: 6/1/1941 to 12/31/2007**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max. Temperature (°F) | 29.0 | 37.7 | 54.1 | 66.0 | 76.9 | 87.6 | 94.7 | 91.7 | 81.3 | 67.9 | 48.0 | 33.1 | 64.0 |
| Average Min. Temperature (°F) | 2.4 | 10.0 | 23.7 | 33.5 | 42.5 | 50.2 | 56.1 | 54.0 | 43.9 | 32.5 | 20.5 | 7.9 | 31.4 |
| Average Total Precipitation (in.) | 0.37 | 0.33 | 0.46 | 0.67 | 0.69 | 0.51 | 0.59 | 0.67 | 0.76 | 0.93 | 0.43 | 0.37 | 6.77 |
| Average Total Snowfall (in.) | 4.4 | 2.7 | 1.5 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 1.6 | 4.0 | 15.1 |
| Average Snow Depth (in.) | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

**Bonanza, Utah (420802) – Period of Record: 3/16/1938 to 2/25/1993**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max. Temperature (°F) | 30.7 | 37.3 | 50.1 | 63.4 | 73.9 | 85.0 | 92.5 | 89.7 | 80.8 | 66.2 | 48.1 | 35.5 | 62.8 |
| Average Min. Temperature (°F) | 7.1 | 13.2 | 24.9 | 34.2 | 42.6 | 50.0 | 57.1 | 54.9 | 46.3 | 35.5 | 23.0 | 12.7 | 33.5 |
| Average Total Precipitation (in.) | 0.59 | 0.42 | 0.66 | 0.83 | 0.93 | 0.76 | 0.72 | 0.91 | 0.91 | 1.12 | 0.49 | 0.50 | 8.85 |
| Average Total Snowfall (in.) | 6.7 | 5.1 | 4.2 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 2.3 | 5.1 | 24.9 |
| Average Snow Depth (in.) | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

Representative wind data for climatological conditions are available from the National Climatic Data Center's Integrated Surface Hourly data set for the airport monitoring station located at Vernal. This site is in relatively open terrain and is not influenced by very local topographic features; therefore, the wind pattern at this location should be representative of surface conditions in the Uinta Basin region (**Figure 2-1**). As shown in the

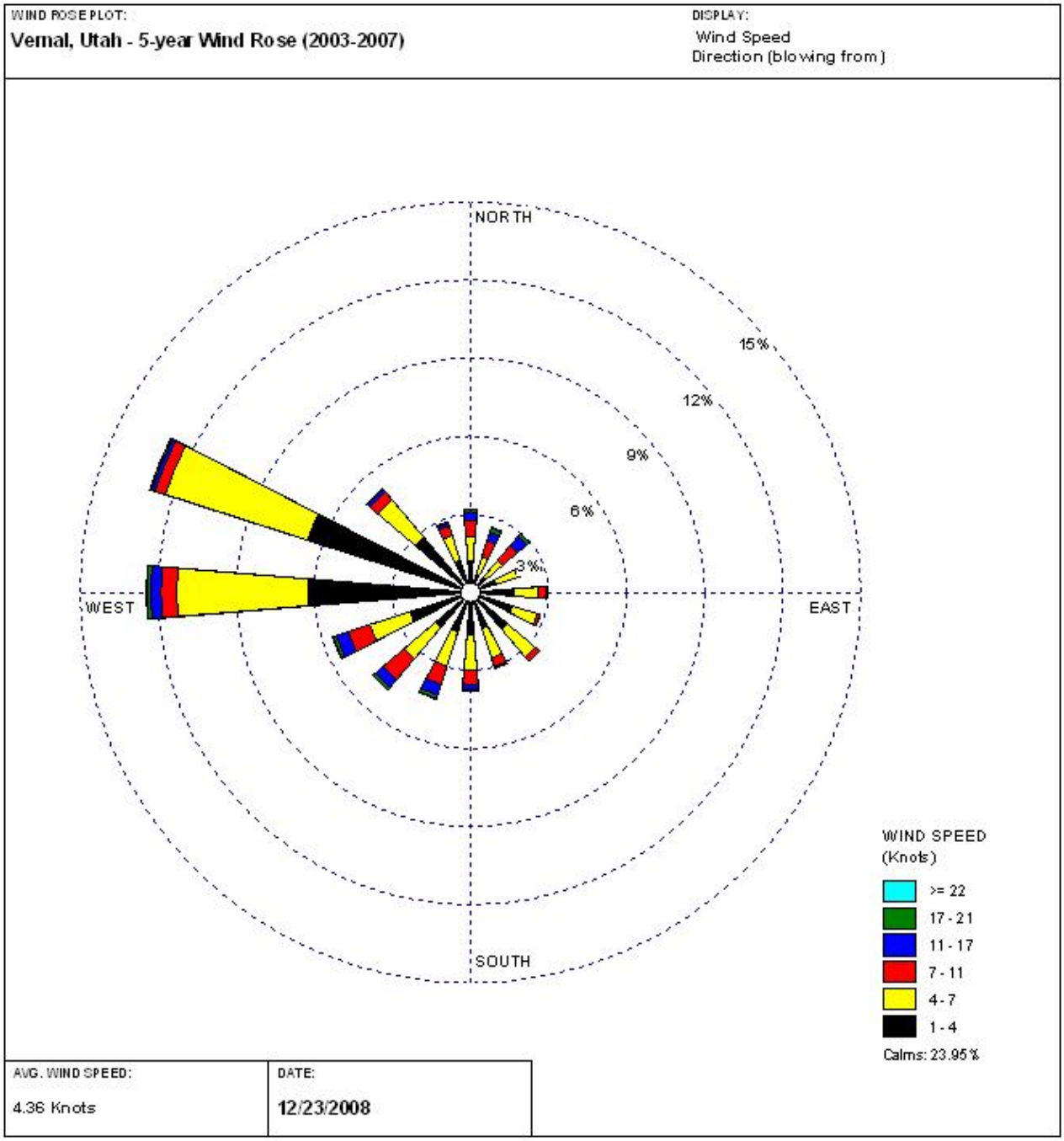



**Figure 2-1 Wind Rose from Vernal, Utah, Airport**

Resource Management Plan and Final EIS for the BLM Vernal Field Office (BLM 2008a), wind patterns from specific Remote Air Weather Stations show some variability in prevailing wind directions.

**Figure 2-1** depicts the wind direction and wind speed for a 5-year period including calendar year 2003 through calendar year 2007 for the airport site in Vernal, Utah. The pattern shows a distinctly prevailing wind from the west (at 10 m above ground level), while light winds can occur from any of the indicated directions. The pattern can be used to develop impacts associated with local sources, but each individual source would have a distinct flow regime based on the indicated prevailing wind direction.

## 2.2 Recent Development in the Region

Other developmental projects are completed or underway in the Uinta Basin that must be considered in the cumulative impact analysis of the proposed project. These projects required air quality reviews and were included in the WRAP Phase III inventory, which was used to estimate future Projected Baseline emissions. Sections 3.1 and 3.2 provide a more detailed discussion of how the WRAP Phase III data is incorporated into this study.

## 2.3 Background Air Quality

Air quality in a given location is defined by pollutant concentrations in the atmosphere and generally is expressed in units of parts per million (ppm) or micrograms per cubic meter (µg/m$^3$). The existing air quality in the proposed development area is compliant with both the NAAQS and SAAQS or has insufficient data to establish compliance (see Section 2.4.1.1). Representative ambient background levels of pollutants measured in Uintah and Salt Lake counties, Utah, and Sweetwater County, Wyoming, are shown in **Table 2-2**. Data for this table was obtained from the Utah Division of Air Quality (UDAQ) Air Monitoring Network data archives website.

**Table 2-2 Background Ambient Air Quality Data**

| Pollutant | Averaging Period | Ranking[1] | Year | Concentration (µg/m$^3$) | County | State |
|---|---|---|---|---|---|---|
| Nitrogen Dioxide ($NO_2$) | Annual | H | 2006 | 13.2 | Sweetwater | Wyoming |
| | | H | 2007 | 13.2 | Sweetwater | Wyoming |
| | | | AQIA | 13.2 | Sweetwater | Wyoming |
| Carbon Monoxide (CO) | 1-hour | H2H | 2004 | 6,210 | Salt Lake | Utah |
| | | H2H | 2005 | 6,325 | Salt Lake | Utah |
| | | H2H | 2006 | 6,325 | Salt Lake | Utah |
| | | | AQIA | 6,325 | Salt Lake | Utah |
| | 8-hour | H2H | 2004 | 3,680 | Salt Lake | Utah |
| | | H2H | 2005 | 3,910 | Salt Lake | Utah |
| | | H2H | 2006 | 3,450 | Salt Lake | Utah |
| | | | AQIA | 3,910 | Salt Lake | Utah |
| Sulfur Dioxide ($SO_2$) | 3-hour | H2H | 2006 | 18.3 | Sweetwater | Wyoming |
| | | H2H | 2007 | 15.7 | Sweetwater | Wyoming |
| | | | AQIA | 18.3 | Sweetwater | Wyoming |
| | 24-hour | H2H | 2006 | 10.5 | Sweetwater | Wyoming |
| | | H2H | 2007 | 5.2 | Sweetwater | Wyoming |
| | | | AQIA | 10.5 | Sweetwater | Wyoming |
| | Annual | H | 2006 | 2.6 | Sweetwater | Wyoming |
| | | H | 2007 | 2.6 | Sweetwater | Wyoming |
| | | | AQIA | 2.6 | Sweetwater | Wyoming |
| | | H2H | 2004 | 14.0 | Uintah | Utah |

**Table 2-2 Background Ambient Air Quality Data**

| Pollutant | Averaging Period | Ranking[1] | Year | Concentration ($\mu g/m^3$) | County | State |
|---|---|---|---|---|---|---|
| PM with an aerodynamic diameter of 10 microns or less ($PM_{10}$) | 24-hour | H2H | 2005 | 18.0 | Uintah | Utah |
| | | H2H | 2006 | 16.0 | Uintah | Utah |
| | | | AQIA | 18.0 | Uintah | Utah |
| | Annual | H | 2004 | 5.0 | Uintah | Utah |
| | | H | 2005 | 7.0 | Uintah | Utah |
| | | H | 2006 | 7.0 | Uintah | Utah |
| | | | AQIA | 7.0 | Uintah | Utah |
| PM with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) | 24-hour | 98th percentile | 2007 | 27.0 | Uintah | Utah |
| | | | AQIA[2] | 27.0 | Uintah | Utah |

[1] H = Highest value recorded

H2H = High Second High (second highest value from the highest receptor site).

[2] AQIA = Air Quality Impact Assessment (representative of ambient background). The AQIA selected for each averaging period for a specific pollutant is the maximum ranked value from a recent representative 2- or 3-year period.

A background $PM_{2.5}$ concentration was developed from UDAQ data collected at the Vernal, Utah, monitoring site. A background $PM_{2.5}$ concentration of 27 $\mu g/m^3$ was obtained from the 98th percentile of 90 data points collected from March 1, 2007, to December 14, 2007. This time frame eliminates data for the winter months because these are not representative of conditions in the GNBPA. The Vernal monitor has reported values as high as 63 $\mu g/m^3$, with 3 readings above 50 $\mu g/m^3$ in the winter months. The monitor is located in what is essentially an "urban" setting, which monitors impacts from unique sources such as woodstoves, fireplaces, traffic, etc., which would not be present in the GNBPA. The background $PM_{2.5}$ concentration of 27 $\mu g/m^3$ compares favorably with the 98th percentile of 12 months of $PM_{10}$ data from the nearby Myton (Duchesne County) and Whiterocks (Uintah County) stations (25 $\mu g/m^3$), located in a rural setting. Because $PM_{2.5}$ is a portion of $PM_{10}$, and never greater than $PM_{10}$, data developed using rural $PM_{10}$ data are conservative estimates of rural $PM_{2.5}$ levels. Since the Myton and Whiterocks data do not show the wintertime peaks in $PM_{10}$ levels, it is clear that the wintertime peak $PM_{2.5}$ levels in Vernal are a localized effect of a small city.

UDAQ collected ozone data near Vernal, Utah, in 2007. The annual sample was incomplete and required additional quality review; however, the data were subjectively evaluated, and the limited, unofficial data analysis resulted in a fourth highest 8-hour ozone level of 69 parts per billion (ppb). As the monitoring represents only 1 incomplete year, the ozone level must be considered as an approximation of the “design value” for ozone at this site.

## 2.4 Standards and Evaluation

The CAA of 1970 (42 United States Code 7401) as amended in 1977 and 1990 is the basic federal statute governing air pollution. Provisions of the CAA that potentially are relevant to the GNBPA are listed and discussed below:

- NAAQS;
- PSD;
- Nonattainment New Source Review;
- Conformity Regulations;
- New Source Performance Standards; and
- National Emissions Standards for Hazardous Air Pollutants (NESHAP).

### 2.4.1 National Ambient Air Quality Standards

The federal CAA amendments of the 1990s require all states to control air pollution emissions sources so that NAAQS are met and maintained. The NAAQS establishes maximum acceptable concentrations for nitrogen ($NO_2/NO_X$), CO, $SO_2$, $PM_{10}$, $PM_{2.5}$, ozone, and lead. Given the extremely low levels of lead emissions from project sources, the lead standards were not addressed in this analysis. These pollutants are known as criteria pollutants. The NAAQS are established by USEPA and are outlined in 40 Code of Federal Regulations (CFR) 50. These standards represent the maximum allowable atmospheric concentrations that may occur without jeopardizing public health and welfare, and include a reasonable margin of safety to protect the more sensitive individuals in a population. The NAAQS represent maximum acceptable concentrations that generally may not be exceeded more than once per year; the annual standards may never be exceeded. An area that does not meet the NAAQS is designated as a nonattainment area on a pollutant-by-pollutant basis. The State of Utah has adopted the NAAQS as the SAAQS. Applicable federal and state criteria are presented in **Table 2-3**.

**Table 2-3 Applicable Ambient Air Quality Standards**

| Pollutant | Averaging Period | Ambient Air Quality Standards[1] (µg/m3) | | | |
|---|---|---|---|---|---|
| | | National | Wyoming | Utah | Colorado |
| $NO_2$ | Annual[2] | 100 | 100 | 100 | 100 |
| CO | 1-hour[3] | 40,000 | 40,000 | 40,000 | 40,000 |
| | 8-hour[3] | 10,000 | 10,000 | 10,000 | 10,000 |
| $SO_2$ | 3-hour[3] | 1,300 | 1,300 | 1,300 | 1,300 |
| | 24-hour[3] | 365 | 260 | 365 | 365 |
| | Annual[2] | 80 | 60 | 80 | 80 |
| $PM_{10}$ | 24-hour[4] | 150 | 150 | 150 | 150 |
| | Annual[2] | --[7] | 50 | 50 | 50 |
| $PM_{2.5}$ | 24-hour[5] | 35 | 35 | 35 | 35 |
| | Annual[6] | 15 | 15 | 15 | 15 |
| Ozone | 8-hour[8] | 75/84 | 75/84 | 75/84 | 75/84 |

[1] Sources: USEPA 2009, Wyoming Department of Environmental Quality (WDEQ) 2008, UDAQ 2008, and Colorado Department of Public Health and Environment 2007.

[2] Never to be exceeded.

[3] Not to be exceeded more than once per year.

[4] Not to be exceeded more than once per year on average over 3 years.

[5] Three-year average of the 98th percentile of the 24-hour concentrations at each population-oriented monitor within an area must not exceed this standard.

[6] Three-year average of the weighted annual mean concentrations from single or multiple community-oriented monitors must not exceed this standard.

[7] The annual $PM_{10}$ NAAQS of 50 µg/m$^3$ was revoked by USEPA on September 21, 2006. See Federal Register Volume 71, Number 200, October 17, 2006.

[8] Values provided reflect the 2008 standard/1997 standard. Three-year average of the fourth highest daily maximum 8-hour average measured at each monitor within an area over each year must not exceed this standard. The 1997 standard – and the implementation rules for that standard – remain in place for implementation purposes as USEPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

### 2.4.2 Prevention of Significant Deterioration

PSD regulations restrict the degree of ambient air quality deterioration allowed and apply to proposed new or modified major stationary sources located in an attainment area that have the potential to emit criteria pollutants in excess of predetermined de minimis values (40 CFR 51). Increments for criteria pollutants are based on the PSD classification of the area. Class I area status is assigned to federally protected wilderness areas and allows the lowest amount of permissible deterioration. This designation essentially precludes development near these areas. Class II areas are designed to allow for moderate, controlled growth, and Class III areas allow for heavy industrial use.

As defined in 40 CFR 51, a source is considered a major stationary source if it:

- Can be classified in one of 28 named source categories listed in Section 169 of the CAA and it emits or has the potential to emit 100 tpy of any pollutant regulated by the Act; or
- Is any other stationary source that emits or has the potential to emit 250 tpy or more of any pollutants regulated by the CAA (USEPA 1990).

Compressor stations and other upstream oil and gas sources are not listed as one of the 28 named source types in Section 169 of the Act; therefore, 250 tpy is the threshold for major source status.

Federal PSD Class I areas, which include certain national wilderness areas, national memorial parks, and national parks, are afforded the highest level of protection. Ambient air criteria that apply within Class I areas are more stringent than those that apply to other areas. In addition to more stringent ambient air increments, Class I areas also are protected by the regulation of AQRVs within their borders. FLMs are responsible for the management of PSD Class I areas. **Table 2-4** provides a list of federal Class I and sensitive Class II areas considered in this analysis.

**Table 2-4 Class I and Sensitive Class II Areas of Concern for Air Quality Impact Analysis**

| |
|---|
| **National Park Service (NPS) Class I Areas** |
| Arches National Park |
| Black Canyon of the Gunnison National Park |
| Canyonlands National Park |
| Capitol Reef National Park |
| Mesa Verde National Park |
| **USFS Class I Areas** |
| Eagles Nest Wilderness Area |
| Flat Tops Wilderness Area |
| La Garita Wilderness Area |
| Maroon Bells-Snowmass Wilderness Area |
| Mount Zirkel Wilderness Area |
| Weminuche Wilderness Area |
| West Elk Wilderness Area |
| **NPS Class II Areas** |
| Colorado National Monument |
| Dinosaur National Monument |
| USFS Class II Areas |
| Flaming Gorge National Recreation Area |
| High Uintah Wilderness Area |
| Holy Cross Wilderness Area |
| Hunter/Frying Pan Wilderness Area |
| Raggeds Wilderness Area |
| **U.S. Fish and Wildlife Service Class II Areas** |
| Browns Park National Wildlife Refuge |

Allowable deterioration to air quality can be expressed as the incremental increase to ambient concentration of criteria pollutants, or PSD increment. Modeled air concentration of $NO_2$, $SO_2$, and $PM_{10}$ predicted at near-field receptors that result from project emissions were compared to the threshold of allowable PSD increments. This comparison to PSD Class II increments did not represent a regulatory PSD increment consumption analysis because the focus of this study was the Proposed Action and alternatives under NEPA, not increment-affecting sources that were not relevant under NEPA. The allowable PSD increments for Class II areas also are given in **Table 2-5**.

**Table 2-5 PSD Increments for Class I and Class II Areas**

| PSD Class | Pollutant | Allowable Increment (µg/m$^3$) | | |
|---|---|---|---|---|
| | | Annual Arithmetic Mean | 24-hour Maximum | 3-hour Maximum |
| Class I | $NO_2$ | 2.5 | - | - |
| | $SO_2$ | 2 | 5 | 25 |
| | $PM_{10}$ | 4 | 8 | - |
| Class II | $NO_2$ | 25 | - | - |
| | $SO_2$ | 20 | 91 | 512 |
| | $PM_{10}$ | 17 | 30 | - |

### 2.4.3 Nonattainment New Source Review

Nonattainment New Source Review is required for major stationary sources locating or expanding in nonattainment areas. The areas potentially impacted by the proposed project are currently in attainment for all criteria pollutants; therefore, this review would not apply.

### 2.4.4 Conformity for General Federal Actions

According to Section 176(c) of the CAA (40 CFR 51.853), a federal agency must make a conformity determination in the approval of a project having air emissions that exceed specified thresholds in nonattainment and/or maintenance areas. The proposed project does not pass through a nonattainment or maintenance area; therefore, a general conformity analysis would not apply to the proposed or alternative actions.

### 2.4.5 New Source Performance Standards

The regulation of new sources, through the development of standards applicable to a specific category of sources, was a significant step taken by the CAA (PL 91-604). The USEPA was to publish a proposed regulation establishing a standard of performance for any new source that fell into any category. The significant feature of the law is that it applies to all new, modified, or reconstructed sources within a given category, regardless of geographic location or the existing ambient air quality. The standards defined emission limitations that would be applicable to a particular source group. The New Source Performance Standards potentially applicable to the project include the following subparts of 40 CFR Part 60:

- Subpart A – General Provisions;
- Subpart Kb – Standards of Performance for Volatile Organic Storage Vessels;
- Subpart KKK – Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants;
- Subpart LLL – Standards of Performance for Onshore Natural Gas Processing: $SO_2$ Emissions;
- Subpart JJJJ – Standards of Performance for Stationary Spark-Ignition Internal Combustion Engines; and
- Subpart KKKK – Standards of Performance for Stationary Combustion Turbines.

#### 2.4.5.1 Subpart A – General Provisions

Certain provisions of Subpart A apply to the owner or operator of any stationary source subject to a New Source Performance Standard. Provisions of Subpart A potentially could apply depending on the applicability of other subparts of 40 CFR Part 60.

#### 2.4.5.2 Subpart Kb – Volatile Organic Liquid Storage Vessels

Subpart Kb is applicable to storage vessels containing volatile organic liquids with a capacity greater than 75 $m^3$ (approximately 19,800 gallons). This subpart potentially would be applicable to storage tanks for natural gas liquids and pipeline liquids tanks located at pump or meter stations.

#### 2.4.5.3 Subpart KKK – Equipment Leaks from Onshore Natural Gas Processing Plants

Subpart KKK dictates emissions standards, operating procedures, and work practice standards to control emissions of VOC from leaks in equipment during handling of gas or natural gas liquids at onshore processing plants. The provisions of Subpart KKK apply to all equipment at an onshore natural gas processing plant handling VOC or wet gas that is constructed, modified, or reconstructed on or after January 20, 1984. This includes all compressor stations, dehydration units, sweetening units, underground storage tanks, field gas gathering systems, or liquefied natural gas handling located at the processing plant, but excludes any of these activities conducted at field sites. The scope of the proposed project does not include natural gas processing plants, so the provisions of the Subpart would not apply.

#### 2.4.5.4 Subpart LLL – $SO_2$ Emissions from Onshore Natural Gas Processing

Subpart LLL provides emissions standards, operating procedures, and work practice standards to control emissions of $SO_2$ from sweetening units, including those followed by a sulfur recovery unit that is constructed, modified, or reconstructed after January 20, 1984. Facilities processing less than 2 metric tons/day are required to comply only with 40 CFR 60.647(c). The proposed project may include sweetening units at a major stationary source to which this Subpart may apply.

#### 2.4.5.5 Subpart JJJJ – Stationary Spark-ignition Internal Combustion Engines

On January 18, 2008, USEPA published in the Federal Register the finalized rule for $NO_X$, CO, and non-methane hydrocarbons from certain new stationary spark-ignited internal combustion (IC) engines that commence construction, modification, or reconstruction after the date the particular standard for a specified engine is identified. For the purposes of this Subpart, the date that construction commences is the date that the engine is ordered by the owner or operator. The requirements of this Subpart apply to owners or operators of stationary spark-ignition IC engines that commence construction after June 12, 2006, where IC engines greater than or equal to 500 hp are manufactured on or after July 1, 2007, and where emergency generator engines are manufactured on or after January 1, 2009.

#### 2.4.5.6 Subpart KKKK – Stationary Combustion Turbines

On February 18, 2005, USEPA published proposed rules in the Federal Register for $NO_X$ and $SO_2$ from new stationary combustion turbines larger than 1 megawatt that commence construction, modification, or reconstruction after February 18, 2005. The preamble to the proposed rule states that new stationary combustion turbines subject to the proposed standards are exempt from the requirements of the 40 CFR 60 Subpart GG. Combustion turbines that operate in emergency situations are exempt from the regulations. USEPA promulgated the new construction turbine Subpart KKKK rule on July 6, 2006.

### 2.4.6 National Emission Standards for Hazardous Air Pollutants

Under the NESHAP, USEPA promulgated Maximum Achievable Control Technology (MACT) standards pursuant to Section 112 of the 1990 CAA Amendments, and those rules are provided in 40 CFR 63. The MACT standards potentially applicable to the proposed project include:

- Subpart A – General Provisions;
- Subpart HH – Oil and Natural Gas Production Facilities;
- Subpart YYYY – Stationary Combustion Turbines; and
- Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines.

#### 2.4.6.1 Subpart A – General Provisions

The general provisions for all sources affected by a MACT standard are promulgated under Subpart A. Each of the promulgated standards contains a detailed list of Subpart A provisions that are applicable to the affected facility. The critical sections of Subpart A are summarized in 40 CFR 63.6, specifically including 40 CFR 63.6(e), which provides operation and maintenance requirements.

#### 2.4.6.2 Subpart HH – Oil and Natural Gas Production Facilities

In the January 3, 2007, Federal Register, the USEPA promulgated a rule to amend 40 CFR 63 Subpart HH to include area sources rather than just major sources of HAPs. An affected source under this final rule is each tri-ethylene glycol dehydration unit located at an area source oil and natural gas production facility.

#### 2.4.6.3 Subpart YYYY – Stationary Combustion Turbines

USEPA published this final stationary combustion turbine MACT in the Federal Register on March 5, 2004. New lean premix and diffusion flame gas- and oil-fired turbines at major HAP facilities are required to limit formaldehyde emissions to 91 ppb volume dry at 15 percent oxygen. On April 7, 2004, USEPA published two proposed rules affecting natural gas-fired lean premix combustion turbines and three other subcategories. On August 18, 2004, USEPA issued a final rule to stay the effectiveness for two categories of stationary combustion turbines: lean pre-mix gas-fired turbines and diffusion flame gas-fired turbines.

#### 2.4.6.4 Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines

On January 18, 2008, the USEPA published finalized rules in the Federal Register to amend 40 CFR 63 Subpart ZZZZ. An affected source under this amended Subpart is any existing, new, or reconstructed stationary reciprocating internal combustion engine with a site-rating of more than 25 brake horsepower (bhp), located at either a major source or area source of HAP.

## 2.5 Carbon Dioxide and Other Greenhouse Gases

In *Massachusetts v. EPA*, the U.S. Supreme Court (April 7, 2007) held that carbon dioxide ($CO_2$) satisfies the definition of “air pollutant” and that USEPA has authority to regulate emissions of $CO_2$ and other greenhouse gases (GHG) from new motor vehicles under the CAA. The Supreme Court remanded the case to USEPA to determine whether such motor vehicle emissions contribute to global climate change, and thereby endanger public health or welfare. The ruling, however, did not require the USEPA to create any emission control standards or ambient air quality standards for GHG.

$CO_2$ and other GHG are naturally occurring gases in the atmosphere whose status as a pollutant is not related to their toxicity, but to the added long-term impacts they may have on climate because of their increased incremental levels in the earth’s atmosphere. Because they are non-toxic and non-hazardous at normal ambient concentrations, $CO_2$ and other naturally occurring GHG are, therefore, not regulated under the major environmental regulatory programs that primarily address toxic and hazardous substances.

On March 10, 2009, the USEPA issued the proposed mandatory reporting rule for GHG. The USEPA expects to finalize the proposed rule by the end of 2009, requiring a wide range of sources and source groups to record and report selected GHG emissions, including $CO_2$, methane, nitrous oxide, and some halogenated compounds. No controls are required under this rule.

The proposed rule specifically identifies monitoring and reporting requirements for oil and natural gas systems. The oil and natural gas source category includes on-shore natural gas processing facilities and on-shore natural gas transmission compression facilities, which are applicable components of the proposed project. Combustion units associated with these processes also are included under a separate industrial facility grouping. The preamble to the proposed rule discusses the USEPA review of on-shore petroleum and natural gas production facilities, but the USEPA indicates that these facilities are not proposed for inclusion within the rule because of the unique difficulty in defining “facility.” However, the USEPA specifically seeks comments on

reporting of the major fugitive emissions by corporations at the basin level. Given the nature of the regulatory environment and the possibility of review by the USEPA, it is possible that the natural gas production facilities ultimately would be included as a facility under this rule.

The March 2009 proposed rule does not require any controls or establish any standards related to GHG emissions or impacts. Therefore, there is no evident requirement at this time that would affect development of the proposed project under the proposed rule, other than the possibility of monitoring, recordkeeping, and reporting of GHG emissions. Chapter 6.0 provides a detailed GHG emission calculation for the Proposed Action and Optimal Recovery Alternative.

# 3.0 Emissions Data

This chapter provides a detailed discussion of the air emissions inventories for the base year and each project alternative. The four emissions inventories developed and analyzed for this study include the:

- 2006 Baseline – 2006 base year actual emissions;
- 2018 Projected Baseline – 2018 projected emissions without the proposed project;
- 2017 Proposed Action – 2018 Projected Baseline emissions with project emissions from the proposed development alternative in 2017; and
- 2026 Optimal Recovery Alternative – 2018 Projected Baseline emissions with project emissions from the maximum recovery development alternative in 2026.

The 2006 inventory was developed from the WRAP Phase III inventories for model validation and as the foundation of projected baseline development. This inventory represented existing conditions for that year only. To create the 2018 Projected Baseline inventory, the 2006 inventory was extrapolated as described in Section 3.1 to include emissions increases that include ongoing and approved projects as well as reasonably foreseeable future development. This Projected Baseline was incorporated into the cumulative analysis for the Proposed Action and the Optimal Recovery Alternative.

Development of project alternatives would include additional activities that must be added to the Projected Baseline inventory. These activities included drilling, completion, compression, and production-related activities. Analysis of the project alternatives included quantification of criteria air pollutants and selected HAPs. Benzene, toluene, ethylbenzene, xylenes, formaldehyde, and n-hexane were selected for quantification. Of the 187 HAPs regulated under Section 112 of the CAA, these 6 have the greatest contribution, while emissions factors of the remaining HAPs are negligible.

Emissions for each activity were developed on a per unit basis and were based on approved emissions factors, mass balance, or process simulation where appropriate. Supporting information such as operation schedules, equipment specification, and physical and chemical properties of fuel and materials were provided by KMG where available. Where site-specific information was not available, the analysis used published references or assumptions based on professional experience. A detailed discussion of these parameters appears in Sections 3.3 through 3.6 in the relevant sections for each activity.

Emissions for the project alternatives were tabulated based on the intensity of each activity as identified in the project description for each alternative. Criteria pollutant emissions were allocated by township, range, and section to generate a spatial distribution of emissions for modeling. This is described in detail in Section 3.7. These emissions comprised the air emissions inventory for the Proposed Action for cumulative analysis of ambient air quality and AQRV impacts as described in Chapter 5.0.

## 3.1 Current and Projected Baseline Emissions Input Procedures

The baseline emissions inventories utilized for this study were based on several sources. The ozone modeling required CMAQ-ready emissions estimates for 2006 and an additional future modeling year. The year 2018 was selected as the future baseline year modeling inventory because it coincided with the WRAP inventory and was representative of the year 2017 when the GNB field development is projected to reach the maximum emissions associated with the Proposed Action.

As discussed in Section 1.3, the WRAP inventories maintain the oil- and gas-related emissions as separate source categories. The 2006 Baseline CMAQ-ready emissions were developed from the WRAP 2002 Plan2d and 2018 PRP18a inventories using the same methodology as followed by the Uinta Basin Air Quality Study (UBAQS) (ENVIRON 2009). For the 2006 Baseline, the draft 2006 WRAP Phase III oil and gas emissions for

the Piceance and Uinta basins were used. For the area, non-road and non-Continuous Emission Monitor (CEM) point source emissions, the 2006 emission rates were directly interpolated from the 2002 and 2018 values. The 2006 on-road motor vehicle emissions were calculated using vehicle miles traveled (VMT) values interpolated from the 2002 and 2018 VMT totals combined with mobile source emissions factors and meteorological data specific for the 2006 episodes. Day-specific emissions for the 2006 episodes were obtained for the CEM point sources and fire emissions and were calculated for the biogenic emissions.

The 2018 future year emissions estimates were based mainly on the WRAP 2018 PRP18a and PRP18b inventories. For non oil and gas related sources, the predicted emissions for the 2018 forecast year for non-road and on-road mobile sources were directly from the WRAP 2018 PRP18a inventory. The WRAP 2018 PRP18b inventory update was incorporated for area sources and point sources. Fire and biogenic source categories were maintained at 2006 levels, which is consistent with the WRAP Phase II 2018 PRP18a development approach.

In the Uinta basin, the 2018 oil and gas emissions were projected based on predicted growth in key operating activity parameters by county from 2006 to 2018. These growth rates were applied to specific oil and gas sources by Source Classification Codes (SCC) and control efficiencies were applied for control measures being adopted by operators under federal rule or consent decree. This is discussed in detail in Section 3.1.1.

In the Piceance Basin, the 2018 oil and gas emissions were estimated by developing a growth rate from the 2006 and 2012 WRAP III estimates for the basin, applying the growth rates by county and SCC code, and then accounting for control measures being adopted in Colorado. For oil and gas emissions in areas outside of the Uinta and Piceance basins, the 2018 WRAP Phase II oil and gas emissions were used directly. Note that the growth of oil and gas development is uncertain and highly dependent on economic and market factors. The emission source categories and the development of these baseline inventories for 2006 and 2018 are summarized in **Table 3-1**.

**Table 3-1 Summary of Baseline Inventory Development**

| Emissions Source Category | Inventory Used for 2006 Baseline | Inventory Used for 2018 Projected Baseline |
|---|---|---|
| Oil and Gas – Uinta Basin | WRAP Oil and Gas Phase III 2006 | Projected from WRAP Phase III Oil and Gas 2006 based on projected cumulative activity in 2018 |
| Oil and Gas – Piceance Basin | WRAP Oil and Gas Phase III 2006 | Projected from WRAP Phase III Oil and Gas 2006 and 2012 |
| Oil and Gas – All Other Basins | Interpolated from WRAP Phase II Oil and Gas 2002 and 2018[1] | WRAP Oil and Gas Phase II 2018 |
| Point Sources – Non Oil and Gas | Interpolated from WRAP 2002 Plan2d and WRAP 2018 PRP18a[1] | WRAP 2018 PRP18b |
| Area Sources – Non Oil and Gas | Interpolated from WRAP 2002 Plan2d and WRAP 2018 PRP18a[1] | WRAP 2018 PRP18b |
| Non-Road Motor Vehicle | Interpolated from WRAP 2002 Plan2d and WRAP 2018 PRP18a[1] | WRAP 2018 PRP18a |
| On-Road Motor Vehicle | Calculated with 2005/2006 meteorology and 2006 VMT interpolated from WRAP 2002 Plan2d and WRAP 2018 PRP18a VMT[1] | Calculated with 2005/2006 Meteorology and WRAP 2018 PRP18a VMT |
| Biogenic | Model of Emissions of Gases and Aerosols from Nature (MEGAN) with 2005/2006 meteorology | MEGAN with 2005/2006 meteorology (held steady from 2005/2006) |

**Table 3-1 Summary of Baseline Inventory Development**

| Emissions Source Category | Inventory Used for 2006 Baseline | Inventory Used for 2018 Projected Baseline |
|---|---|---|
| Wildfire | 2006 Wildfire Inventory | 2006 Wildfire Inventory (held steady from 2006) |

[1] Same as used for the 2006 UBAQS emission inventory (ENVIRON 2009).

To address project-related impacts, the 2018 baseline emissions inventories were supplemented with local oil and gas-related emissions data for each of the two action alternatives analyzed. The oil and gas-related emissions data were converted into Sparse Matrix Operator Kernel Emissions (SMOKE)-ready input files, and maintained as an individual processing stream to allow easy update of the oil and gas emissions data, detailed quality assurance, and reporting.

### 3.1.1 Development of Uinta Basin 2018 Projected Baseline Emissions

The 2018 projected baseline was estimated based on the growth of five operating parameters in each of the five counties within the Uinta Basin. The level of each of these parameters was based on the reasonably foreseeable future development demonstrated by pending or proposed projects filed with the BLM. These projects and associated well counts are summarized in **Table 3-2**. These parameters included:

- Total well count – total number of operating wells for all operators in each county;
- Spud count – number of wells drilled by all operators in each county;
- Total gas production – total gas produced by all operators in each county;
- Total condensate production – total condensate produced by all operators in each county; and
- Total oil production – total oil produced by all operators in each county.

**Table 3-2 Summary of New Well Development for Proposed Projects in the Uinta Basin**

| Proposed Project | Total Natural Gas Wells | Natural Gas Wells by 2018 | Wells per County by 2018 | | |
|---|---|---|---|---|---|
| | | | Uintah | Duchesne | Carbon |
| BBC West Tavaputs Plateau EIS | 807 | 807 | 20 | 23 | 764 |
| Berry Petroleum ANF South Unit EIS | 400 | 140 | -- | 140 | -- |
| Enduring Resources Big Pack Environmental Assessment (EA) | 664 | 490 | 490 | -- | -- |
| Enduring Resources Southam Canyon EA | 249 | 225 | 225 | -- | -- |
| EOG Greater Chapita Wells EIS | 7,028 | 3,752 | 3,752 | -- | -- |
| EOG North Alger EA | 44 | 44 | 44 | -- | -- |
| Gasco Uinta Basin EIS | 1,538 | 900 | 301 | 599 | -- |
| Newfield Monument Butte EIS | 2,500 | 700 | 272 | 428 | -- |
| XTO Hill Creek Unit EA | 144 | 144 | 144 | -- | -- |
| XTO Little Canyon EA | 510 | 510 | 510 | -- | -- |
| XTO River Bend Unit Infill EA | 484 | 484 | 484 | -- | -- |

In reviewing proposed projects, no reasonably foreseeable future development was anticipated for Grand or Emery counties; therefore, these counties were maintained at their 2006 uncontrolled emissions levels for the purposes of this analysis.

Uncontrolled emissions of criteria pollutants for 2018 were calculated for each source category as the product of the 2006 emissions and the ratio of 2018 predicted activity level to the historic 2006 level for that parameter. The list of the source categories and the relevant activity parameter are summarized in **Table 3-3**. A control efficiency was applied to the predicted uncontrolled emissions for certain source categories based on implementation of more stringent federal emission standards or installation of additional controls required by consent decree. Determination of these control efficiencies is discussed in detail in Section 3.1.1.7.

**Table 3-3 Activity Parameters Used for Emissions Scaling by Source Category Code**

| SCC | Description | Scaling Parameter |
|---|---|---|
| 2310000100 | Heaters | Total well count |
| 2310000220 | Drill rigs | Spud count |
| 2310000230 | Workover rigs | Total well count |
| 2310000300 | Pneumatic devices | Total well count |
| 2310000330 | Artificial lift | Total oil production |
| 2310000700 | Unpermitted fugitives | Total well count |
| 2310000800 | Truck loading of condensate | Total condensate production |
| 2310000801 | Truck loading of oil | Total oil production |
| 2310000820 | Gas plant truck loading | Total condensate production |
| 2310001610 | Venting - initial completions | Spud count |
| 2310001611 | Initial completion flaring | Spud count |
| 2310001620 | Venting - recompletions | Spud count |
| 2310001630 | Venting - blowdowns | Total gas production |
| 2310001640 | Venting - compressor startup | Total gas production |
| 2310001650 | Venting - compressor shutdown | Total gas production |
| 2310002230 | Condensate tank | Total condensate production |
| 2310002231 | Condensate tank flaring | Total condensate production |
| 2310002240 | Oil tank | Total oil production |
| 2310003100 | Miscellaneous engines | Total well count |
| 2310003200 | Pneumatic pumps | Total well count |
| 2310020600 | Compressor engines | Total gas production |
| 2310021410 | Dehydrator | Total gas production |
| 2310021411 | Dehydrator flaring | Total gas production |

#### 3.1.1.1 Development of Total Well Counts

Additional conventional well counts were taken from the proposed projects listed in **Table 3-2** and were spatially allocated to each county on an annual basis based on the fraction of the project area in each county and the estimated start date, drilling rate, and schedule. This information was taken from pending EA or EIS documents for each project and was accumulated with recorded total well counts for each county for 2009 from the IHS, Inc. Exploration and Production Information database. Although development of many projects will continue beyond 2018, for the purposes of this study, a summary of the incremental and cumulative well counts from 2008 to 2018 is provided in **Table 3-4**.

**Table 3-4 Projected Total New and Cumulative Well Count by Year and County**

| Project/Activity | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| **Uintah County** | | | | | | | | | | | |
| Existing Wells (Conventional and Coal Bed Methane [CBM]) | 5,103 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Remaining Ongoing and Approved | -- | 192 | 192 | 192 | 192 | 94 | -- | -- | -- | -- | -- |
| BBC West Tavaputs Plateau EIS | -- | -- | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | -- |
| Enduring Resources Big Pack EA | -- | -- | 70 | 70 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Enduring Resources Southam Canyon EA | -- | -- | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| EOG Greater Chapita Wells EIS | -- | -- | -- | 469 | 469 | 469 | 469 | 469 | 469 | 469 | 469 |
| EOG North Alger EA | -- | -- | 10 | 10 | 10 | 10 | 4 | -- | -- | -- | -- |
| Gasco Uinta Basin EIS | -- | -- | 34 | 34 | 34 | 34 | 33 | 33 | 33 | 33 | 33 |
| Newfield Monument Butte EIS | -- | -- | -- | -- | 39 | 39 | 39 | 39 | 39 | 39 | 38 |
| XTO Hill Creek Unit EA | -- | -- | 17 | 17 | 24 | 24 | 24 | 24 | 14 | -- | -- |
| XTO Little Canyon EA | -- | -- | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 30 |
| XTO River Bend Unit Infill EA | -- | -- | 46 | 60 | 93 | 57 | 66 | 64 | 61 | 37 | -- |
| New Wells Per Year | -- | 192 | 458 | 940 | 999 | 864 | 772 | 766 | 753 | 715 | 645 |
| **Cumulative Total** | **5,103** | **5,295** | **5,753** | **6,693** | **7,692** | **8,556** | **9,328** | **10,094** | **10,847** | **11,562** | **12,207** |
| **Duchesne County** | | | | | | | | | | | |
| Existing Wells (Conventional and CBM) | 1,791 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Remaining Ongoing and Approved | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| BBC West Tavaputs Plateau EIS | -- | -- | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | -- |
| Berry Petroleum ANF South Unit EIS | -- | -- | -- | -- | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Gasco Uinta Basin EIS | -- | -- | 66 | 66 | 66 | 66 | 67 | 67 | 67 | 67 | 67 |
| Newfield Monument Butte EIS | -- | -- | -- | -- | 61 | 61 | 61 | 61 | 61 | 61 | 62 |
| New Wells Per Year | -- | 0 | 71 | 70 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| **Cumulative Total** | **1,791** | **1,791** | **1,932** | **1,932** | **2,082** | **2,232** | **2,382** | **2,532** | **2,682** | **2,832** | **2,981** |
| **Carbon County** | | | | | | | | | | | |
| Existing Wells (Conventional and CBM) | 851 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Remaining Ongoing and Approved | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| BBC West Tavaputs Plateau EIS | -- | -- | 159 | 120 | 114 | 76 | 76 | 76 | 76 | 67 | -- |
| New Wells Per Year | -- | 0 | 159 | 120 | 114 | 76 | 76 | 76 | 76 | 67 | 0 |
| **Cumulative Total** | **851** | **851** | **1,010** | **1,130** | **1,244** | **1,320** | **1,396** | **1,472** | **1,548** | **1,615** | **1,615** |

### 3.1.1.2 Development of Projected Spud Counts

Spud counts were estimated based on the change in total wells (conventional and CBM) from 2017 to 2018 in each county. An additional 5 percent spud to well rate was assumed to account for unsuccessful holes and ancillary drilling activities including monitoring and injection wells. **Table 3-5** summarizes the estimated spud rate for each county.

**Table 3-5 Project Spud Count for 2018 by County**

| County | Total Completed Wells | | | Spud/Well Ratio | Spud Count |
|---|---|---|---|---|---|
| | 2017 | 2018 | Change | | 2018 |
| Uintah | 11,562 | 12,207 | 645 | 1.05 | 677 |
| Carbon | 1,615 | 1,615 | 0 | | 0 |
| Duchesne | 2,832 | 2,981 | 149 | | 156 |

### 3.1.1.3 Development of Projected Total Gas Production

Gas production in 2018 from each county was predicted using a county-specific estimated well production decline over time as shown for each county in **Tables 3-6**, **3-7**, and **3-8**. The number of wells at each given age was estimated as the number of new wells in each year based on data shown in **Table 3-4** and historical data. Gas production in each year is the product of the number of new wells and the assigned gas production rate for a well of that age; the total 2018 gas production is the sum of these products. New well production must account for wells that begin production throughout the year and the "average" would be one-half of the calculated new well production rate. Therefore, only one-half of the production rate is considered due to well completion and shakedown for year 2018.

**Table 3-6 Projected 2018 Gas and Condensate Production for Uintah County**

| Year | Age | Conventional Wells Installed[1] | Gas Production | | Condensate Production | |
|---|---|---|---|---|---|---|
| | | | (MMscf/well-yr) | (MMscf/yr) | (bbl/well-yr) | (bbl/yr) |
| 2018 | 1 | 645 | 215.0 | 69,346 | 3,242.3 | 1,045.6 |
| 2017 | 2 | 715 | 106.0 | 75,780 | 1,448.5 | 1,035.7 |
| 2016 | 3 | 753 | 80.8 | 60,846 | 1,007.0 | 758.3 |
| 2015 | 4 | 766 | 67.7 | 51,872 | 770.1 | 589.9 |
| 2014 | 5 | 772 | 59.4 | 45,828 | 616.0 | 475.5 |
| 2013 | 6 | 864 | 53.4 | 46,173 | 506.1 | 437.3 |
| 2012 | 7 | 999 | 49.0 | 48,914 | 423.3 | 422.9 |
| 2011 | 8 | 940 | 45.4 | 42,700 | 358.8 | 337.2 |
| 2010 | 9 | 458 | 43.0 | 19,692 | 309.8 | 141.9 |
| 2009 | 10 | 192 | 40.7 | 7,820 | 268.2 | 51.5 |
| 2008 | 11 | 648 | 38.3 | 24,809 | 30.1 | 149.1 |
| 2007 | 12 | 420 | 36.0 | 15,115 | 97.3 | 82.9 |
| 2006 | 13 | 577 | 33.8 | 19,519 | 169.2 | 97.6 |
| 2005 | 14 | 431 | 31.8 | 13,705 | 145.3 | 62.6 |
| 2004 | 15 | 349 | 29.9 | 10,432 | 125.0 | 43.6 |
| 2003 | 16 | 236 | 28.1 | 6,631 | 107.3 | 25.3 |
| 2002 | 17 | 209 | 26.4 | 5,520 | 91.6 | 19.2 |
| 2001 | 18 | 280 | 24.8 | 6,952 | 78.6 | 22.0 |
| 2000 | 19 | 219 | 23.3 | 5,111 | 67.7 | 14.8 |
| 1999 | 20 | 95 | 21.9 | 2,084 | 57.8 | 5.5 |
| 1998 | 21 | 140 | 20.6 | 2,887 | 50.0 | 7.0 |
| 1997 | 22 | 70 | 19.4 | 1,357 | 42.7 | 3.0 |
| 1996 | 23 | 15 | 18.2 | 273 | 36.4 | 0.5 |
| 1995 | 24 | 60 | 17.1 | 1,028 | 31.2 | 1.9 |
| 1994 | 25 | 17 | 16.1 | 274 | 27.1 | 0.5 |
| 1993 | 26 | 140 | 15.1 | 2,119 | 23.4 | 3.3 |
| 1992 | 27 | 85 | 14.2 | 1,209 | 19.8 | 1.7 |
| 1991 | 28 | 93 | 13.4 | 1,244 | 17.2 | 1.6 |
| 1990 | 29 | 6 | 12.6 | 75 | 14.6 | 0.1 |

**Table 3-6 Projected 2018 Gas and Condensate Production for Uintah County**

| Year | Age | Conventional Wells Installed[1] | Gas Production | | Condensate Production | |
|---|---|---|---|---|---|---|
| | | | (MMscf/well-yr) | (MMscf/yr) | (bbl/well-yr) | (bbl/yr) |
| 1989 | 30 | 9 | 11.8 | 106 | 12.5 | 0.1 |
| 1988 | 31 | 8 | 11.1 | 89 | 10.9 | 0.1 |
| 1987 | 32 | -41 | 10.4 | 0 | 9.4 | 0.0 |
| 1986 | 33 | -15 | 9.8 | 0 | 7.8 | 0.0 |
| 1985 | 34 | 102 | 9.2 | 941 | 6.8 | 0.7 |
| 1984 | 35 | 394 | 8.7 | 3,417 | 5.7 | 2.3 |
| 1983 | 36 | 70 | 8.2 | 571 | 5.2 | 0.4 |
| 1982 | 37 | 115 | 7.7 | 881 | 4.2 | 0.5 |
| 1981 | 38 | 135 | 2.5 | 331 | 1.0 | 0.1 |
| | | | **Total Production by 2018** | **595,651** | | **5,842** |

[1] Negative values are based on records of wells shut down.

**Table 3-7 Projected 2018 Gas and Condensate Production for Duchesne County**

| Year | Age | Conventional Wells Installed[1] | Gas Production | | Condensate Production | |
|---|---|---|---|---|---|---|
| | | | (MMscf/well-yr) | (MMscf/yr) | (bbl/well-yr) | (bbl/yr) |
| 2018 | 1 | 149 | 70.3 | 5,240 | 1,263.5 | 94.1 |
| 2017 | 2 | 150 | 34.7 | 5,201 | 564.5 | 84.7 |
| 2016 | 3 | 150 | 26.4 | 3,965 | 392.4 | 58.9 |
| 2015 | 4 | 150 | 22.2 | 3,323 | 300.1 | 45.0 |
| 2014 | 5 | 150 | 19.4 | 2,913 | 240.0 | 36.0 |
| 2013 | 6 | 150 | 17.5 | 2,622 | 197.2 | 29.6 |
| 2012 | 7 | 150 | 16.0 | 2,403 | 165.0 | 24.7 |
| 2011 | 8 | 70 | 14.9 | 1,040 | 139.8 | 9.8 |
| 2010 | 9 | 71 | 14.1 | 999 | 120.7 | 8.6 |
| 2009 | 10 | 0 | 13.3 | 0 | 104.5 | 0.0 |
| 2008 | 11 | 181 | 12.5 | 2,267 | 89.7 | 16.2 |
| 2007 | 12 | 136 | 11.8 | 1,601 | 76.9 | 10.5 |
| 2006 | 13 | 193 | 11.1 | 2,136 | 65.9 | 12.7 |
| 2005 | 14 | 147 | 10.4 | 1,529 | 56.6 | 8.3 |
| 2004 | 15 | 158 | 9.8 | 1,545 | 48.7 | 7.7 |
| 2003 | 16 | 39 | 9.2 | 358 | 41.8 | 1.6 |
| 2002 | 17 | -12 | 8.6 | 0 | 35.7 | 0.0 |
| 2001 | 18 | 39 | 8.1 | 317 | 30.6 | 1.2 |
| 2000 | 19 | 1 | 7.6 | 8 | 26.4 | 0.0 |
| 1999 | 20 | -45 | 7.2 | 0 | 22.5 | 0.0 |
| 1998 | 21 | 24 | 6.7 | 162 | 19.5 | 0.5 |
| 1997 | 22 | 115 | 6.3 | 729 | 16.6 | 1.9 |
| 1996 | 23 | 102 | 6.0 | 608 | 14.2 | 1.4 |
| 1995 | 24 | 7 | 5.6 | 39 | 12.2 | 0.1 |
| 1994 | 25 | 10 | 5.3 | 53 | 10.6 | 0.1 |
| 1993 | 26 | 2 | 5.0 | 10 | 9.1 | 0.0 |
| 1992 | 27 | 13 | 4.7 | 60 | 7.7 | 0.1 |
| 1991 | 28 | 1 | 4.4 | 4 | 6.7 | 0.0 |
| 1990 | 29 | 7 | 4.1 | 29 | 5.7 | 0.0 |
| 1989 | 30 | -5 | 3.9 | 0 | 4.9 | 0.0 |
| 1988 | 31 | 1 | 3.6 | 4 | 4.3 | 0.0 |
| 1987 | 32 | -22 | 3.4 | 0 | 3.7 | 0.0 |
| 1986 | 33 | 13 | 3.2 | 42 | 3.0 | 0.0 |

**Table 3-7 Projected 2018 Gas and Condensate Production for Duchesne County**

| Year | Age | Conventional Wells Installed[1] | Gas Production | | Condensate Production | |
|---|---|---|---|---|---|---|
| | | | (MMscf/well-yr) | (MMscf/yr) | (bbl/well-yr) | (bbl/yr) |
| 1985 | 34 | 76 | 3.0 | 229 | 2.6 | 0.2 |
| 1984 | 35 | 85 | 2.8 | 241 | 2.2 | 0.2 |
| 1983 | 36 | 74 | 2.7 | 197 | 2.0 | 0.2 |
| 1982 | 37 | 52 | 2.5 | 130 | 1.6 | 0.1 |
| 1981 | 38 | 26 | 0.8 | 21 | 0.4 | 0.0 |
| | | | **Total Production by 2018** | **40,025** | | **455** |

[1] Negative values are based on records of wells shut down.

**Table 3-8 Projected 2018 Gas Production for Carbon County**

| Year | Age | Conventional Wells Installed | Gas Production | |
|---|---|---|---|---|
| | | | (MMscf/well-yr) | (MMscf/yr) |
| 2018 | 1 | 0 | 769 | 0 |
| 2017 | 2 | 67 | 379 | 25,393 |
| 2016 | 3 | 76 | 248 | 18,848 |
| 2015 | 4 | 76 | 183 | 13,908 |
| 2014 | 5 | 76 | 145 | 11,020 |
| 2013 | 6 | 76 | 119 | 9,044 |
| 2012 | 7 | 114 | 101 | 11,514 |
| 2011 | 8 | 120 | 87 | 10,440 |
| 2010 | 9 | 159 | 77 | 12,243 |
| 2009 | 10 | 0 | 68 | 0 |
| 2008 | 11 | 65 | 62 | 4,030 |
| 2007 | 12 | 35 | 55 | 1,925 |
| 2006 | 13 | 26 | 50 | 1,300 |
| 2005 | 14 | 21 | 45 | 945 |
| 2004 | 15 | 0 | 40 | 0 |
| 2003 | 16 | 16 | 36 | 576 |
| 2002 | 17 | 6 | 32 | 192 |
| 2001 | 18 | 7 | 29 | 203 |
| 2000 | 19 | 3 | 26 | 78 |
| 1999 | 20 | 6 | 24 | 144 |
| | | | **Total Production by 2018** | **121,803** |

### 3.1.1.4 Development of Projected Total Condensate Production

For Uintah and Duchesne counties, condensate production in 2018 was predicted using a county-specific estimated well condensate production decline over time. The number of wells at each given age was estimated as the number of new wells in each year based on data shown in **Table 3-4** and historical data. Condensate production in each year was the product of the number of new wells and the condensate production for a well of that age; the total 2018 gas production is the sum of these products. For year 2018, only one-half of the production from new wells was considered due to well completion activities throughout the year. Calculations of total gas production in Uintah and Duchesne counties are summarized in **Tables 3-6** and **3-7**, respectively. However, for Carbon County, condensate production data was not available. Therefore, condensate production in Carbon County was predicted based on the historical ratio of the change in

condensate production to the change in gas production of 0.0012. **Table 3-9** summarizes the projected condensate production for Carbon County based on this approach.

**Table 3-9 Historic and Projected 2018 Gas and Condensate Production for Carbon County**

| Year | | Gas Production (MMscf/year) | | Condensate Production (bbl/year) | |
|---|---|---|---|---|---|
| | | Volume | Change Year-to-Year | Volume | Change Year-to-Year |
| Historic | 2003 | 3,236,826 | 1,883,762 | 1,885 | 1,839 |
| | 2004 | 7,122,169 | 3,885,343 | 6,224 | 4,339 |
| | 2005 | 8,772,841 | 1,650,672 | 9,307 | 3,083 |
| | 2006 | 20,496,544 | 11,723,703 | 43,078 | 33,771 |
| | 2007 | 34,974,657 | 14,478,113 | 47,020 | 3,942 |
| | 2008 | 39,955,400 | 4,980,743 | 49,692 | 2,672 |
| Projected | 2009 | 44,192,000 | 4,236,600 | 54,776 | 5,084 |
| | 2010 | 92,638,500 | 48,446,500 | 112,912 | 58,136 |
| | 2011 | 131,003,000 | 38,364,500 | 158,949 | 46,037 |
| | 2012 | 148,923,000 | 17,920,000 | 180,453 | 21,504 |
| | 2013 | 148,364,000 | -559,000 | 179,782 | -671 |
| | 2014 | 146,057,000 | -2,307,000 | 177,014 | -2,768 |
| | 2015 | 147,010,000 | 953,000 | 178,158 | 1,144 |
| | 2016 | 149,287,000 | 2,277,000 | 180,890 | 2,732 |
| | 2017 | 148,277,500 | -1,009,500 | 179,679 | -1,211 |
| | 2018 | 121,803,000 | -26,474,500 | 147,909 | -31,769 |

### 3.1.1.5 Development of Projected Total Oil Production

The Newfield Monument Butte EIS indicated there will be 3,250 oil wells installed in Uintah and Duchesne counties over the life of the project; however, no data were available to predict oil production based on well schedule. Therefore, oil production in these counties was linearly forecast based on historical data. For each county, the linear increase was based on the growth rate from the last upturn in production (2001 for Uintah County and 2002 for Duchesne County). Projected oil production for the remaining counties in the Uinta Basin was held at their 2006 levels. A summary of projected oil production in Uintah and Duchesne counties is provided in **Table 3-10**.

**Table 3-10 Historic and Projected 2018 Oil Production for Uintah and Duchesne Counties**

| Year | | Oil Production ($10^3$ bbl/yr) | |
|---|---|---|---|
| | | Uintah | Duchesne |
| Historic | 2002 | 2,573 | 4,295 |
| | 2003 | 2,665 | 4,344 |
| | 2004 | 3,085 | 5,841 |
| | 2005 | 3,338 | 6,671 |
| | 2006 | 3,399 | 6,402 |
| | 2007 | 3,291 | 7,565 |
| | 2008 | 3,567 | 8,340 |
| Projected | 2009 | 3,781 | 8,942 |
| | 2010 | 3,805 | 9,625 |
| | 2011 | 3,933 | 10,309 |
| | 2012 | 4,061 | 10,992 |
| | 2013 | 4,189 | 11,676 |
| | 2014 | 4,317 | 12,359 |
| | 2015 | 4,444 | 13,043 |
| | 2016 | 4,572 | 13,726 |
| | 2017 | 4,700 | 14,409 |
| | 2018 | 4,828 | 15,093 |

### 3.1.1.6 Summary of Projected Activity Parameters and 2018 Scaling Ratios

**Table 3-11** summarizes the historical 2006 activity parameter data and the projected 2018 activity levels. The ratio of 2018 to 2006 levels was used to develop a scaling ratio for uncontrolled emissions to predict 2018 emissions by source category for each county.

**Table 3-11 Summary of Projected Activity Parameters and 2018 Scaling Ratios**

| | Total Well Count (total wells) | | | Spud Count (spuds/yr) | | | Total Gas Production (MMscf/yr) | | | Total Condensate Production ($10^3$ bbl/yr) | | | Total Oil Production ($10^3$ bbl/yr) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **County** | **2006** | **2018** | **Scaling Ratio** | **2006** | **2018** | **Scaling Ratio** | **2006** | **2018** | **Scaling Ratio** | **2006** | **2018** | **Scaling Ratio** | **2006** | **2018** | **Scaling Ratio** |
| Uintah | 4,035 | 12,207 | 3.03 | 685 | 677 | 0.99 | 203,391 | 595,651 | 2.93 | 1,554 | 5,842 | 3.76 | 3,399 | 4,828 | 1.42 |
| Carbon | 730 | 1,615 | 2.21 | 58 | 0 | 0.00 | 20,497 | 121,803 | 5.94 | 43 | 148 | 3.43 | 0.3 | 0.3 | 1.00 |
| Duchesne | 1,474 | 2,981 | 2.02 | 277 | 156 | 0.56 | 22,526 | 40,025 | 1.77 | 163 | 455 | 2.79 | 6,402 | 15,093 | 2.36 |
| Grand | 368 | 368 | 1.00 | 27 | 27 | 1.00 | 6,855 | 6,855 | 1.00 | 9 | 9 | 1.00 | 116 | 116 | 1.00 |
| Emery | 56 | 56 | 1.00 | 23 | 23 | 1.00 | 951 | 951 | 1.00 | 4 | 4 | 1.00 | 4 | 4 | 1.00 |

### 3.1.1.7 Baseline Emissions Control Efficiency from Federal Rule and Consent Decree

Several existing federal rules will require more stringent emission standards on existing sources. Furthermore, some operators have entered into consent decrees with the U.S. Department of Justice that require them to install additional controls. This analysis reviewed and determined emissions reductions to baseline emissions for selected source categories based on these rules or agreements. For rules that affect only new sources, these controls were applied only to the portion of emissions above 2006 levels. Control efficiencies derived from retroactive rules or requirements were applied to all emissions for the relevant source category.

Baseline Emissions Control Efficiency from Federal Rule

**Table 3-12** summarizes the analysis of existing and pending federal rules. As shown in this table, enforceable emissions reductions occur with the stationary and non-road engine requirements under 40 CFR Part 60, Subpart JJJJ and 40 CFR 89, respectively. VOC reductions from dehydrators at area sources under 40 CFR Part 63, Subpart HH are not likely to be required since these standards apply to area sources with a gas throughput of 3 MMscf/day. Based on the decline curve, the average production of a new well under the proposed project is 215 MMscf/yr (0.59 MMscf/day). Therefore, there is no expected applicability or enforceability of these reductions at area sources, and thus, reductions from this rule were not considered.

Baseline Emissions Control Efficiency from Consent Decree

The U.S. District Court recently entered into the following 3 Consent Decrees with 7 operators in the Uinta Basin requiring controls on selected dehydrators, compressor engines, selected condensate tanks, and pneumatic devices:

- U.S. v. Wind River Resources Corporation and Bill Barrett Corporation;
- U.S. v. Dominion Exploration and Production, Inc. and XTO Energy, Inc.; and
- U.S. v. Miller, Dyer, & Co., LLC, Chicago Energy Associates, and Whiting Oil and Gas Corporation.

As shown in **Table 3-13**, the only requirement under these consent decrees to have measurable and enforceable impact to baseline emissions is the installation of low-bleed pneumatics. Since low bleed pneumatics reduce the maximum release of actuating gas by 50 percent, emissions of VOC were assumed to be reduced by 50 percent as well. The total control efficiency for a county for pneumatic pumps and devices was then calculated as the product of this 50 percent control and the fraction of operator control of future assets.

## Table 3-12 Baseline Emissions Control Efficiencies from Promulgated Federal Rules

| Rule | Applicability | Potentially Affected Source Categories | Emissions Standards | | | 2018 ΔCE (%)[1] |
|---|---|---|---|---|---|---|
| | | | Pollutant | 2006 | 2018 | |
| 40 CFR 60 Subpart JJJJ | Stationary Spark Ignition ICE | Miscellaneous Engines Compression Engines Artificial Lift Engines | $NO_X$ | 12-15 g/bhp-hr[2] | 1.0 g/bhp-hr | 90.0[2,3] |
| | | | CO | 7-13 g/bhp-hr[2] | 2.0 g/bhp-hr | 80[3] |
| | | | VOC | 0.6-1.0 g/bhp-hr[2] | 1.0 g/bhp-hr | 0[3] |
| 40 CFR 63 Subpart HH | Onshore Natural Gas Processing | Dehydrators – Area Sources | VOC (HAP) | None | 95% Reduction | 0[4] |
| 40 CFR 63 Subpart ZZZZ | Stationary RICE | Miscellaneous Engines Compression Engines | CO | 7-13 g/bhp-hr[2] | 93%[5] | 0[3] |
| | | | VOC | 0.6-1.0 g/bhp-hr[2] | 76%[5] | 0[3] |
| 40 CFR 89 | Non-road engines | Drill Rigs Workover Rigs | Tier | Tier 1 | Tier 4 | |
| | | | $NO_X$ | 6.9 g/bhp-hr | 2.6 g/bhp-hr | 62.3[6] |
| | | | CO | 8.5 g/bhp-hr | 2.6 g/bhp-hr | 69.4[6] |
| | | | $SO_2$ | 500 ppm weight (ppmw) fuel | 15 ppmw fuel | 97.0[6] |
| | | | PM | 0.4 g/bhp-hr | 0.03 g/bhp-hr | 92.5[6] |
| | | | VOC | 1.0 g/bhp-hr | 0.14 g/bhp-hr | 86.0[6] |

[1] ΔCE is used to adjust 2018 baseline emissions from the 2006 WRAP Phase III emissions by source category. Projected emissions for modeling are based on increased activity (well count, spud count, gas production, condensate production, and oil production). These projected emissions are reduced based on this improved control effectiveness from promulgated federal standards that impact future activity.

For non-retroactive sources, this is applied as: 2006 Emissions + [(2018 Emissions-2006 Emissions)(1-ΔCE)]
For retroactive sources, this is applied as: 2018 Emissions (1-ΔCE)

[2] Pre-control (2006) emissions determined from preamble to *Standards of Performance for Stationary Spark Ignition Internal Combustion Engines and National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines; Proposed Rule.* 71 Federal Register 33815-3816, Section IV.B.1.c.-d.

[3] Rule is not retroactive; reductions apply to emissions from sources installed after 2006 only.

[4] The area source provisions for this rule apply to glycol dehydrators with an actual annual average gas throughput rate of 85,000 scf/day (3 MMscf/day) and emissions of benzene greater than 1.0 tpy. Based on the production decline curve, the highest annual average production for a well is 215 MMscf/yr, which is an annual average of 0.59 MMscf/day. This indicates that this rule will not apply to dehydrators in this basin.

[5] Applies to engines >500 hp at major sources of HAP only; area sources and engines <500 hp would demonstrate compliance by complying with the emission standards of 40 CFR 60 Subpart JJJJ.

[6] Calculated as [1 – (Tier 4/Tier 1)]; rule applies to operating equipment and is therefore retroactive.

## Table 3-13 Baseline Emissions Control Efficiency from Consent Decrees

| Potentially Affected Source Category | Operator[1] | Consent Decree Requirement | Estimated Operator Control of Future Assets by County[2] | Pollutant | Anticipated Control from Consent Decree (CE) | 2018 ΔCE by County (%)[3] |
|---|---|---|---|---|---|---|
| Dehydrators | Wind River Bill Barrett | Selected existing compressor stations subject to the MACT HH major source standards (95% VOC control). New dehydrators with uncontrolled VOC emissions >20 tpy must install controls at 95% DRE or better.[4] | 0.3% Uintah 100.0% Carbon 1.9% Duchesne | All | 0% - with controls limited to sources >20 tpy and the option to remove controls after 1 year; VOC controls are not likely or quantifiable. | 0% All |
| | Dominion XTO Energy | | 16% Uintah 0% Other | | | |
| Compressor Engines | Wind River Bill Barrett | Selected existing compressor engines must install NSCR and AFR and meet MACT ZZZZ standards and $NO_X$ standards of 1 g/bhp-hr (2 g/bhp-hr for Miller Dyer et al.). New facilities must comply with MACT ZZZZ. | 0.3% Uintah 100.0% Carbon 1.9% Duchesne | $NO_X$ VOC | 0% - $NO_X$ and VOC controls on future assets are already included in the rule effectiveness for New Source Performance Standard JJJJ. VOC reductions under MACT ZZZZ apply only to selected existing facilities that are not likely to provide quantifiable reductions. | 0% All |
| | Dominion XTO Energy | | 16% Uintah 0% Other | | | |
| Storage Tanks | Wind River Bill Barrett | Existing tanks at compression facilities and new facilities >14 bbl/day must meet 95% control.[5] | 0.3% Uintah 100.0% Carbon 1.9% Duchesne | VOC | 0% - with controls limited to sources >14 bbl/day and the option to remove controls after 1 year; VOC controls are not likely or quantifiable. | 0% All |

**Table 3-13 Baseline Emissions Control Efficiency from Consent Decrees**

| Potentially Affected Source Category | Operator[1] | Consent Decree Requirement | Estimated Operator Control of Future Assets by County[2] | Pollutant | Anticipated Control from Consent Decree (CE) | 2018 ΔCE by County (%)[3] |
|---|---|---|---|---|---|---|
| Pneumatics | Wind River<br>Bill Barrett | Retrofit existing high bleed pneumatics with low bleed pneumatics. All new facilities must install low bleed pneumatics. | 0.3% Uintah<br>100.0% Carbon<br>1.9% Duchesne | VOC | 50% - high bleed pneumatics are classed as >6 scf/day; low bleed pneumatics are classified as <3 scf/day. This ratio of maximum to minimum specification is considered conservative. | 8.2% Uintah[6]<br>50% Carbon[6]<br>1% Duchesne[6] |
| | Dominion<br>XTO Energy | | 16% Uintah<br>0% Other | | | |

[1] Miller, Dyer & Co., Chicago Energy Associates and Whiting O&G have no future assets in the list of proposed action and are not considered for controls.

[2] Percent operator control (%O) of future assets determined as the fraction of planned new wells in each county in 2018 for each operator divided by the total new wells in each county in 2018.

[3] $\Delta CE = \sum(\%O \times CE)$ for each operator in each county.

[4] Controls may be removed from a facility after 1 year provided that uncontrolled VOC emissions can be shown to be less than 5 tpy.

[5] Controls may be removed from a facility after 1 year provided that uncontrolled VOC emissions can be shown to be less than 10 tpy.

[6] Since the consent decrees mandate retrofits to existing assets, this control efficiency will be applied retroactively under the assumption that the operator's stake in future assets is equal to its existing stake.

### 3.1.1.8 Summary of Projected Baseline Controlled Emissions for 2018

**Tables 3-14** through **3-18** show the emissions of each pollutant as well as the ratio of the controlled 2018 Projected Baseline emissions to the historical 2006 emissions for each county. Detailed calculations appear in **Appendix A**. WRAP Phase III emissions for 2006 were multiplied by the appropriate emissions scaling factors, and control efficiencies were applied. Note that non-road engines and pneumatics controls were retroactive while controls to stationary engines only applied to the portion of emissions greater than the 2006 emissions levels.

**Table 3-14 Summary of Projected Baseline $NO_X$ Emissions for 2018**

| County | Historical WRAP 2006 | 2018 Projected Baseline | | Projected/Historical Ratio |
|---|---|---|---|---|
| | | Uncontrolled | Controlled | |
| Uintah | 6,096 | 10,841 | 5,888 | 0.97 |
| Carbon | 995 | 3,823 | 1,322 | 1.33 |
| Duchesne | 3,053 | 4,797 | 2,512 | 0.82 |
| Grand | 337 | 337 | 213 | 0.63 |
| Emery | 273 | 273 | 204 | 0.75 |
| **Total** | **10,754** | **20,071** | **10,138** | **0.94** |

**Table 3-15 Summary of Projected Baseline CO Emissions for 2018**

| County | Historical WRAP 2006 | 2018 Projected Baseline | | Projected/Historical Ratio |
|---|---|---|---|---|
| | | Uncontrolled | Controlled | |
| Uintah | 4,133 | 8,589 | 5,136 | 1.24 |
| Carbon | 814 | 3,855 | 1,550 | 1.90 |
| Duchesne | 2,448 | 4,768 | 2,723 | 1.11 |
| Grand | 207 | 207 | 154 | 0.74 |
| Emery | 199 | 199 | 170 | 0.85 |
| **Total** | **7,800** | **17,618** | **9,732** | **1.25** |

**Table 3-16 Summary of Projected Baseline $SO_2$ Emissions for 2018**

| County | Historical WRAP 2006 | 2018 Projected Baseline | | Projected/Historical Ratio |
|---|---|---|---|---|
| | | Uncontrolled | Controlled | |
| Uintah | 247 | 275 | 20 | 0.08 |
| Carbon | 22 | 7 | 2 | 0.08 |
| Duchesne | 96 | 58 | 6 | 0.07 |
| Grand | 16 | 16 | 1 | 0.05 |
| Emery | 9 | 9 | 1 | 0.06 |
| **Total** | **391** | **365** | **30** | **0.08** |

**Table 3-17 Summary of Projected Baseline $PM_{10}$ Emissions for 2018**

| County | Historical WRAP 2006 | 2018 Projected Baseline | | Projected/Historical Ratio |
|---|---|---|---|---|
| | | Uncontrolled | Controlled | |
| Uintah | 344 | 523 | 284 | 0.83 |
| Carbon | 40 | 86 | 81 | 2.02 |
| Duchesne | 173 | 235 | 186 | 1.08 |
| Grand | 22 | 22 | 7 | 0.34 |
| Emery | 14 | 14 | 6 | 0.44 |
| **Total** | **592** | **879** | **565** | **0.95** |

**Table 3-18 Summary of Projected Baseline VOC Emissions for 2018**

| County | Historical WRAP 2006 | 2018 Projected Baseline | | Projected/Historical Ratio |
|---|---|---|---|---|
| | | Uncontrolled | Controlled | |
| Uintah | 45,646 | 130,489 | 126,425 | 2.77 |
| Carbon | 2,747 | 14,027 | 13,553 | 4.93 |
| Duchesne | 19,019 | 41,663 | 41,495 | 2.18 |
| Grand | 2,360 | 2,360 | 2,345 | 0.99 |
| Emery | 453 | 453 | 444 | 0.98 |
| **Total** | **70,226** | **188,040** | **184,262** | **2.62** |

It should be noted that emission controls utilized to address ozone precursor emissions from oil and gas activities also would control $PM_{2.5}$ levels. The condensable fraction of $PM_{2.5}$ is formed largely by sulfates and nitrates that are formed in the atmosphere from $SO_2$ and $NO_X$ emissions. Therefore, the combined effect of low $SO_2$ emissions from oil and gas activities, along with the controls on $NO_X$ emissions, will act to limit the formation of $PM_{2.5}$ in the atmosphere.

### 3.1.2 Development of CMAQ-ready Emissions Inventories

Emissions inventory development for CMAQ modeling addressed several source categories including: a) stationary point sources, b) area sources, c) non-road mobile sources, d) on-road mobile sources, e) biogenic sources, and f) fire sources. For this analysis, CMAQ-ready emissions input files were created using SMOKE Version 2.2 for the 2006 and 2018 annual periods over the 36- and 12-km grids. The modeling grids are defined in Section 4.2.2. SMOKE Version 2.2 was used because several of the WRAP-developed emissions files were not directly compatible with SMOKE Version 2.4, the newest version of SMOKE.

CMAQ required emission input files containing hourly emission estimates, distributed both vertically and horizontally in the modeling domain. For ozone modeling alone, hourly emissions were required for nitrogen oxide (NO), $NO_2$, CO, several classes of VOCs, and other chemicals as available. The VOC classes used

depended upon the chemical mechanism selected, which for this study was the Carbon Bond 2005 speciation methodology (CB-05) with updates to the isoprene chemistry.

### 3.1.3 Set-up of SMOKE for the Baseline Emissions Development

For this analysis, SMOKE Version 2.2 was configured to generate point, area, non-road, highway, and biogenic source emissions. In addition, certain subcategories, such as fires and electric generating units (EGU) were maintained in separate source category files to allow maximum flexibility in producing alternate emissions modeling strategies. Domain-specific oil- and gas-related emissions also were maintained as a separate source category. Pre-computed annual emissions were processed using the month, day, and hour-specific temporal profiles of the SMOKE model, with the exception of biogenic and highway mobile source emissions. These emissions were generated using the MEGAN biogenics model and USEPA's guideline model for mobile source emissions (MOBILE6) modules in SMOKE.

Producing 365 day-specific input files for all source categories would place a burden on available computing facilities and data management systems, but would not provide a more refined analysis given the nature of the input data. Selecting representative model days for some or all of the source categories reduced the processing and file handling requirements to a more manageable level, and for the purposes here, did not compromise the accuracy of the emissions files. Other current or recent projects undertaken by USEPA, WRAP, and the Lake Michigan Air Directors Consortium have used representative weekday/Saturday/Sunday emissions estimates for all source categories except biogenics for either each month or each season.

In an attempt to better represent the level of temporal and spatial detail available for each source category, a more detailed strategy was adopted. Biogenic emissions were modeled for each episode day using the daily meteorology. Point sources, including CEM and fire emissions, were modeled for each episode day to take advantage of the available day-specific emissions and meteorology. All sources were treated by SMOKE as potentially elevated. In conformance with the modeling strategies provided in Section 4.2, no plume-in-grid sources were modeled. Wildfire emissions were handled as point sources using plume rise calculations to place emissions into appropriate vertical layers.

Area sources, including non-road mobile and dust emissions that did not utilize meteorological data, were temporally allocated by the monthly, daily, and hourly profiles contained in SMOKE. Review of these temporal profiles indicated that maximum temporal definition was achieved by selecting representative Thursday, Friday, Saturday, Sunday, and Monday profiles for each month. A single week per month was selected to model emissions from on-road mobile sources. To best represent the average temperature ranges for that month, this week was selected from mid-month and adjusted to exclude holidays that would have required atypical processing. To simplify data handling procedures, the area source modeling dates also were selected from these weeks. The selected weeks for area source and on-road mobile source emissions modeling are shown in **Table 3-19**.

**Table 3-19 2006 Weeks Representing On-road Mobile Sources**

| | |
|---|---|
| January 15-21 | February 11-17 |
| March 12-18 | April 16-22 |
| May 14-20 | June 11-17 |
| July 16-22 | August 13-19 |
| September 17-23 | October 15-21 |
| November 12-18 | December 17-23 |

### 3.1.4 Development of Point Source Emissions

Stack parameter data frequently are not verified and careful attention is required to ensure that the point source emissions are properly located both horizontally and vertically on the modeling grid. This is especially true in some of the current regional modeling inventories. To screen for simple, but potentially serious

inventory errors such as these, the study team modified procedures originally developed by USEPA to provide a quality check. Where necessary, stack parameters were reviewed to evaluate the accuracy of the point source emissions, and procedures were standardized to identify and correct stack data errors. SMOKE has a number of built-in quality assurance procedures invoked in the processing of the point source data that are designed to catch missing or out-of-range stack parameters.

Point source emissions were separated into EGU and non-EGU categories. The non-EGU category did not include day- or hour-specific emissions. All non-EGU point source emissions were temporally allocated to month, day, and hour using annual emissions and SCC-based allocation factors. These factors were based on the cross-reference and profile data supplied with SMOKE Version 2.2 and supplemented with relevant data developed during the WRAP and Visibility Improvement States and Tribal Association of the Southeast (VISTAS) modeling studies.

The EGU point source emissions were temporally allocated for an actual and a typical modeling scenario. The actual emission scenarios reflected the temporal distribution of CEM measured emissions values that occurred in 2005 or 2006. The actual emissions scenarios were used for model validation and performance evaluation. All point sources were spatially allocated in the domain based on the stationary source geographic coordinates. If a point source was missing its latitude/longitude coordinates, the source was placed in the center of its respective county.

The typical 2005 and 2006 modeling inventories were developed to reflect an average temporal distribution of emissions from EGU point sources. This approach created a set of temporal profiles by averaging CEM emissions distributions over a number of years in order to remove exceptional operating conditions, such as upsets or shutdowns. These temporal profiles were applied to the 2005 and 2006 emissions totals, as well as to any future year scenarios. The typical emissions modeling scenarios were used as a basis of comparison for baseline and future year emissions.

### 3.1.5 Development of Area and Non-road Source Emissions

All area and non-road source emissions were temporally allocated to month, day, and hour using annual emissions and SCC-based allocation factors. These factors were based on the cross-reference and profile data supplied with SMOKE Version 2.2 and supplemented with relevant data developed during the WRAP and VISTAS studies. Area and non-road sources were spatially allocated in the domain based on SCC-based spatial surrogate allocation factors. If an area or non-road source SCC did not have an existing cross reference profile assigned to it, the county-level emissions were allocated by population density in the respective county.

A PM transport factor was applied to fugitive dust emission sources identified in USEPA modeling to have only a portion of its mass transported from the source of the emissions generation. The USEPA studies indicated that 60 to 90 percent of PM emissions from fugitive dust sources are rapidly deposited to near-source locales, and hence, do not participate in the physicochemical processes on the spatial scales that are typically used in air quality modeling simulations. For this reason, county-specific fugitive dust emissions transport factors (i.e., ratios) were applied to these sources to adjust PM emissions prior to the SMOKE modeling.

### 3.1.6 Development of On-road Mobile Source Emissions

The MOBILE6 module of SMOKE was used to develop the base year on-road mobile source emissions estimates for $NO_X$, CO, PM, and VOC emissions. The MOBILE6 parameters, vehicle fleet descriptions, and VMT estimates were combined with gridded, episode-specific temperature data to calculate the gridded, hourly emission estimates. For the proposed project 36- and 12-km modeling, no link based data were used. The

MOBILE6 emissions factors were based on episode-specific temperatures predicted by the meteorological model. Further, the MOBILE6 emissions factors model accounted for the following:

- Hourly and daily minimum/maximum temperatures;
- Traffic speeds;
- Locale-specific inspection and maintenance control programs, if any;
- Adjustments for running losses;
- Splitting of evaporative and exhaust emissions into separate source categories; and
- VMT, fleet turnover, and changes in fuel composition and Reid vapor pressure (RVP).

The primary input to MOBILE6 was the MOBILE shell file, which contains the various options (e.g., type of inspection and maintenance program in effect, type of oxygenated fuel program in effect, alternative vehicle mix profiles, RVP of in-use fuel, operating mode) that direct the calculation of the MOBILE6 emissions factors.

### 3.1.7 Development of Biogenic Source Emissions

Biogenic emissions were generated using MEGAN, which uses high resolution Geographic Information System data on plant types and biomass loadings and the Fifth Generation National Center for Atmospheric Research/ Penn State Mesoscale Model (MM5) surface temperature fields, and solar radiation (modeled or satellite-derived) to develop hourly emissions for biogenic species on the 36- and 12-km grids. MEGAN was selected over BEIS as the biogenics model of choice to maintain consistency with the UBAQS emissions inventory development.

### 3.1.8 Wildfires and Prescribed Burns

Wildfire and prescribed burn emissions were handled separately from the standard area source input files. This study used nation-wide fire emissions for the 2006 year, developed by the National Center for Atmospheric Research. Spatial and temporal distributions of the fire emissions were calculated based on this information rather than relying on standard distribution profiles. Vertical distribution of the fire emissions also was calculated based on fire size and biomass involvement. SMOKE Version 2.2 can model fire plume rise if provided with the following variables:

- PTOP – Top of the fire plume profile (meters above ground level);
- PBOT – Bottom of the fire plume profile (meters above ground level); and
- Lay1 – The percent of the emissions entrained in the first modeling layer.

The WRAP Fire Emissions Joint Forum Emissions Inventory Report (2002) provides an approach to estimate these plume descriptors. In this method, fires are assigned to one of five size categories based on the total burn acreage and the biomass fuel loading. These categories are then used to calculate representative hourly plume profiles used by SMOKE Version 2.2 to distribute the vertical emissions for the fires.

### 3.1.9 Products of the Emissions Inventory Development Process

In addition to the CMAQ-ready input files generated for each hour of the days modeled in the annual run, a number of quality assurance files were prepared and used to check for gross errors in the emissions inputs. Importing the model-ready emissions into the Package for Analysis and Visualization of Environmental Data and looking at both the spatial and temporal distribution of the emissions, provided insight into the quality and

accuracy of the emissions inputs. It also allowed for the following quality assurance checks on the emissions estimated using SMOKE Version 2.2:

- Visualizing the model-ready emissions with the scale of the plots set to a very low value allows for corrections to areas where emissions are omitted from the raw inventory or are erroneously located (such as area source industrial emission in water cells);
- Normalizing the emissions by population for each state illustrates where the inventories may have been deficient and provides a reality check of the inventories vis-à-vis a spatial evaluation of the population weighted emissions estimates; and
- Spot-checking vertical allocation of point source emissions estimates.

State inventory summaries were prepared prior to the emissions processing to compare against SMOKE output report totals generated after each major step of the emissions generation process. To check the vertical allocation of the emissions estimates, reports were created by source, hour, and layer for the domain.

Quantitative quality assurance analyses often reveal deficiencies in the input data or the model setup. Sometimes, tailored procedures are necessary to track down the source of each problem. Some of the reports that are generated to review the processed emissions estimates include the following:

- State and county totals from inventory for each source category;
- State and county totals after spatial allocation for each source category;
- State and county totals by day after temporal allocation for each source category for representative days;
- State and county totals by model species after chemical speciation for each source category;
- State and county model-ready totals (after spatial allocation, temporal allocation, and chemical speciation) for each source category and for all source categories combined;
- If elevated source selection is chosen, the report indicating which sources have been selected as elevated and plume-in-grid will be included;
- Totals by SCC from the inventory for area, mobile, and point sources;
- Totals by state and SCC from the inventory for area, mobile, and point sources;
- Totals by county and SCC from the inventory for area, mobile, and point sources;
- Totals by SCC and spatial surrogates code for area and mobile sources;
- Totals by speciation profile code for area, mobile, and point sources;
- Totals by speciation profile code and SCC for area, mobile, and point sources;
- Totals by monthly temporal profile code for area, mobile, and point sources;
- Totals by monthly temporal profile code and SCC for area, mobile, and point sources;
- Totals by weekly temporal profile code for area, mobile, and point sources;
- Totals by weekly temporal profile code and SCC for area, mobile, and point sources;
- Totals by diurnal temporal profile code for area, mobile, and point sources; and
- Totals by diurnal temporal profile code and SCC for area, mobile, and point sources.

These reports and data were used to validate the emissions modeling process.

## 3.2 Determination of Cumulative Impacts

As discussed in Section 3.1, the emissions estimate for the 2018 Projected Baseline was calculated from a combination of the WRAP II data for 2018 sources and from the WRAP III data for 2006 scaled up in a manner identical to the WRAP II ratio of 2006 to 2018 data for oil and gas sources. Although 2017 is identified as the year of maximum emissions for the Proposed Action, the projected 2018 emissions are considered representative of the 2017 non-project emissions. These emissions represent the currently approved and reasonably foreseeable future actions in the Uinta Basin.

Study-specific emission inventories are described in more detail in Section 3.7. These emissions were developed for the GNBPA for both the Proposed Action and Optimal Recovery Alternative and were added to the 2018 Projected Baseline to estimate cumulative total emissions from each alternative. These action alternative inventories included the construction, drilling and completion, production, and operation emissions calculated for the last year of construction and the year when the proposed project is expected to be fully developed – 2017 for the Proposed Action and 2026 for the Optimal Recovery Alternative. Because the Proposed Action is expected to be fully developed in 2018, the WRAP 2018 inventory could be used, thus allowing for the inclusion of the most precise emissions estimates for the future year.

## 3.3 Construction Emissions

The project descriptions for both the Proposed Action and the Optimal Recovery Alternative include the construction of well pads and additional infrastructure in fixed and linear facilities. Well pads consist of single well pads built to house one new well, or twin/multi-well pads constructed by expanding an existing single well pad to accommodate one or more additional wells. Other fixed facilities that would be constructed include:

- Worker camps for housing construction personnel (man camp);
- Compressor stations for processing and transporting additional production;
- Water tank batteries for storage and handling of additional produced water; and
- Water injection facilities (injection wells) for disposal of produced water.

Linear facilities and infrastructure that would be constructed for these project alternatives include:

- Access roads to wells and support facilities;
- Gas pipelines for gathering and transport of produced natural gas;
- Water pipelines for gathering and transport of produced water to tank batteries and injection wells; and
- Electric power lines to provide electrical power to wells, compressors, and other facilities.

Gas and water pipelines would include both surface and buried lines. Surface lines installed in existing rights-of-way are assumed to have minimal disturbance or resulting construction emissions.

The primary pollutants of concern relative to construction emissions are PM, $PM_{10}$, and $PM_{2.5}$ from surface disturbance, wind erosion, and vehicle traffic. Additionally, emissions of all PM species as well as other criteria pollutants such as $NO_X$, CO, $SO_2$, VOC, and HAP result from the operation of heavy mobile equipment. These emissions are difficult to quantify due to the uncertainty and variability in the scale and duration of construction activity. Furthermore, emissions from construction activities are temporary and localized making definitive quantification of emissions and impacts impossible. Finally, no regulatory standards exist to evaluate impacts of construction activities. For these reasons, this analysis did not include modeling of construction emissions from the proposed project.

## 3.4 Drilling Emissions

All project action alternatives include the installation of new production wells in two phases. The first phase would consist of operating the diesel-fired drill rig and associated equipment. In the second phase, the well would be completed by installation of the well casing and injection of a fracturing liquid to enhance production. In both phases, equipment would be hauled or serviced by heavy and light duty vehicles. These operations emit criteria pollutants from fuel combustion and PM from vehicle traffic. Each of these sources of emissions are described and quantified in the following sections.

### 3.4.1 Emissions from Drill Rig Operation

Each drill rig would be driven by a series of high-hp diesel-fired engines. Since the rig fleet generally is leased, the exact engine size for the rigs cannot be determined with certainty. Based on data provided by KMG, an average of 4,000 hp in total engine capacity per rig was assumed. Since the peak production year would occur after the compliance date for Tier 4 engines, emission factors of $NO_X$, CO, $PM_{10}$ ($PM_{2.5}$), and VOC (as non-methane hydrocarbon) were based on Tier 4 engine standards from Table 1 of the non-road diesel engine standards (40 CFR 1039.101). The emission factor for $SO_2$ was derived using **Equation 3-1** assuming 15 ppmw of sulfur in the fuel per fuel sulfur standards in 40 CFR 89. HAP emission factors were taken from the National Mobile Inventory Model database (USEPA 2005a). Emissions from the drill rig engine for each well drilled are calculated using **Equation 3-2** and shown in **Table 3-20**.

**Equation 3-1 Calculation of $SO_2$ Emission Factor Based on Fuel Sulfur**

$$EF_{SO2} = \frac{15\ lb\ S}{10^6\ lb\ \ fuel}\ x\ \frac{6.8\ lb\ \ fuel}{gal}\ x\ \frac{gal}{137{,}000\ Btu}\ x\ \frac{7{,}000\ Btu}{hp-hr}\ x\ \frac{64.06\ lb\ SO_2}{32.06\ lb\ S}\ x\ \frac{453.6\ g}{lb} = 4.7x10^{-3}\ g/hp-hr$$

**Equation 3-2 Calculation of Criteria Pollutant Emissions from Diesel Fired Drill Rig Engines**

$$E(tons\ /\ well) = EF\ (g\ /\ hp\ -\ hr)\ x\ \frac{hp}{rig}\ x\ \frac{days}{well}\ x\ \frac{24\ rig\ -\ hour}{day}\ x\ 0.42\ load\ \ x\ \frac{lb}{453.6\ g}\ x\ \frac{ton}{2000\ \ lb}$$

**Table 3-20 Criteria Pollutant Emissions from Rig Engines per Well Drilled**

| **Rig Size = 4,000 hp**<br>**Overall Load Factor[1] = 0.42**<br>**Duration = 15 days/well; 24 hours/day** | | | |
|---|---|---|---|
| **Pollutant** | **Emission Factor (g/hp-hr)** | **Emission Rate** | |
| | | **lb/hr** | **tons/well** |
| $NO_X$ | 0.3 | 1.12 | 0.2 |
| CO | 2.60 | 9.69 | 1.74 |
| $SO_2$ | 0.0047 | 0.02 | 0.0032 |
| $PM_{10}$ | 0.015 | 0.06 | 0.01 |
| VOC | 0.14 | 0.52 | 0.09 |
| Benzene | 0.003 | 0.01 | 0.002 |
| Toluene | 0.002 | 0.008 | 0.001 |
| Ethylbenzene | 0.0004 | 0.002 | 0.0003 |
| Xylene | 0.001 | 0.006 | 0.001 |
| Formaldehyde | 0.02 | 0.06 | 0.01 |
| n-Hexane | 0.0002 | 0.0008 | 0.0001 |

[1] Pfleider 1972.

Each rig would be equipped with a diesel-fired boiler to provide heat and steam during cold periods. It was assumed that the boilers would run at 2.8 million British thermal units (MMBtu)/hr per boiler (20.4 gal/hr based on 137,000 Btu/gal) and operate 4,380 hr/yr. Emissions factors were taken from AP-42, Table 1.3-1 and Table 1.3-9 for distillate oil fired boilers (USEPA 1998b). Emissions per rig are the product of the emission factor, fuel use, and operating time. Since each rig was estimated to drill 2 wells per month, the emissions per

well drilled equal the annual emissions per rig divided by 24 wells per rig. A summary of emissions from rig boilers is provided in **Table 3-21**.

**Table 3-21 Criteria Pollutant Emissions from Rig Boilers per Well Drilled**

| **Design Firing Rate = 2.8 MMBtu/hour**<br>**= 20.4 gallons/hour[1]**<br>**Annual Operating Hours = 4,380** | | | | |
|---|---|---|---|---|
| **Pollutant** | **Emission Factor ($lb/10^3$ gal)** | **Emission Rate** | | |
| | | **lb/hr-rig** | **tpy/rig** | **tons/well** |
| $NO_X$ | 18.0 | 0.37 | 0.81 | 0.034 |
| CO | 5.0 | 0.10 | 0.22 | 0.009 |
| $SO_2$ | 0.2 | 0.004 | 0.01 | 0.0004 |
| $PM_{10}$ | 2.0 | 0.04 | 0.09 | 0.004 |
| VOC | 0.34 | 0.007 | 0.02 | 0.0008 |
| Benzene | 0.0002 | 4.37E-06 | 9.58E-06 | 3.99E-07 |
| Toluene | 0.006 | 0.0001 | 0.0003 | 0.006 |
| Ethylbenzene | 0.00006 | 1.30E-06 | 2.85E-06 | 1.19E-07 |
| Xylenes | 0.0001 | 2.23E-06 | 4.88E-06 | 2.03E-07 |
| Formaldehyde | 0.03 | 0.0007 | 0.001 | 0.00006 |
| n-Hexane | No data | No data | No data | No data |

[1] Based on fuel heating value of 137,000 Btu per gallon.

### 3.4.2 Criteria Pollutant Emissions from Drilling and Completion Traffic

Light and heavy duty vehicles would move on unpaved roads during drilling and completion. Emission factors for $PM_{10}$ and $PM_{2.5}$ emissions from the unpaved roadways were developed from Equation 1a in Section 13.2.2 of AP-42 (USEPA 2006a) for industrial sites, as shown in **Equation 3-3**. Emissions factors for $PM_{10}$ and $PM_{2.5}$ from light duty vehicle traffic on publicly accessible unpaved roads were developed using Equation 1b in Section 13.2.2 of AP-42 (USEPA 2006a), as shown in **Equation 3-4**. The silt loading value of 5.1 was taken from AP-42, Table 13.2.2-1 (USEPA 2006a). For emission calculation purposes, total VMT per site and control efficiencies were benchmarked from similar calculations from the Pinedale Anticline EIS (BLM 2008b). No added controls were assumed from naturally occurring precipitation events, as controls are based on routine watering operations. The k factors used for $PM_{2.5}$ in **Equations 3-3** and **3-4** were based on a 2003 version of AP-42, which is slightly higher than the 2006 version and was used here to be conservative.

**Equation 3-3 Calculation of Uncontrolled PM Emission Factors from Unpaved Roads at Industrial Sites**

$$E_{PM}\ (lb/VMT) = k\ x \left( \frac{sL\ (5.1\%)}{12} \right)^{0.9} x \left( \frac{W\ (tons)}{3} \right)^{0.45}$$

Where: k (unitless) = 1.5 for $PM_{10}$ and 0.27 for $PM_{2.5}$

**Equation 3-4 Calculation of Uncontrolled PM Emission Factors from Publicly Accessible Unpaved Roads**

$$E_{PM}\ (lb/VMT) = k\ x \frac{\left( \frac{sL\ (5.1\%)}{12} \right) x \left( \frac{S\ (mph)}{30} \right)^{0.5}}{\left( \frac{M}{0.5} \right)^{0.2}} - C$$

Where: k (unitless) = 1.8 for $PM_{10}$ and 0.23 for $PM_{2.5}$
C (lb/VMT) = 0.00047 for $PM_{10}$ and 0.00036 for $PM_{2.5}$

A summary of traffic PM emissions is provided in **Tables 3-22** through **3-24**. Data were provided where needed for emissions calculations. The total emissions were calculated for each well site that is drilled,

**Table 3-22 PM Emissions from Unpaved Roads for Drilling Traffic**

| Vehicle Type | Dust Control Method | Mean Weight (ton) | Mean Speed (mph) | Moisture Content (%) | Estimated Round Trips (round trip/well) | Round Trip Distance (miles) | Vehicle Miles Traveled (VMT/well) | Uncontrolled $PM_{10}$ Emission Factor (lb/VMT) | Uncontrolled $PM_{2.5}$ Emission Factor (lb/VMT) | Control Efficiency (%) | Controlled $PM_{10}$ Emissions (lb/well) | Controlled $PM_{2.5}$ Emissions (lb/well) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy Trucks | Chemical | 22.0 | N/A | N/A | 360 | 10 | 3600 | 1.70 | 0.26 | 85 | 919.22 | 140.95 |
| | Water | | | | 360 | 1 | 360 | 1.70 | 0.26 | 50 | 306.41 | 46.98 |
| Light Trucks | Chemical | N/A | 20 | 2.4 | 540 | 10 | 5400 | 0.46 | 0.07 | 85 | 369.32 | 55.16 |
| | Water | | 20 | | 540 | 1 | 540 | 0.46 | 0.07 | 50 | 123.11 | 18.39 |
| | | | | | | | | | | **Total** | **1,718.06** | **261.48** |

**Table 3-23 PM Emissions from Unpaved Roads for Completion Traffic**

| Vehicle Type | Dust Control Method | Mean Weight (ton) | Mean Speed (mph) | Moisture Content (%) | Estimated Round Trips (round trip/well) | Round Trip Distance (miles) | Vehicle Miles Traveled (VMT/well) | Uncontrolled $PM_{10}$ Emission Factor (lb/VMT) | Uncontrolled $PM_{2.5}$ Emission Factor (lb/VMT) | Control Efficiency (%) | Controlled $PM_{10}$ Emissions (lb/well) | Controlled $PM_{2.5}$ Emissions (lb/well) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy Trucks | Chemical | 22.0 | N/A | N/A | 300 | 10 | 3000 | 1.70 | 0.26 | 85 | 766.02 | 117.46 |
| | Water | | | | 300 | 1 | 300 | 1.70 | 0.26 | 50 | 255.34 | 39.15 |
| Light Trucks | Chemical | N/A | 20 | 2.4 | 450 | 10 | 4500 | 0.46 | 0.07 | 85 | 307.77 | 45.97 |
| | Water | | 20 | | 450 | 1 | 450 | 0.46 | 0.07 | 50 | 102.59 | 15.32 |
| | | | | | | | | | | **Total** | **1,431.72** | **217.90** |

**Table 3-24 PM Emissions from Unpaved Roads for Rig Hauling Traffic**

| Vehicle Type | Dust Control Method | Mean Weight (ton) | Mean Speed (mph) | Moisture Content (%) | Estimated Round Trips (round trip/well) | Round Trip Distance (miles) | Vehicle Miles Traveled (VMT/well) | Uncontrolled $PM_{10}$ Emission Factor (lb/VMT) | Uncontrolled $PM_{2.5}$ Emission Factor (lb/VMT) | Control Efficiency (%) | Controlled $PM_{10}$ Emissions (lb/well) | Controlled $PM_{2.5}$ Emissions (lb/well) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy Trucks | Chemical | 22.0 | N/A | N/A | 26 | 10 | 260 | 1.70 | 0.26 | 85 | 66.39 | 10.18 |
| | Water | | | | 26 | 1 | 26 | 1.70 | 0.26 | 50 | 22.13 | 3.39 |
| Light Trucks | Chemical | N/A | 20 | 2.4 | 9 | 10 | 90 | 0.46 | 0.07 | 85 | 6.16 | 0.92 |
| | Water | | 20 | | 9 | 1 | 9 | 0.46 | 0.07 | 50 | 2.05 | 0.31 |
| | | | | | | | | | | **Total** | **96.72** | **14.80** |

including drilling, completion, and rig hauling. The calculations were based on the assumption of a 10-mile industrial site road controlled by chemical surfactants and a 1-mile on-site haul road controlled by water sprays. The total number of round trips, distance traveled, control effectiveness, and total controlled and uncontrolled emissions are shown in **Tables 3-22** through **3-24**.

Emissions of criteria pollutants from rig hauling also were included since there would be a large volume of haul traffic per well. Emissions factors for heavy equipment hauling were taken from AP-42 for mobile sources for high altitude heavy-duty diesel powered vehicle traffic (USEPA 1995a). Emission factors were based on the 2018 inventory year with a 2013 model year emission rate. Emission rates for $SO_2$ for these sources were taken from the earlier version of AP-42. Total hauling traffic is the sum of drilling, completion, and rig haul heavy truck traffic. A summary of hauling emissions is provided in **Table 3-25**.

**Table 3-25 Heavy Truck Criteria Pollutant Emissions from Well Drilling, Completion, and Rig Hauling**

| **Haul Truck Round Trips = 686 round trips/well**<br>**Round Trip Distance = 11 miles/round trip**<br>**Total Distance per Well = 7,546 VMT/well** | | |
|---|---|---|
| **Pollutant** | **Emission Factor (g/VMT)** | **Emission Rate (lb/well)** |
| $NO_X$ | 6.5 | 108.1 |
| CO | 18.2 | 302.8 |
| $SO_2$ | 0.18 | 3.0 |
| VOC | 4.7 | 78.2 |

### 3.4.3 Drilling Emissions Summary

The emissions of criteria pollutants and HAP per well installed are summarized in **Table 3-26**. Note that when $PM_{2.5}$ emission factors were unavailable, $PM_{10}$ was used as a surrogate.

**Table 3-26 Summary of Criteria Pollutant Emissions for Well Installation**

| **Activity** | **Criteria Pollutant Emissions (tons/well)** | | | | | |
|---|---|---|---|---|---|---|
| | **$NO_X$** | **CO** | **$SO_2$** | **$PM_{10}$** | **$PM_{2.5}$** | **VOC** |
| Drill Rig | 0.2 | 1.74 | 0.0032 | 0.01 | 0.01 | 0.0094 |
| Rig Boiler | 0.034 | 0.0093 | 0.00040 | 0.0037 | 0.0037 | 0.00063 |
| Drill Road Traffic | - | - | - | 0.9 | 0.1 | - |
| Completion Road Traffic | - | - | - | 0.7 | 0.1 | - |
| Rig Hauling Traffic | - | - | - | 0.05 | 0.007 | - |
| Hauling Tailpipe | 0.054 | 0.151 | 0.0015 | - | - | 0.039 |
| **Total** | **1.3** | **1.9** | **0.005** | **1.6** | **0.2** | **0.05** |
| **Activity** | **Hazardous Air Pollutant Emissions (tons/well)** | | | | | |
| | **Benzene** | **Toluene** | **Ethyl Benzene** | **Xylene** | **Formaldehyde** | **n-Hexane** |
| Drill Rig | 1.91E-03 | 1.41E-03 | 2.91E-04 | 9.94E-04 | 1.11E-02 | 1.49E-04 |
| Rig Boiler | 3.99E-07 | 1.16E-05 | 1.19E-07 | 2.03E-07 | 6.15E-05 | - |
| **Total** | **1.91E-03** | **1.42E-03** | **2.91E-04** | **9.94E-04** | **1.12E-02** | **1.49E-04** |

## 3.5 Production Emissions

Criteria pollutants are emitted during the operation of a production well. Primarily, emissions of VOC result from the volatilization of light organic liquids in the separator, known as flashing. Wells installed as part of these project alternatives would be equipped with zero emissions dehydrators. Additionally, each well would

operate a small gas-fired heater during the cold season to prevent freezing. Fugitive emissions of VOC result from leaks in flanges, pneumatic devices, and connectors at the well site. Finally, PM and gaseous pollutants are emitted from the traffic of tanker trucks hauling produced water and light duty vehicles transporting crews servicing the well. Each of these sources of emissions are described and quantified in the following sections.

### 3.5.1 VOC and HAP Emissions from Condensate Flashing

The gas extracted from a production well also contains various other components including large non-methane or non-ethane hydrocarbons. Most of these hydrocarbons are in liquid phase under the well pressure and volatilize when returned to ambient pressure in the phase separator. These hydrocarbons are emitted as VOC (and selected HAP). Calculating the emission rate is complex and depends on numerous process variables including the physical and chemical characteristics of the condensate as well as changes in pressure and temperature between the separator vessel and ambient conditions.

American Petroleum Institute's (API's) process simulator E&P Tanks Version 2.0 was used to determine emissions from condensate flashing. KMG provided high pressure condensate analytical information (see **Appendix B**). **Table 3-27** summarizes the project input and physical data for the process simulation, while **Table 3-28** shows the condensate mole fraction of each organic compound and the calculated process stream data from the simulation. The simulation was run for two process rates to account for anticipated well production decline over time.

**Table 3-27 Condensate Flashing Calculation Process Physical Characteristics**

| **Setup Information** | |
|---|---|
| **Flowsheet Selection** | **Oil Tank with Separator** |
| **Calculation Method** | **RVP Distillation** |
| **Separator Stream** | **High Pressure Oil** |
| **Data Input [1]** | |
| Separator Pressure (psig) | 90 |
| Separator Temperature (°F) | 78 |
| Ambient Pressure (psia) | 14.7 |
| Ambient Temperature (°F) | 70 |
| C10+ Specific Gravity | 0.74 |
| C10+ Molecular Weight | 159.67 |
| Days of Annual Operation (days/year) | 365 |
| API Gravity | 61.28 |
| Reid Vapor Pressure (psia) | 7.25 |

[1] See **Appendix B** for analytical data.

Estimated condensate production was 10 barrels (bbl)/day during the first year of production, while wells over a year old were assumed to only produce 3 bbl/day of condensate. **Table 3-29** provides a summary of VOC emissions for each well type. Raw output from the E&P Tanks Version 2.0 simulation is provided in **Appendix B**.

### 3.5.2 Emissions from Separator Heaters

Each separator would be equipped with a gas-fired heater to provide heat during cold periods. It was assumed that these boilers would run at 0.5 MMBtu/hr each and operate 4,380 hr/yr. Emissions factors were taken from AP-42, Tables 1.4 1, 1.4-2 and 1.4-3 for small uncontrolled boilers (USEPA 1998c). Emission factors for $SO_2$ were derived from fuel sulfur content. It was assumed that there is no more than 20 ppmw (0.012 gr/standard cubic feet [scf]) in the fuel gas, yielding an emission factor of 3.4 lb/MMscf as shown in **Equation 3-5**. Emissions per well are the product of the emission factor, fuel use, and operating time as shown in **Table 3-30**.

**Table 3-28 Condensate Flashing Calculation Chemical Characteristics**

| Condensate Chemical Characteristics | | Stream Data (E&P Tanks Version 2.0 Output) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Chemical Component | Mol% | Molecular Weight | LP Oil mol% | Flash Oil mol% | Sale Oil mol% | Flash Gas mol% | Working and Standing Gas mol% | Total Emission mol% | Molar Wt g/mol | % Wt Wt % |
| $H_2S$ | 0.0000 | 34.8 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 | 0.00 |
| $O_2$ | 0.0000 | 32 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 | 0.00 |
| $CO_2$ | 0.4190 | 44.01 | 0.3769 | 0.0840 | 0.0484 | 5.2604 | 4.3922 | 5.1881 | 13.41 | 0.14 |
| $N_2$ | 0.0000 | 28.01 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 | 0.00 |
| C1 | 4.0438 | 16.04 | 3.0671 | 0.2776 | 0.0764 | 49.5796 | 16.1487 | 46.7933 | 113.27 | 1.21 |
| C2 | 1.9669 | 30.07 | 1.8755 | 0.7128 | 0.5332 | 21.2616 | 24.7510 | 21.5524 | 31.55 | 0.34 |
| C3 | 1.9609 | 44.1 | 1.9500 | 1.3882 | 1.2657 | 11.3178 | 19.5050 | 12.0002 | 58.96 | 0.63 |
| i-C4 | 0.9410 | 58.12 | 0.9460 | 0.8468 | 0.8174 | 2.5996 | 5.4619 | 2.8382 | 41.50 | 0.44 |
| n-C4 | 1.7049 | 58.12 | 1.7176 | 1.6152 | 1.5774 | 3.4243 | 7.7374 | 3.7837 | 99.09 | 1.06 |
| i-C5 | 1.6679 | 72.15 | 1.6854 | 1.7044 | 1.6948 | 1.3689 | 3.6023 | 1.5550 | 96.94 | 1.03 |
| n-C5 | 2.1989 | 72.15 | 2.2232 | 2.2764 | 2.2705 | 1.3361 | 3.7528 | 1.5375 | 158.65 | 1.69 |
| C6 | 6.2227 | 86.16 | 6.2976 | 6.5962 | 6.6208 | 1.3189 | 4.3371 | 1.5705 | 448.97 | 4.79 |
| C7 | 17.1271 | 100.2 | 17.3395 | 18.3079 | 18.4224 | 1.1933 | 4.6814 | 1.4840 | 1,475.67 | 15.75 |
| C8 | 15.6182 | 114.23 | 15.8140 | 16.7422 | 16.8634 | 0.3374 | 1.5895 | 0.4418 | 1,564.94 | 16.71 |
| C9 | 12.5804 | 128.28 | 12.7386 | 13.4971 | 13.5994 | 0.0921 | 0.5165 | 0.1275 | 1,437.06 | 15.34 |
| C10+ | 17.2661 | 159.67 | 17.4836 | 18.5312 | 18.6571 | 0.0163 | 0.1260 | 0.0255 | 2,214.90 | 23.65 |
| Benzene | 0.9069 | 78.11 | 0.9180 | 0.9649 | 0.9696 | 0.1354 | 0.4661 | 0.1630 | 144.80 | 1.55 |
| Toluene | 5.6567 | 92.13 | 5.7273 | 6.0569 | 6.0982 | 0.2326 | 0.9761 | 0.2946 | 441.84 | 4.72 |
| Ethyl benzene | 0.4490 | 106.17 | 0.4546 | 0.4815 | 0.4851 | 0.0060 | 0.0296 | 0.0079 | 41.37 | 0.44 |
| Xylenes | 6.5727 | 106.17 | 6.6553 | 7.0499 | 7.1026 | 0.0756 | 0.3871 | 0.1016 | 697.82 | 7.45 |
| n-Hexane | 2.6969 | 86.18 | 2.7297 | 2.8668 | 2.8797 | 0.4440 | 1.5392 | 0.5352 | 286.33 | 3.06 |
| 2,2,4-Trimethylpentane | 0.0000 | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 | 0.00 |

**Table 3-29 Emissions of VOC and HAP from Condensate Flashing**

| Chemical Component | Mol% | New Well[1] | | Old Well[1] | |
|---|---|---|---|---|---|
| | | (tpy) | (lb/hr) | (tpy) | (lb/hr) |
| C3 | 1.9609 | 1.422 | 0.325 | 0.427 | 0.097 |
| i-C4 | 0.9410 | 0.443 | 0.101 | 0.133 | 0.030 |
| n-C4 | 1.7049 | 0.591 | 0.135 | 0.177 | 0.040 |
| i-C5 | 1.6679 | 0.301 | 0.069 | 0.090 | 0.021 |
| n-C5 | 2.1989 | 0.298 | 0.068 | 0.089 | 0.020 |
| C6 | 6.2227 | 0.354 | 0.081 | 0.106 | 0.024 |
| C7 | 17.1271 | 0.387 | 0.088 | 0.116 | 0.026 |
| C8 | 15.6182 | 0.132 | 0.030 | 0.040 | 0.009 |
| C9 | 12.5804 | 0.042 | 0.010 | 0.013 | 0.003 |
| C10+ | 17.2661 | 0.011 | 0.003 | 0.003 | 0.001 |
| Benzene | 0.9069 | 0.034 | 0.008 | 0.010 | 0.002 |
| Toluene | 5.6567 | 0.073 | 0.017 | 0.022 | 0.005 |
| Ethyl benzene | 0.4490 | 0.002 | 0.000 | 0.001 | 0.000 |
| Xylenes | 6.5727 | 0.029 | 0.007 | 0.009 | 0.002 |
| n-Hexane | 2.6969 | 0.124 | 0.028 | 0.037 | 0.008 |
| 2,2,4-Trimethylpentane | 0.0000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | **Total VOC Emissions** | **4.243** | **0.970** | **1.273** | **0.288** |

[1] Production at a new well is assumed to be 10 bbl/day; at an old well 3 bbl/day.

**Equation 3-5 $SO_2$ Emissions Factor from Combustion of Fuel Gas in Heaters**

$$EF_{SO2} = \frac{0.012\ gr\ S}{scf\ \ fuel}\ x\ \frac{lb}{7{,}000\ gr}\ x\ \frac{64.06\ lb\ SO_2}{32.06\ lb\ S}\ x\ \frac{10^6\ scf}{MMscf} = 3.4\ lb\ /\ MMscf$$

**Table 3-30 Emissions from Separator Heaters at Production Wells**

**Annual Operating Hours = 4,380**
**Heat Content = 950 Btu/scf**
**Fuel Sulfur Content = 0.012 gr/scf**
**Design Firing Rate = 0.5 MMBtu/hr**
**= 0.00053 MMscf/hr**

| | Emission Factor | Emission Rate (per well) | |
|---|---|---|---|
| Pollutant | (lb/MMscf) | (lb/hr) | (tpy) |
| $NO_X$ | 100.0 | 0.053 | 0.12 |
| CO | 84.0 | 0.044 | 0.097 |
| $SO_2$ | 3.4 | 0.0018 | 0.0039 |
| Total PM | 7.6 | 0.0040 | 0.0088 |
| VOC | 5.5 | 0.0029 | 0.0063 |
| Benzene | 0.002 | 1.11E-06 | 2.42E-06 |
| Toluene | 0.003 | 1.79E-06 | 3.92E-06 |
| Ethylbenzene | No data | No data | No data |
| Xylene | No data | No data | No data |
| Formaldehyde | 0.08 | 0.00004 | 0.00008 |
| n-Hexane | 1.80 | 0.0009 | 0.002 |

### 3.5.3 Fugitive Emissions

Emissions of VOC and HAP also result from gas and light oil (condensate) leaking from flanges and other connections. Total leakage of gas and VOC from light oil was estimated using the USEPA Protocol for Equipment Leak Estimates (USEPA 1995b) based on assumptions regarding component counts at each well site. VOC emissions were calculated based on the VOC (non-methane and non-ethane) weight fraction in the respective material stream. For gas leaks, this also was reduced by the weight fraction of gas in the condensate stream; 10 percent was assumed for this analysis. **Table 3-31** summarizes the emissions of VOC for fugitive leaks for each well based on the individual number of components at each well site.

**Table 3-31 Emissions of VOC from Fugitive Leaks at Production Wells**

| Gas and Condensate Data | | | | | | |
|---|---|---|---|---|---|---|
| **Gas = 10.0% Total Organic Compounds (TOC) by weight**<br>**Methane = 92.5% of TOC by weight**<br>**Ethane = 3.7% of TOC by weight**<br>**Condensate = 98.31% of VOC by weight** | | | | | | |
| **VOC Emissions** | | | | | | |
| **Source Components** | **Service Type** | **Quantity** | **TOC Emission Factor (kg/hr/component)** | **TOC Emissions (lb/hr)** | **VOC[1, 2] (lb/hr)** | **(tpy)** |
| Valves | Gas | 20 | 0.004 | 0.02 | 0.0008 | 0.003 |
| | Light Oil | 5 | 0.002 | 0.03 | 0.03 | 0.12 |
| Flanges | Gas | 30 | 0.0004 | 0.003 | 0.0001 | 0.0004 |
| | Light Oil | 10 | 0.0001 | 0.002 | 0.002 | 0.01 |
| Connections | Gas | 275 | 0.0002 | 0.01 | 0.0005 | 0.002 |
| | Light Oil | 100 | 0.0002 | 0.05 | 0.05 | 0.20 |
| Pump seals | Gas | 2 | 0.002 | 0.001 | 0.00004 | 0.0002 |
| | Light Oil | 2 | 0.013 | 0.06 | 0.06 | 0.25 |
| Open ended lines | Gas | 3 | 0.002 | 0.001 | 0.00005 | 0.0002 |
| | Light Oil | 3 | 0.001 | 0.009 | 0.009 | 0.04 |
| All Sources | Gas | | | 0.04 | 0.001 | 0.006 |
| | Light Oil | | | 0.14 | 0.14 | 0.62 |
| | | | | **Total Emissions/Well** | **0.14** | **0.62** |

[1] $E_{gas}$ (tpy) = TOC EF * Quantity * Gas Weight Fraction * (1 - (Methane + Ethane Weight Fraction))

[2] $E_{lt\ oil}$ (tpy) = TOC EF * Quantity * Gas Weight Fraction

HAP emissions were based on the fraction in the total organic carbon of the selected HAP in both gas and light oil. Gas fractions were taken from the condensate analysis presented in **Table 3-28** while light oil fractions are taken from WDEQ guidance (WDEQ 2007). These results are presented in **Table 3-32**.

**Table 3-32 Emissions of Selected HAP from Fugitive Leaks at Production Wells**

| | **Light Oil** | | | **Gas** | | | **Total** |
|---|---|---|---|---|---|---|---|
| **Pollutant** | **Weight[1]** | **lb/well-hr** | **lb/well-yr** | **Fraction of TOC[2]** | **lb/well-hr** | **lb/well-yr** | **tpy/well** |
| Benzene | 1.55% | 0.002 | 19 | 2.30E-04 | 8.5E-06 | 0.07 | 0.01 |
| Toluene | 4.72% | 0.007 | 59 | 3.90E-04 | 1.4E-05 | 0.13 | 0.03 |
| Ethylbenzene | 0.44% | 0.0006 | 5.5 | 2.00E-05 | 7.4E-07 | 0.006 | 0.003 |
| Xylene | 7.45% | 0.01 | 93 | 1.00E-03 | 3.7E-05 | 0.32 | 0.05 |
| Formaldehyde | 3.06% | 0.004 | 38 | 0.00 | 0.00 | 0.00 | 0.02 |
| n-Hexane | No data | | | | | | |

[1] Fugitive HAPs Weight % of TOC is from condensate analysis.

[2] Fugitive HAPs Fraction of TOC is from WDEQ 2007.

### 3.5.4 Production Traffic

Each well would be serviced by well operators in light duty vehicles as well as water tank trucks collecting produced water. Emissions factors for $PM_{10}$ and $PM_{2.5}$ emissions from the unpaved roadways were developed from Equation 1a in Section 13.2.2 of AP-42 (USEPA 2006a) for industrial sites, as shown in **Equation 3-3**. Emissions factors for $PM_{10}$ and $PM_{2.5}$ from light duty vehicle traffic on publicly accessible unpaved roads were developed using Equation 1b in Section 13.2.2 of AP-42 (USEPA 2006a), as shown in **Equation 3-4**. Silt loading was assumed to be 5.1 percent based on AP-42 as described in Section 3.4.2 and a moisture content of 2.4 percent as discussed in Section 3.4.2. A summary of traffic PM emissions is provided in **Table 3-33**.

**Table 3-33 PM Emissions from Unpaved Roads for Production Traffic per Operational Well**

| Vehicle Type | Dust Control Method | Mean Weight (ton) | Mean Speed (mph) | Moisture Content (%) | Estimated Round Trips (round trip/well-yr) | Round Trip Distance (miles) | Vehicle Miles Traveled (VMT/well-yr) | Uncontrolled $PM_{10}$ Emission Factor (lb/VMT) | Uncontrolled $PM_{2.5}$ Emission Factor (lb/VMT) | Control Efficiency (%) | Controlled $PM_{10}$ Emissions (lb/well-yr) | Controlled $PM_{2.5}$ Emissions (lb/well-yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heavy Trucks | Chemical | 27.0 | N/A | N/A | 365 | 1.3 | 474.5 | 1.87 | 0.29 | 85 | 132.85 | 20.37 |
| | Water | | | | 365 | 0.1 | 36.5 | 1.87 | 0.29 | 50 | 34.07 | 5.22 |
| Light Trucks | Chemical | N/A | 35 | 2.4 | 156 | 2.6 | 405.6 | 0.60 | 0.09 | 85 | 36.71 | 5.49 |
| | Water | | 20 | | 156 | 0.3 | 46.8 | 0.46 | 0.07 | 50 | 10.67 | 1.59 |
| | | | | | | | | | | **Total** | **214.30** | **32.68** |

Emissions of criteria pollutants from tanker traffic also was included due to the volume of tanker traffic per well. Emissions factors for tanker truck hauling were taken from AP-42 for mobile sources (USEPA 1995a) for high altitude heavy vehicle traffic identical to the factors applied in **Table 3-25**. A summary of hauling emissions is provided in **Table 3-34**. **Table 3-34** also demonstrates that criteria pollutant emissions are negligible for production traffic for $NO_X$, CO, $SO_2$, and VOC.

**Table 3-34 Criteria Pollutant Emissions from Tanker Truck Traffic**

| **Tanker Truck Round Trips = 365 round trips/well**<br>**Round Trip Distance = 1.4 miles/round trip**<br>**Distance = 511 VMT/well** | | |
|---|---|---|
| **Pollutant** | **Emission Factor (g/VMT)** | **Emission Rate (lb/well)** |
| $NO_X$ | 6.5 | 7.32 |
| CO | 18.2 | 20.50 |
| $SO_2$ | 0.18 | 0.20 |
| VOC | 4.7 | 5.29 |

### 3.5.5 Summary

The emissions of criteria pollutants per well installed are summarized in **Table 3-35**. Note that when $PM_{2.5}$ emission factors were not available, $PM_{10}$ is used as a surrogate.

**Table 3-35 Summary of Criteria Pollutant Emissions for Production Wells**

| | **Criteria Pollutant Emissions (tpy per well)** | | | | | |
|---|---|---|---|---|---|---|
| **Activity – New Well** | **$NO_X$** | **CO** | **$SO_2$** | **$PM_{10}$** | **$PM_{2.5}$** | **VOC** |
| Condensate Flashing - New Well | - | - | - | - | - | 4.2 |
| Separator Heaters | 0.12 | 0.097 | 0.0039 | 0.0088 | 0.0088 | 0.0063 |
| Fugitive Emissions | - | - | - | - | - | 0.62 |
| Production Traffic | - | - | - | 0.1 | 0.016 | - |
| Production Traffic (Tailpipe) | 0.0037 | 0.01 | 0.0004 | - | - | 0.0026 |
| **Total** | **0.12** | **0.11** | **0.0043** | **0.11** | **0.025** | **4.9** |
| | | | | | | |
| **Activity – Old Well** | | | | | | |
| Condensate Flashing - Old Well | | | | | | 1.3 |
| Separator Heaters | 0.12 | 0.097 | 0.0039 | 0.0088 | 0.0088 | 0.0063 |
| Fugitive Emissions | - | - | - | - | - | 0.62 |
| Production Traffic | - | - | - | 0.1 | 0.016 | - |
| Production Traffic (Tailpipe) | 0.0037 | 0.01 | 0.0004 | - | - | 0.0026 |
| **Total** | **0.121** | **0.1** | **0.0043** | **0.11** | **0.025** | **1.9** |
| | **Hazardous Air Pollutant Emissions (tpy per well)** | | | | | |
| **Activity – New Well** | **Benzene** | **Toluene** | **Ethyl Benzene** | **Xylene** | **Formaldehyde** | **n-Hexane** |
| Condensate Flashing - New Well | 0.034 | 0.073 | 0.002 | 0.029 | - | 0.124 |
| Separator Heaters | 2.42E-06 | 3.92E-06 | - | - | 8.64E-05 | 0.002 |
| Fugitive Emissions | 0.010 | 0.030 | 0.003 | 0.047 | - | 0.019 |
| **Total** | **0.044** | **0.103** | **0.005** | **0.076** | **8.64E-05** | **0.145** |
| | | | | | | |
| **Activity – New Well** | **Benzene** | **Toluene** | **Ethyl Benzene** | **Xylene** | **Formaldehyde** | **n-Hexane** |
| Condensate Flashing - Old Well | 0.010 | 0.022 | 0.001 | 0.009 | - | 0.037 |
| Separator Heaters | 2.42E-06 | 3.92E-06 | - | - | 8.64E-05 | 0.002 |
| Fugitive Emissions | 0.010 | 0.030 | 0.003 | 0.047 | - | 0.019 |
| **Total** | **0.020** | **0.052** | **0.004** | **0.056** | **8.64E-05** | **0.058** |

## 3.6 Operation Emissions

The Proposed Action and Optimal Recovery Alternative would include the installation and operation of facilities to manage produced water and provide gas compression. Produced water would be gathered by a gathering and transport pipeline system as well as tanker trucks, delivered to several central tank batteries for storage and additional condensate separation, and then transported to several injection wells for disposal into aquifers as well as to evaporation ponds.

### 3.6.1 Water Tank Battery Operation

It was assumed that the tank batteries would use 2,900 bbl tanks for storing produced water, which includes some small amount of condensate in non-aqueous phase. As the produced water is drawn from these tanks, the remaining condensate would be piped to 1,500 bbl tanks for recovery. Emissions of VOC in both sets of tanks would result from both the standing evaporation losses and working losses from emptying or filling these tanks. These emissions were estimated using USEPA TANKS 4.09, which implements the procedures in AP-42, Chapter 7.1 for Liquid Storage Tanks (USEPA 2006b).

To accurately predict emissions, TANKS 4.09 requires physical characteristic data for the stored material. Since VOC emissions from the produced water result from the non-aqueous layer on top of the total fluid, the non-aqueous condensate properties were used to estimate emissions from both non-aqueous condensate and produced water tanks. The condensate analysis from E&P Tanks Version, as discussed in Section 3.5.1 and presented in **Appendix B**, was used to determine the necessary physical properties, which are shown in **Table 3-36**.

**Table 3-36 Physical Properties of Tank Condensate**

| Parameter | Value |
|---|---|
| Vapor Molecular Weight (lb/lb-mol) | 36.24 |
| Liquid Molecular Weight (lb/lb-mol) | 110.68 |
| Liquid Density (lb/gal) | 5.71 |
| Liquid Reid Vapor Pressure (psia) | 7.25 |

Based on data provided by KMG, produced water would be generated at a rate of 90 bbl/MMscf of gas production. As stated in Section 3.5.1, new wells would produce 10 bbls of condensate per day and old wells would produce 3 bbls/day. The sum of this production distributed over the tank batteries and tanks determines the total throughput to each tank for emissions calculations. Eight water tank batteries are included in the 2018 Projected Baseline as approved actions, and KMG proposes to install 2 more as part of Proposed Action or 5 more as part of the Optimal Recovery Alternative. A summary of throughput calculation data and assumptions is provided in **Table 3-37**. The output from TANKS 4.09 for each alternative is provided in **Appendix B**.

Additionally, KMG has committed to installing controls capable of 95 percent reduction on sources exceeding 20 tpy of uncontrolled VOC emissions. Therefore, a control efficiency of 95 percent was applied since the aggregate emissions from every battery exceed this threshold. Total VOC emissions from each water tank battery are summarized in **Table 3-38**. **Table 3-38** also summarizes the emissions of selected HAP from water tank batteries.

HAP emissions were calculated based on the mass fraction of the selected HAP of the condensate as TOC. This mass fraction was taken from the condensate analytical information provided in **Table 3-28**. Since TANKS calculates emissions as VOC, the TANKS data were converted to TOC by multiplying by 1.13, which is the ratio of TOC to VOC based on the data in **Table 3-28**.

**Table 3-37 Produced Water and Condensate Throughput for Water Tank Batteries**

| Parameter | Unit | Proposed Action | Optimal Recovery Alternative |
|---|---|---|---|
| **Produced Water** | | | |
| Peak Field Production | Bscf/yr | 318.9 | 616.7 |
| Water Production | bbl/MMscf | 90 | 90 |
| | MMbbl/yr | 28.7 | 55.5 |
| Number of Tank Batteries | | 10 | 13 |
| Number of Tanks per Battery | | 4 | 4 |
| Tank Capacity | bbl/tank | 2,900 | 2,900 |
| Tank Turnovers | turnovers/yr | 247.4 | 368.1 |
| **Condensate** | | | |
| New Wells | wells | 336 | 672 |
| Old Wells | wells | 3,339 | 12,774 |
| New Well Production | bbl/well-day | 10 | 10 |
| Old Well | bbl/well-day | 3 | 3 |
| Condensate Production | MMbbl/yr | 4.88 | 16.44 |
| Number of Tanks per Battery | | 2 | 4 |
| Tank Capacity | bbl/tank | 1,500 | 1,500 |
| Tank Turnovers | turnovers/yr | 162.8 | 210.8 |

**Table 3-38 VOC and HAP Emissions from Water Tank Batteries**

| **VOC Emissions** | | | |
|---|---|---|---|
| **Parameter** | **Unit** | **Proposed Action** | **Optimal Recovery Alternative** |
| **Produced Water** | | | |
| Working Losses | lb/tank-yr | 28,460.10 | 36,497.38 |
| Breathing Losses | lb/tank-yr | 10,485.43 | 10,485.43 |
| VOC Emissions (per tank) | ton/tank-yr | 19.5 | 23.5 |
| Tanks per Battery | tanks/battery | 4 | 4 |
| VOC Emissions (per battery) | ton/battery-yr | 77.9 | 94.0 |
| **Condensate (per tank)** | | | |
| Working Losses | lb/tank-yr | 11,806.90 | 13,460.14 |
| Breathing Losses | lb/tank-yr | 6,758.09 | 6,758.09 |
| VOC Emissions (per tank) | ton/tank-yr | 9.3 | 10.1 |
| Tanks per Battery | tanks/battery | 2 | 4 |
| VOC Emissions (per battery) | ton/battery-yr | 18.6 | 40.4 |
| Uncontrolled VOC Emissions | ton/battery-yr | 96.5 | 134.4 |
| Control Efficiency | % | 95% | 95% |
| **Controlled VOC Emissions** | **ton/battery-yr** | **4.8** | **6.7** |
| **Hazardous Air Pollutant Emissions** | | | |
| **Pollutant** | **Unit** | **Proposed Action** | **Optimal Recovery Alternative** |
| TOC | ton/battery-yr | 5.5 | 7.6 |
| Benzene | %wt | 2.15% | 2.15% |
| | ton/battery-yr | 0.12 | 0.16 |
| Toluene | %wt | 2.20% | 2.20% |
| | ton/battery-yr | 0.12 | 0.17 |
| Ethylbenzene | %wt | 0.08% | 0.08% |
| | ton/battery-yr | 0.0043 | 0.0060 |
| Xylene | %wt | 1.19% | 1.19% |
| | ton/battery-yr | 0.065 | 0.090 |
| n-Hexane | %wt | 4.72% | 4.72% |
| | ton/battery-yr | 0.26 | 0.36 |

### 3.6.2 Water Injection Facility Operation

Each water injection facility would be equipped with a gas-fired engine to drive the injection pumps. For purposes of this analysis, these engines were estimated at 650 hp each and assumed to operate continuously. Emissions factors for $NO_X$, CO, and VOC were taken from the New Source Performance Standard, Subpart JJJJ for non-emergency gas-fired engines greater than 500 hp (Table 1, 40 CFR 60.4231) manufactured after July 1, 2010. Emission factors for $SO_2$ were derived from fuel sulfur content as shown in **Equation 3-6**. $PM_{10}$ emission factors were taken from AP-42, Table 3.2-2 (USEPA 2000). Additionally, emissions of CO and VOC would be controlled by an oxidation catalyst reducing emissions by 93 and 50 percent, respectively. Emissions of criteria pollutants (excluding $PM_{10}$) were the product of the emission factor, engine size, and operating time. Emissions for $PM_{10}$ were the product of the emission factor, fuel use, and operating time. Criteria pollutant emissions from individual water injection engines are shown in **Table 3-39**. HAP emission factors were taken from AP-42, Table 3.2-2 (USEPA 2000).

**Equation 3-6 $SO_2$ Emissions Factor from Combustion of Fuel Gas in Engines**

$$EF_{SO2} = \frac{0.012\ gr\ S}{scf\ \ fuel}\ x\ \frac{scf\ \ fuel}{950\ Btu}\ x\ \frac{7{,}000\ Btu}{hp-hr}\ x\ \frac{lb}{7{,}000\ gr}\ x\ \frac{mwSO_2}{mwS} = 2.52x10^{-5}\ lb/hp-hr$$

**Table 3-39 Criteria Pollutant Emissions from Water Injection Engines**

**Annual Operating Hours = 8,760**
**Heat Content = 950 Btu/scf**
**Fuel Sulfur Content = 0.012 gr/scf**
**Rated Engine Size = 650 bhp**
**Fuel Consumption = 4.55 MMBtu/hr**

| Pollutant | Emission Factor | | Control Efficiency (%) | Emission Rate (lb/hr) | Emission Rate (tpy) |
|---|---|---|---|---|---|
| $NO_X$ | 1.00 | g/hp-hr | -- | 1.43 | 6.28 |
| CO | 2.00 | g/hp-hr | 93 | 0.20 | 0.88 |
| $SO_2$ | 0.000025 | lb/hp-hr | -- | 0.02 | 0.07 |
| $PM_{10}$ | 0.01 | lb/MMBtu | -- | 0.05 | 0.20 |
| VOC | 0.70 | g/hp-hr | 50 | 0.37 | 1.64 |
| Benzene | 0.0004 | lb/MMBtu | 50 | 0.001 | 0.004 |
| Toluene | 0.0004 | lb/MMBtu | 50 | 0.0009 | 0.004 |
| Ethylbenzene | 0.00004 | lb/MMBtu | 50 | 0.00009 | 0.0004 |
| Xylene | 0.0002 | lb/MMBtu | 50 | 0.0004 | 0.002 |
| Formaldehyde | 0.05 | lb/MMBtu | 50 | 0.12 | 0.53 |
| n-Hexane | 0.001 | lb/MMBtu | 50 | 0.003 | 0.01 |

### 3.6.3 Gas-fired Compression Engines

The Proposed Action and Optimal Recovery Alternative both would include the installation of additional gas-fired compression to transport the increase in field production. For this analysis, the additional compression will be provided by gas-fired engines of three sizes (1,265 hp, 1,340 hp, and 2,370 hp). Emissions factors for $NO_X$, CO, and VOC were taken from manufacturer specifications as provided in **Appendix B**. Emission factors for $SO_2$ were derived from fuel sulfur content as shown in **Equation 3-6**. Emission factors for $PM_{10}$ were taken from AP-42, Table 3.2-2 (USEPA 2000). Emissions of criteria pollutant per engine are shown in **Tables 3-40**, **3-41**, and **3-42**. A listing of additional compression engines at each site for both the Proposed Action and Optimal Recovery Alternative, as well as the total emissions for each facility by alternative are summarized in **Tables 3-43** and **3-44**. HAP emissions factors were taken from AP-42, Table 3.2-2 for four-stroke lean burn engines. Emissions of HAP were calculated as the product of these

emission factors and the total proposed hp of gas-fired compression. **Table 3-45** and **Table 3-46** summarize total HAP emissions from gas-fired compression for each alternative.

**Table 3-40 Criteria Pollutant Emissions from Gas-fired Compression Engines (1,265 hp)**

| **Annual Operating Hours = 8,760**<br>**Heat Content = 950 Btu/scf**<br>**Fuel Sulfur Content = 0.012 gr/scf**<br>**Rated Engine Size = 1,265 bhp**<br>**Fuel Consumption = 8.9 MMBtu/hr** | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Emission Factor[1]** | | **Control Efficiency (%)** | **Emission Rate (lb/hr)** | **(tpy)** |
| $NO_X$ | 1.50 | g/hp-hr | -- | 4.2 | 18.3 |
| CO | 2.42 | g/hp-hr | 93 | 0.5 | 2.1 |
| $SO_2$ | 0.000023 | lb/hp-hr | -- | 0.03 | 0.1 |
| $PM_{10}$ | 0.01 | lb/MMBtu | -- | 0.09 | 0.4 |
| VOC | 0.56 | g/hp-hr | 50 | 0.8 | 3.4 |

[1] Emissions factors for $NO_X$, CO, and VOC for CAT Model G3516 LE, see **Appendix B**.

**Table 3-41 Criteria Pollutant Emissions from Gas-fired Compression Engines (1,340 hp)**

| **Annual Operating Hours = 8,760**<br>**Heat Content = 950 Btu/scf**<br>**Fuel Sulfur Content = 0.012 gr/scf**<br>**Rated Engine Size = 1,340 bhp**<br>**Fuel Consumption = 9.4 MMBtu/hr** | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Emission Factor[1]** | | **Control Efficiency (%)** | **Emission Rate (lb/hr)** | **(tpy)** |
| $NO_X$ | 1.50 | g/hp-hr | -- | 4.4 | 19.4 |
| CO | 2.42 | g/hp-hr | 93 | 0.5 | 2.2 |
| $SO_2$ | 0.000023 | lb/hp-hr | -- | 0.031 | 0.1 |
| $PM_{10}$ | 0.01 | lb/MMBtu | -- | 0.09 | 0.4 |
| VOC | 0.56 | g/hp-hr | 50 | 0.8 | 3.6 |

[1] Emissions factors for $NO_X$, CO, and VOC for CAT Model G3516 LE, see **Appendix B**.

**Table 3-42 Criteria Pollutant Emissions from Gas-fired Compression Engines (2,370 hp)**

| **Annual Operating Hours = 8,760**<br>**Heat Content = 950 Btu/scf**<br>**Fuel Sulfur Content = 0.012 gr/scf**<br>**Rated Engine Size = 2,370 bhp**<br>**Fuel Consumption = 16.59 MMBtu/hr** | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Emission Factor[1]** | | **Control Efficiency (%)** | **Emission Rate (lb/hr)** | **(tpy)** |
| $NO_X$ | 0.7 | g/hp-hr | -- | 3.66 | 16.02 |
| CO | 2.5 | g/hp-hr | 93 | 0.89 | 3.88 |
| $SO_2$ | 0.000023 | lb/hp-hr | -- | 0.06 | 0.24 |
| $PM_{100.01}$ | 9.99E-3 | lb/MMBtu | -- | 0.17 | 0.73 |
| VOC | 0.83 | g/hp-hr | 50 | 1.46 | 6.41 |

[1] Emissions factors for $NO_X$, CO, and VOC for CAT Model G3516 LE, see **Appendix B**.

**Table 3-43 Summary of Criteria Pollutant Emissions from Gas-fired Compression for the Proposed Action**

| Station | Additional Engines Proposed | | | Criteria Pollutant Emissions (tpy) | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1,265 hp | 1,340 hp | 2,370 hp | $NO_X$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| Antelope Flats | -- | 3 | -- | 58.2 | 6.6 | 0.4 | 1.2 | 10.9 |
| Archie Bench | -- | 4 | -- | 77.6 | 8.8 | 0.5 | 1.6 | 14.5 |
| Bitter Creek | -- | 1 | -- | 19.4 | 2.2 | 0.1 | 0.4 | 3.6 |
| Blue Feather | -- | 2 | -- | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Bonanza East | -- | 2 | -- | 38.8 | 4.4 | 0.3 | 0.5 | 7.2 |
| Bonanza West | -- | 3 | -- | 58.2 | 6.6 | 0.4 | 1.2 | 10.9 |
| Bridge | -- | 2 | -- | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Cottonwood/West 3 | -- | 1 | 1 | 35.4 | 6.1 | 0.4 | 1.1 | 10.0 |
| Diablo | -- | -- | 4 | 64.1 | 16.0 | 1.0 | 2.9 | 38.0 |
| East | -- | 1 | -- | 19.4 | 2.2 | 0.1 | 0.4 | 3.6 |
| Love | -- | 2 | -- | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| North Ouray | -- | 2 | -- | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Ouray | -- | 3 | 1 | 74.2 | 10.5 | 0.7 | 2.0 | 17.3 |
| Rimer Canyon | -- | 6 | -- | 116.5 | 13.2 | 0.8 | 2.5 | 21.7 |
| Sage Grouse | -- | 2 | -- | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Sand Wash | -- | 1 | -- | 19.4 | 2.2 | 0.1 | 0.4 | 3.6 |
| South | 1 | -- | -- | 18.3 | 2.1 | 0.1 | 0.4 | 3.4 |
| White River | -- | 3 | 2 | 90.3 | 14.3 | 0.9 | 2.7 | 23.7 |
| Willow Creek | -- | 3 | 1 | 74.2 | 10.5 | 0.7 | 2.0 | 17.3 |
| **Total** | **1** | **45** | **5** | **958.3** | **127.3** | **8.0** | **23.7** | **222.0** |

**Table 3-44 Summary of Criteria Pollutant Emissions from Gas-fired Compression for the Optimal Recovery Alternative**

| Station | Additional Engines Proposed | | | Criteria Pollutant Emissions (tpy) | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1,265 hp | 1,340 hp | 2,370 hp | $NO_X$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| Antelope Flats | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Archie Bench | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bitter Creek | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Blue Feather | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bonanza East | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bonanza West | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bridge | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Cottonwood/West 3 | -- | 2 | 5 | 118.9 | 23.8 | 1.5 | 4.4 | 39.3 |
| Diablo | -- | -- | 8 | 128.2 | 32.0 | 1.9 | 5.8 | 76.0 |
| East | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Love | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| North Ouray | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Ouray | -- | 4 | 5 | 157.7 | 28.2 | 1.8 | 5.3 | 46.5 |
| Rimer Canyon | -- | 6 | -- | 116.5 | 13.2 | 0.8 | 2.5 | 21.7 |
| Sage Grouse | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Sand Wash | -- | 5 | -- | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| South | 2 | -- | -- | 36.6 | 4.1 | 0.3 | 0.8 | 6.8 |
| White River | -- | 3 | 6 | 154.3 | 29.8 | 1.9 | 5.6 | 49.3 |
| Willow Creek | -- | 3 | 5 | 138.3 | 26.0 | 1.6 | 4.9 | 42.9 |
| **Total** | **2** | **86** | **21** | **2,015.1** | **288.6** | **18.0** | **53.8** | **500.0** |

**Table 3-45 Summary of HAPs from Gas-Fired Compression for the Proposed Action**

| **Annual Operating Hours = 8,760**<br>**Total Proposed Compression = 73,415 bhp**<br>**Fuel Consumption = 513.9 MMBtu/hr** | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Emission Factor[1]** | | **Control Efficiency** | **Emission Rate** | |
| | | | | **(lb/hr)** | **(tpy)** |
| Benzene | 0.0004 | lb/MMBtu | 50% | 0.11 | 0.50 |
| Toluene | 0.0004 | lb/MMBtu | 50% | 0.10 | 0.46 |
| Ethylbenzene | 0.00004 | lb/MMBtu | 50% | 0.01 | 0.04 |
| Xylene | 0.0002 | lb/MMBtu | 50% | 0.05 | 0.21 |
| Formaldehyde | 0.05 | lb/MMBtu | 50% | 13.57 | 59.42 |
| n-Hexane | 0.001 | lb/MMBtu | 50% | 0.29 | 1.25 |

[1] USEPA 2000.

**Table 3-46 Summary of HAPs from Gas-Fired Compression for the Optimal Recovery Alternative**

| **Annual Operating Hours = 8,760**<br>**Total Proposed Compression = 167,540 bhp**<br>**Fuel Consumption = 1172.8 MMBtu/hr** | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Emission Factor[1]** | | **Control Efficiency** | **Emission Rate** | |
| | | | | **(lb/hr)** | **(tpy)** |
| Benzene | 0.0004 | lb/MMBtu | 50% | 0.26 | 1.13 |
| Toluene | 0.0004 | lb/MMBtu | 50% | 0.24 | 1.05 |
| Ethylbenzene | 0.00004 | lb/MMBtu | 50% | 0.02 | 0.10 |
| Xylene | 0.0002 | lb/MMBtu | 50% | 0.11 | 0.47 |
| Formaldehyde | 0.05 | lb/MMBtu | 50% | 30.96 | 135.61 |
| n-Hexane | 0.001 | lb/MMBtu | 50% | 0.65 | 2.85 |

[1] USEPA 2000.

## 3.7 Modeling Inventory Development for Project Alternatives

Sections 3.3 through 3.6 describe the annual emissions for each alternative per activity. However, the additional emissions from each project alternative must be calculated for the peak production year activity and spatially distributed throughout the GNBPA for modeling. The peak production year for the Proposed Action would be 2017, and for the Optimal Recovery Alternative it would be 2026. For the project alternatives, it was assumed that all wells proposed are operating at normal capacity excluding the final year of wells drilled. The wells drilled were assumed to be operating for part of the year and producing condensate at a higher rate. This reflects the last ongoing year of drilling emissions and the maximum operational emissions.

Under the Proposed Action, it was assumed that a fleet of 14 rigs would be operating, drilling an average of two producing wells per month while the Optimal Recovery drilling would require 28 rigs drilling at the same rate. It was assumed that 3 percent of these wells would be dry, resulting in additional drilling emissions.

As described earlier, total emissions for production and drilling activity were the product of the proposed activity level and the emissions per activity. Finally, these emissions were spatially distributed for each alternative to specific township, range, and section based on the predicted activity in each section. The emissions per section for each alternative are summarized in **Appendix C**. These emissions are in addition to the compression emissions shown in **Tables 3-43** and **3-44**. Location of compression emissions are summarized in Chapter 4.0. **Tables 3-47** through **3-50** summarize the total project emissions (criteria pollutant and HAP) for each alternative, based on the summary of emissions provided in **Tables 3-26**, **3-35**, **3-37**, **3-39**, **3-44**, and **3-45**.

**Table 3-47 Summary of Criteria Pollutant Emissions from the Proposed Action**

| Activity | Scenario Description | | | 2017 Annual Emissions (tpy) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Project | 2017 | 2018 | $NO_X$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| **Drilling Activities** | | | | | | | | | |
| Wellbores Drilled (Producing) | 3,675 | 336 | 0 | 615.1 | 639.8 | 1.7 | 550.0 | 87.6 | 44.9 |
| Wellbores Drilled (Non-producing) | 91 | 10 | 0 | 18.3 | 19.0 | 0.0 | 9.2 | 1.5 | 1.3 |
| **Total Drilling Emissions** | | | | **633.4** | **658.9** | **1.7** | **559.2** | **89.1** | **46.2** |
| | | | | | | | | | |
| **Production and Operation Activities** | | | | | | | | | |
| Producing Wells (above baseline) | 3,675 | 3,339 | 3,675 | 397.1 | 357.5 | 14.3 | 387.0 | 83.8 | 6,355.1 |
| Compression Engines | | | | 958.3 | 127.3 | 8.0 | 23.7 | 23.7 | 222.0 |
| Water Tank Batteries Operating | 2 | 2 | 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.6 |
| Water Injection Facilities Operating | 15 | 13 | 15 | 81.6 | 11.4 | 0.9 | 2.1 | 2.1 | 21.3 |
| **Total Production and Operating Emissions** | | | | **1,437.0** | **496.2** | **23.2** | **480.4** | **177.2** | **6,608.0** |
| | | | | | | | | | |
| **Total Project Emissions** | | | | **2,070.6** | **1,155.2** | **24.9** | **972.1** | **198.8** | **6,654.3** |

**Table 3-48 Summary of Criteria Pollutant Emissions for Optimal Recovery Alternative**

| Activity | Scenario Description | | | 2026 Annual Emissions (tpy) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Project | 2026 | 2027 | $NO_X$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| **Drilling Activities** | | | | | | | | | |
| Wellbores Drilled (Producing) | 13,446 | 672 | 0 | 1,230.2 | 1,279.6 | 3.4 | 1,100.0 | 175.3 | 89.8 |
| Wellbores Drilled (Non-producing) | 384 | 20 | 0 | 36.6 | 38.1 | 0.1 | 18.4 | 3.0 | 2.7 |
| **Total Drilling Emissions** | | | | **1,266.8** | **1,317.7** | **3.5** | **1,118.5** | **178.3** | **92.5** |
| | | | | | | | | | |
| **Production and Operation Activities** | | | | | | | | | |
| Producing Wells (above baseline) | 13,446 | 12,774 | 13,446 | 1,519.1 | 1,367.7 | 54.8 | 1,480.6 | 320.6 | 24,312.6 |
| Compression Engines | | | | 2,015.1 | 288.6 | 18.0 | 53.5 | 53.5 | 500.0 |
| Water Tank Batteries Operating | 5 | 5 | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 33.6 |
| Water Injection Facilities Operating | 25 | 23 | 25 | 144.4 | 20.2 | 1.5 | 3.7 | 3.7 | 37.7 |
| **Total Production and Operating Emissions** | | | | **3,678.6** | **1,676.6** | **74.3** | **1,691.3** | **531.3** | **24,883.9** |
| | | | | | | | | | |
| **Total Project Emissions** | | | | **4,945.9** | **2,994.4** | **77.8** | **2,656.6** | **556.4** | **24,976.3** |

**Table 3-49 Summary of Hazardous Air Pollutant Emissions from the Proposed Action**

| Activity | Scenario Description | | | 2017 Annual Emissions (tpy) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Project | 2017 | 2018 | Benzene | Toluene | Ethyl Benzene | Xylene | Formaldehyde | n-Hexane |
| **Drilling Activities** | | | | | | | | | |
| Wellbores Drilled (Producing) | 3,675 | 336 | 0 | 0.6 | 0.6 | 0.1 | 0.3 | 3.7 | 0.05 |
| Wellbores Drilled (Non-producing) | 91 | 10 | 0 | 0.02 | 0.02 | 0.003 | 0.01 | 0.1 | 0.002 |
| **Total Drilling Emissions** | | | | **0.7** | **0.6** | **0.1** | **0.3** | **3.9** | **0.05** |
| | | | | | | | | | |
| **Production and Operation Activities** | | | | | | | | | |
| Producing Wells (above baseline) | 3,675 | 3,339 | 3,675 | 65.8 | 172.2 | 12.6 | 186.2 | 0.3 | 194.3 |
| Compression Engines (bhp) | | 73,415 | | 0.5 | 0.5 | 0.04 | 0.2 | 59.4 | 1.2 |
| Water Tank Batteries Operating | 2 | 2 | 2 | 0.2 | 0.2 | 0.008 | 0.1 | | 0.5 |
| Water Injection Facilities Operating | 15 | 13 | 15 | 0.06 | 0.06 | 0.005 | 0.02 | 6.8 | 0.1 |
| **Total Production and Operating Emissions** | | | | **66.6** | **173.0** | **12.6** | **186.6** | **- 66.6** | **196.2** |
| | | | | | | | | | |
| **Total Project Emissions** | | | | **67.3** | **173.6** | **12.7** | **186.9** | **70.4** | **196.3** |

**Table 3-50 Summary of Hazardous Air Pollutant Emissions for Optimal Recovery Alternative**

| Activity | Scenario Description | | | 2026 Annual Emissions (tpy) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Project | 2026 | 2027 | Benzene | Toluene | Ethyl Benzene | Xylene | Formaldehyde | n-Hexane |
| **Drilling Activities** | | | | | | | | | |
| Wellbores Drilled (Producing) | 13,446 | 672 | 0 | 1.3 | 1.1 | 0.2 | 0.7 | 7.5 | 0.1 |
| Wellbores Drilled (Non-producing) | 384 | 20 | 0 | 0.04 | 0.04 | 0.006 | 0.02 | 0.2 | 0.003 |
| **Total Drilling Emissions** | | | | **1.3** | **1.2** | **0.2** | **0.7** | **8.7** | **0.1** |
| | | | | | | | | | |
| **Production and Operation Activities** | | | | | | | | | |
| Producing Wells (above baseline) | 13,446 | 12,774 | 13,446 | 251.8 | 658.9 | 48.1 | 712.5 | 1.1 | 743.5 |
| Compression Engines (bhp) | | 167,540 | | 1.1 | 1.0 | 0.1 | 0.5 | 135.6 | 2.9 |
| Water Tank Batteries Operating | 5 | 5 | 5 | 0.8 | 0.8 | 0.003 | 0.5 | | 1.8 |
| Water Injection Facilities Operating | 25 | 23 | 25 | 0.1 | 0.09 | 0.009 | 0.04 | 12.1 | 0.3 |
| **Total Production and Operating Emissions** | | | | **253.9** | **660.9** | **48.3** | **713.5** | **- 148.8** | **748.4** |
| | | | | | | | | | |
| **Total Project Emissions** | | | | **255.2** | **662.1** | **48.5** | **714.1** | **156.5** | **748.5** |

# 4.0 Modeling Procedures

Meteorological data for regional atmospheric modeling were developed for 2 meteorological years, 2005 and 2006. This period was utilized due to the availability of concurrent and representative emissions data and meteorological databases. The modeling analysis used three atmospheric dispersion models to evaluate impacts and changes in impacts to air quality and other related AQRVs (i.e., regional haze, acidic deposition, and acid neutralizing capacity) resulting from increased development in the Uinta Basin. The modeling consisted of the following analyses/models:

- CALPUFF – to assess project development and cumulative impacts on air concentrations and other AQRVs at Class I and sensitive Class II areas within the modeling domain using 2006 meteorological data only;
- CMAQ – to assess cumulative impacts on ozone concentrations in the surrounding areas using 2005 and 2006 meteorological data; and
- AERMOD – to assess near-field project development impacts on local air concentrations within 2 km of the development, using 5 years of meteorological data (2002 through 2006).

## 4.1 CALPUFF Modeling

The CALPUFF modeling system (Scire et al. 2000a,b) was promulgated on April 15, 2003, and is USEPA's preferred/recommended model for long-range transport beyond 50 km. When appropriate, the modeling procedure followed recommendations in the Interagency Workgroup on Air Quality Modeling (IWAQM) and FLAG documents for the assessment of impacts (USEPA 1998a; FLAG 2000). Consideration also was given to the modeling procedures described in the draft FLAG 2008 guidance specifically pertaining to the regional haze analysis techniques. This analysis used the current USEPA-approved version of the CALPUFF modeling suite (Version 5.8) to address air quality impacts and AQRVs.

The CALPUFF modeling consisted of three different model simulations: Run 1 (Baseline 2018) was the baseline modeled year (2018 project WRAP III/WRAP II inventory) without the project-specific emissions from the proposed project; Run 2 (Proposed Action) was a combination of Run 1 along with the future Proposed Action project emissions for the year 2017; and Run 3 (Optimal Recovery Alternative) was similar to Run 2 with a different project emission scenario that maximizes the recovery of oil and natural gas. Under the Proposed Action, the year 2017 is projected to have combined maximum production emissions in addition to construction emissions for the GNBPA.

### 4.1.1 Model Options and Computational Domain

Since CALPUFF is a Lagrangian puff model with the capability to simulate regional-scale, long-range dispersion as well as local-scale, short-range dispersion (Scire et al. 2000a), the CALPUFF modeling system was used for assessing impacts from the proposed development within the GNBPA at the identified Class I and sensitive Class II areas.

The CALPUFF modeling system has three main components:

- CALMET Version 5.8, Level 070623 (a diagnostic three-dimensional meteorological model, which develops the meteorological data for modeling input);
- CALPUFF Version 5.8, Level 070623 (the transport and dispersion model that carries out calculations of dispersion); and
- CALPOST Version 5.6394, Level 070622 (a post-processing package that is used to depict overall concentrations and impacts).

The CALPUFF modeling system has several unique features that, given the objectives of the study, make it suited to carry out the required atmospheric dispersion modeling for this study. Those features include:

- Time-varying point, volume, and area source emissions;
- Model domains at distances from tens of meters to hundreds of kilometers from the sources;
- Averaging times from 1 hour to 1 year;
- Impact prediction for inert pollutants that are not chemically reactive in the atmosphere;
- Impact prediction for pollutants that may be subject to removal (i.e., wet scavenging and gravitational settling) and chemical conversion mechanisms; and
- Applications in rough and flat terrain situations.

The modeling domain for this study was designed to closely resemble the CMAQ 12-km domain. This domain incorporated the GNBPA along with Class I and sensitive Class II area locations within approximately 200 to 250 km of sources within the GNBPA. The domain included a majority of Utah and western Colorado along with portions of Wyoming, Arizona, and New Mexico (**Figure 4-1**). The spatial extent of the domain was 672 km (east-west) x 552 km (north-south). The design allowed for 168 x 138 grid cells and a 4-km grid element size. That size domain required the use of a Lambert Conformal Projection (LCP) grid system as follows:

- Central reference LCP point longitude, latitude = (-97.0° W, 40.0° N);
- Standard latitude parallels at 33° N and 45° N; and
- Grid origin (southwest corner) offset from central reference point = (-1392 km, -312 km).

The IWAQM recommended default settings were used when they were consistent with the current version of CALPUFF. Thus, the default dry and wet deposition algorithms were used. In addition, the following CALPUFF options also were selected:

- Pasquill-Gifford (P-G) dispersion coefficients;
- Transitional plume rise;
- Stack tip downwash;
- Transition of horizontal dispersion to time-dependent (Heffter) growth rates;
- Chemical transformation based on MESOPUFF II scheme; and
- Wet and dry deposition modeling.

### 4.1.2 Assessment Areas and Receptor Grids

The receptor grids for the Class I areas for this assessment were based on the NPS national database. For those sensitive areas that were not contained in the NPS database of receptors, receptor sets were developed within the sensitive area's boundary from the existing grid of receptors. The elevations of these receptors were derived using Digital Elevation Model (DEM) data for the 1:250,000 quads with 90-m horizontal resolution (U.S. Geological Survey [USGS] 2000). **Table 2-5** lists each of the Class I areas and sensitive Class II areas of concern within the modeling domain and included in the analysis. **Figure 4-1** also shows the location of each area in relation to the GNBPA.

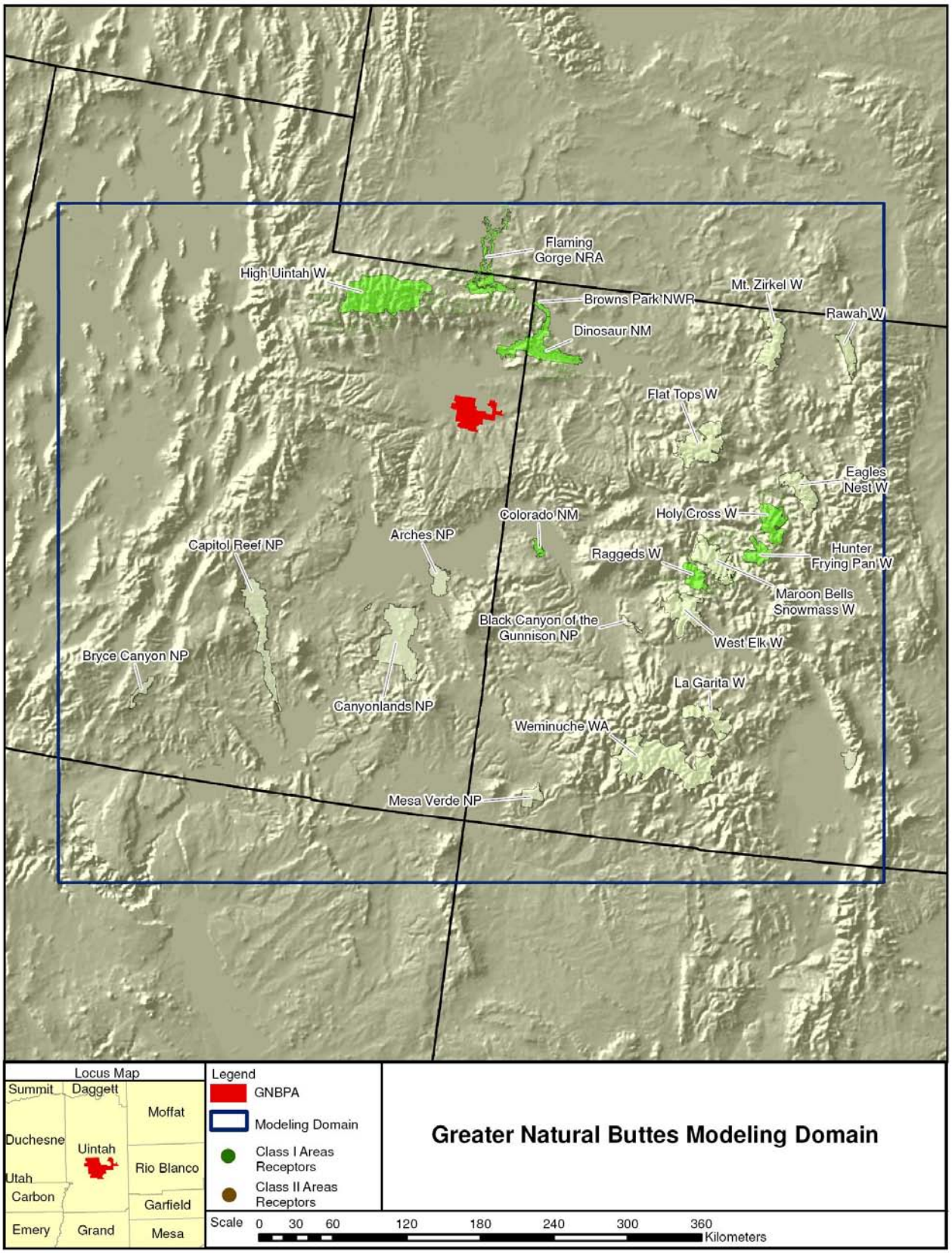



**Figure 4-1 Modeling Domain and Location of Class I and Class II Receptors**

### 4.1.3 CALPUFF Emission Inputs

The project emission inputs to CALPUFF are provided in **Appendix D**. The background source inventory used as inputs to CALPUFF were developed based on the output of SMOKE (also used as input to CMAQ). The development of these emissions is discussed in Chapter 3.0. Two source types modeled from the SMOKE output were area sources and point sources.

The area source emissions were based on the total emissions within each CMAQ 12-km grid box. Before input to CALPUFF, some of these grid boxes were merged based upon their location in proximity to a Class I or Class II area of concern to reduce the number of sources. **Figure 4-2** shows the point and area sources used as input to CALPUFF throughout the modeling domain for the 2018 Projected Baseline.

The SMOKE point source emissions must be consolidated due to the large number of point sources in the WRAP Phase II/Phase III Inventory. Sources were consolidated based on the following methodology:

- For point sources with total facility $NO_X$, $SO_2$, and $PM_{10}$ emissions greater than 100 tpy, a weighted average point source for each facility was derived. The weighting was done based on the sum of $NO_2$, $SO_2$, and $PM_{10}$ emissions for each point relative to the sum of the $SO_2$, $NO_2$, and $PM_{10}$ emissions for the entire facility. The resulting weighted average point source for each facility included the total sum of all the facility emissions released through a weighted average location along with weighted average release parameters. Thus, the modeled source had the location and release parameters consistent with the facility source that had the greatest total emissions of $NO_X$, $SO_2$, and $PM_{10}$.
- For point sources with total facility $NO_X$, $SO_2$, and $PM_{10}$ emissions less than 100 tpy, a weighted average point source for each facility also was derived using the same procedure described above for the facilities with greater than 100 tpy emissions. However, additional consolidating was applied for the sources with facility total emissions less than 100 tpy of combined $NO_X$, $SO_2$, and $PM_{10}$. These sources were further consolidated based on location on the modeling domain. For sources that fell within the same 12-km grid box, these sources were consolidated using the same procedures discussed above. **Figure 4-2** shows the consolidated points sources used as input to CALPUFF. **Appendix D** provides the emissions source inventory used as input to CALPUFF along with some of the steps in the consolidation process.

This source consolidation procedure conserved the total emissions throughout the analysis. As a result, even though the number of sources was lower in the CALPUFF inputs as compared to the SMOKE output (the CMAQ input), the total emissions being modeled for $NO_X$, $SO_2$, and $PM_{10}$ were the same. Since the CALPUFF modeling does not consider CO or VOC, point sources emitting these pollutant(s) were excluded from the analysis.

### 4.1.4 CALMET Processing and Meteorological Data Development

CALMET, one of the three main components of the CALPUFF modeling system, includes a diagnostic wind model that combines surface and upper-air meteorological data with diagnostic effects of terrain and other factors to generate three-dimensional wind fields (Scire et al. 2000b). It also includes other interpolation algorithms that generate three-dimensional temperature, pressure, and other meteorological variables and two-dimensional precipitation fields. For areas with complex terrain and sparse wind observations, a diagnostic wind model cannot accurately depict the complex flow fields by using surface observation data alone. In those situations, CALMET defines the synoptic-scale flow features by using the output from a coarse grid (12- or 36-km) resolution simulation of a prognostic meteorological model (e.g., MM5) to better characterize the local wind variations at a finer scale (e.g., 4 km) by using its diagnostic wind algorithms and local surface observations. For this analysis, CALMET was used to derive hourly three dimensional meteorological data fields for 1 year (2006). The meteorological database was developed using a 4- by 4-km grid resolution.

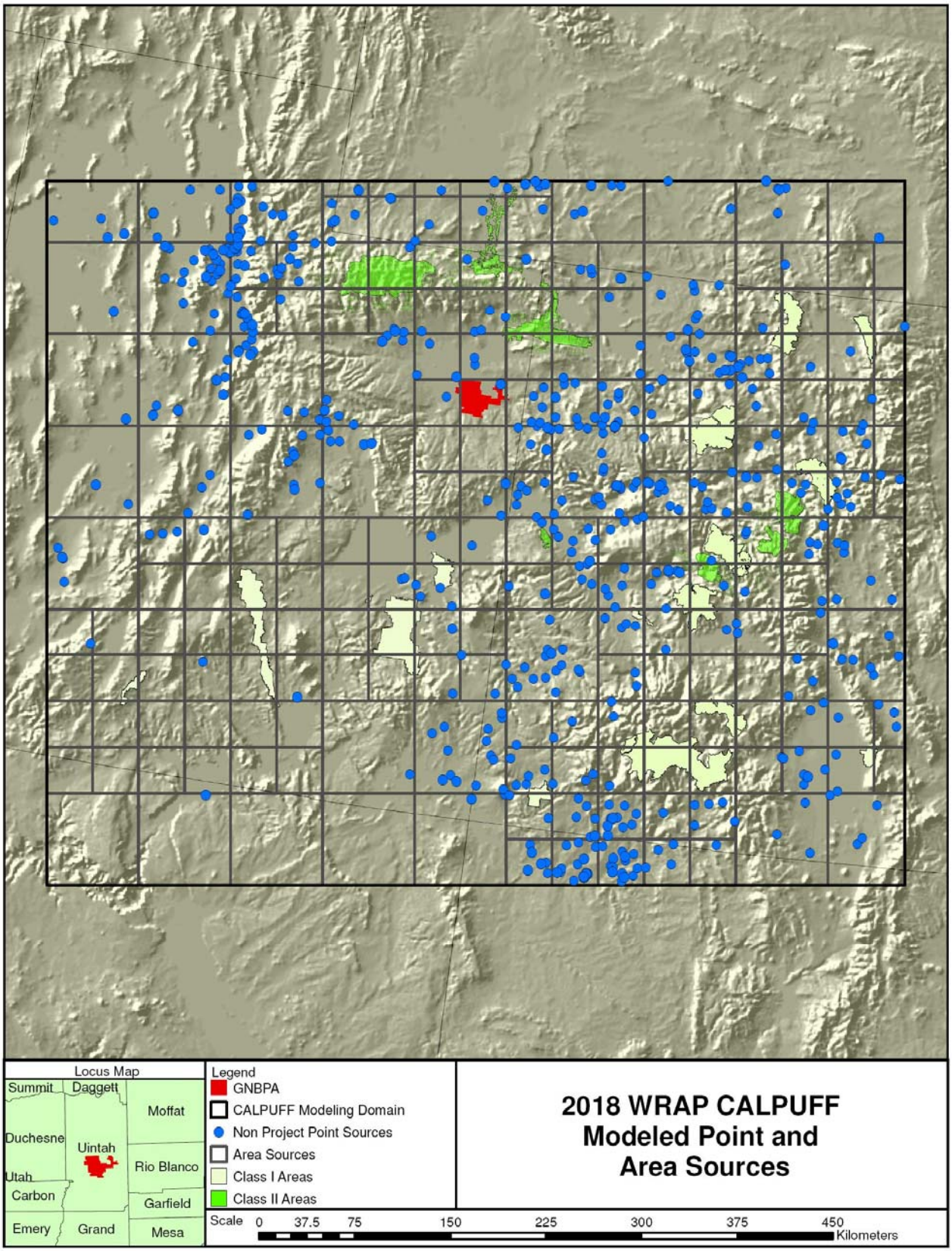



**Figure 4-2 2018 CALPUFF Modeled Point and Area Sources**

The meteorological data were developed in a series of steps. The Step 1 wind field was developed by using 2006 MM5 data available at 12-km resolution combined with 4-km terrain and land use defined throughout the modeling domain. The terrain and land use data were developed from USGS 1:250,000 DEM and 1:250,000 Composite Theme Grid files. Additional surface (from both primary and secondary observation stations – including CASTNET meteorology) and upper-air meteorological data were used in the production of the Step 2 wind field. Precipitation data and other meteorological variables (i.e., temperature, relative humidity, etc.) were then incorporated into the final output of CALMET that was used to drive the CALPUFF model. **Figure 4-3** depicts the location of the meteorological data sources used as input data to the CALMET model. **Table 4-1** presents the user-defined parameters that define the CALMET domain and the weighting values used in developing the CALMET fields.

**Table 4-1 Preliminary CALMET User-defined Fields Not Specified in IWAQM Appendix A**

| Variable | Description | Value |
|---|---|---|
| NX | Number of east-west grid cells | 159 |
| NY | Number of north-south grid cells | 141 |
| DGRIDKM | Meteorology grid spacing (km) | 4 |
| NZ | Number of vertical layers of input meteorology | 12 |
| ZFACE | Vertical cell face heights (meters [m]) | 0,20,40,80,120,180,260,400,600,800,1200, 2000,3500 |
| IEXTRP | Extrapolation of surface winds to upper layers | -4 |
| RMAX1 | Maximum surface over-land extrapolation radius (km) | 20 |
| RMAX2 | Maximum aloft over-land extrapolation radius (km) | 50 |
| RMAX3 | Maximum over-water extrapolation radius (km) | 500 |
| TERRAD | Radius of influence of terrain features (km) | 10 |
| R1 | Relative weight at surface of Step 1 field and observations | 10 |
| R2 | Relative weight aloft of Step 1 field and observations | 25 |
| IPROG | Gridded initial prognostic wind field – MM5 data | 14 |
| RMIN | Minimum radius of influence for wind field interpolation | 0.1 |
| IKINE | Kinematic effects | OFF |

### 4.1.5 CALPUFF Background Air Quality Data

The CALPUFF chemistry algorithms require hourly estimates of background ammonia and ozone concentrations for the conversion of $NO/NO_2$ and $SO_2$ to nitrates and sulfates, respectively. As discussed in Section 2.3, background ozone monitoring data available for the proposed model year from rural located stations from within and just outside the modeling domain were included in the CALPUFF analysis. Hourly ozone data from representative rural USEPA AIRS and CASTNET monitoring sites were used to create a time and spatially varying ozone database used as input into CALPUFF. In areas without hourly data, a regional representative background ozone concentration value based upon the monthly average of all the available regional hourly data was used. The background monthly average ozone values ranged from 26.1 ppb in December to 46.6 ppb in July.[2]

[2] Actual monthly values for January through December are respectively 28.3, 32.0, 37.6, 42.9, 41.9, 45.3, 46.6, 40.5, 34.0, 28.0, 27.7, 26.1.

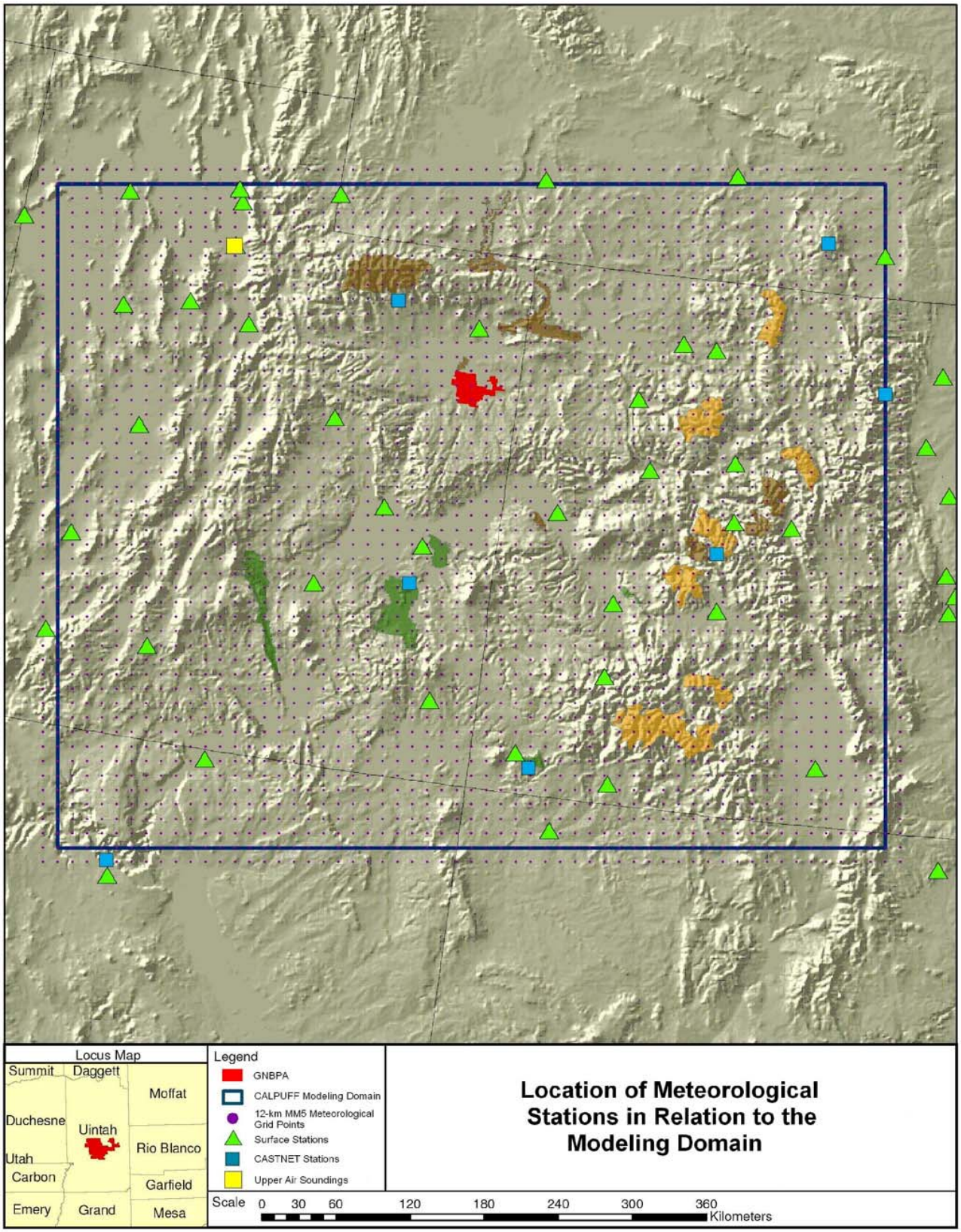



**Figure 4-3 Meteorological Stations Selected for Input to CALMET**

## 4.2 CMAQ Ozone Modeling

For more than a decade, USEPA has been developing the Models-3 CMAQ modeling system with the overarching aim of producing a 'One-Atmosphere' air quality modeling system capable of addressing ozone, PM, visibility, and acid deposition within a common platform (Byun and Ching 1999; Byun and Schere 2006). The original justification for the Models-3 development emerged from the challenges posed by the 1990 CAA Amendments and the USEPA's desire to develop an advanced modeling framework for 'holistic' environmental modeling utilizing state-of-science representations of atmospheric processes in a high performance computing environment. USEPA completed the initial stage of development with Models-3 and released CMAQ in mid-1999 as the initial operating science model under the Models-3 framework. The most recent rendition is CMAQ Version 4.6, publicly released in October 2006.

CMAQ consists of a core CTM and several pre-processors including the MCIP, ICON and BCON, and a JPROC. The USEPA continues to improve and develop new modules for the CMAQ model and typically provides a new release each year. In the past, the USEPA also has provided patches for CMAQ as errors are discovered and corrected. More recently, the USEPA has funded the CMAS center to support the coordination, update, and distribution of the Models-3 system. Byun and Schere (2006) describe the newest features implemented in the previously released CMAQ Version 4.5.

### 4.2.1 CMAQ Modeling Setup

The CMAQ modeling system was used for assessing the potential ozone impacts of the proposed project on the surrounding area. This analysis used the CMAQ meteorological and chemistry databases developed for the UBAQS (ENVIRON 2009). The CMAQ modeling consisted of five different model simulations for each of the CMAQ base years of 2005 and 2006:

- Simulation 1 was the 2005 and 2006 actual years using actual emissions from the UBAQS data base and also is used in the model performance evaluation.
- Simulation 2 was run with 2006 typical emissions for both the 2005 and 2006 meteorological data and was used for comparison with the future case design values and calculations.
- Simulation 3 was a future baseline year, which is 2018 – the year the proposed project would be complete.
- Simulation 4 included the 2018 future baseline year and the anticipated emissions for 2017 from the Proposed Action.
- Simulation 5 included the 2018 future baseline year and the anticipated emissions for 2026 from the Optimal Recovery Alternative.

The impacts from the Proposed Action were estimated by determining the difference between Simulations 4 and 3, and impacts from the Optimal Recovery Alternative were estimated by determining the difference between Simulations 5 and 3.

The years 2005 and 2006 were used for the baseline CMAQ ozone modeling for this study. This selection was appropriate primarily because of data availability for these years from UBAQS.

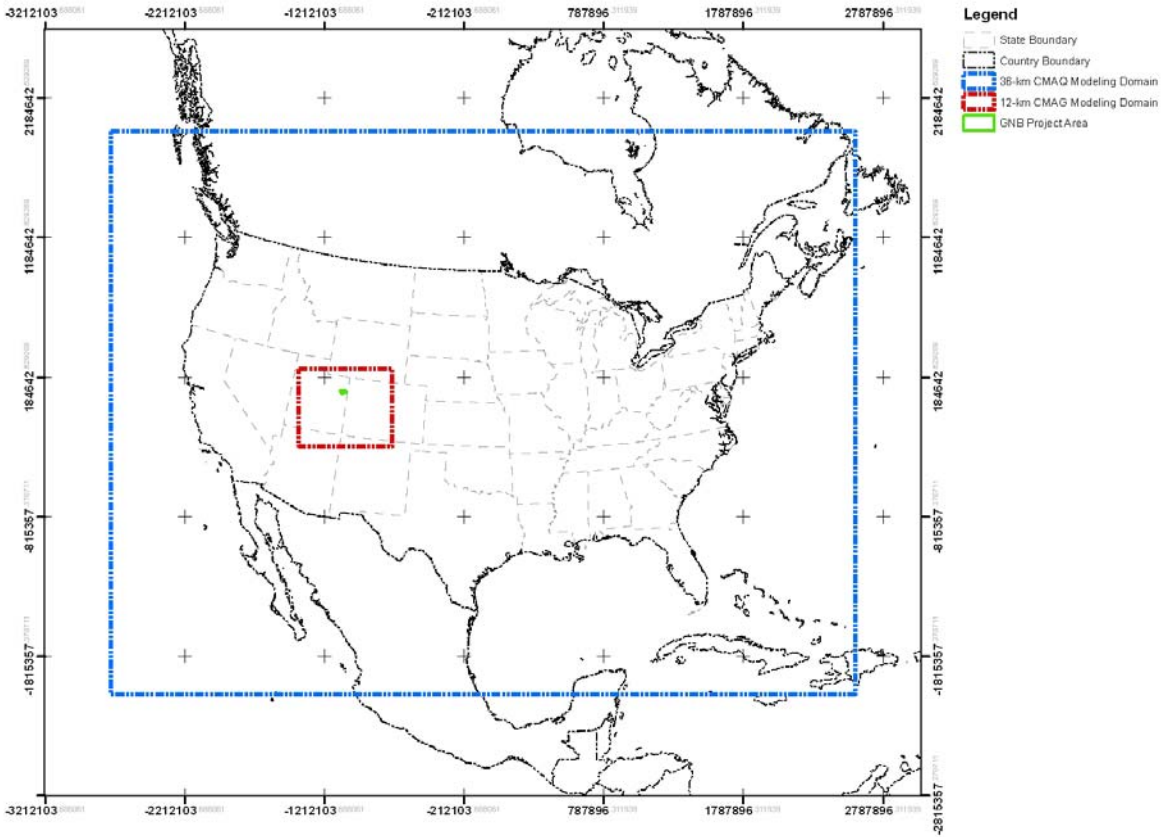
### 4.2.2 Modeling Domains

This section summarizes the model domain definitions for the GNB ozone modeling, including the domain coverage, resolution, map projection, and nesting schemes for the high resolution sub-domain.

#### 4.2.2.1 Horizontal Modeling Domain

**Figure 4-4** displays the 36- and 12-km modeling domains that were used in the CMAQ/SMOKE air quality/emissions modeling. The 36-km continental U.S. horizontal domain for CMAQ air quality and SMOKE emissions modeling were identical to that used by several Regional Planning Organizations (RPOs) for their

regional haze modeling (e.g., WRAP, Central States Regional Air Partnership [CENRAP], and VISTAS). This 36-km modeling domain covered the continental U.S. as well as large portions of Mexico and Canada. The CMAQ 12-km modeling domain is shown in **Figure 4-5** and covers eastern Utah, western Colorado, and portions of Wyoming, Arizona, and New Mexico.




Note: The 12-km domain is highlighted in red and is expanded in **Figure 4-7**.

**Figure 4-4 36- and 12-km Domains for the GNB Study**

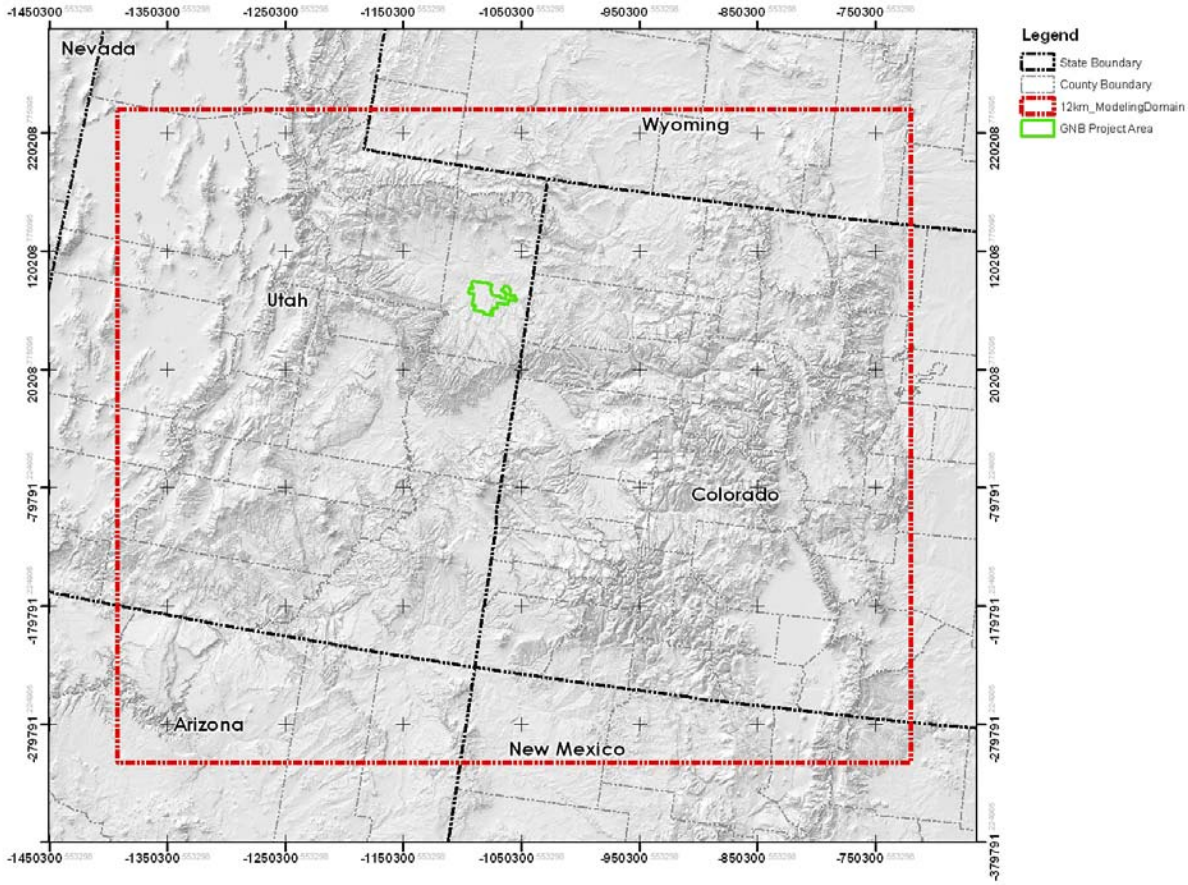



**Figure 4-5 12-km CMAQ Domain for the GNB Study**

The CMAQ air quality and SMOKE emissions modeling 36- and 12-km domains were aligned within the MM5 domains. The larger MM5 modeling domains provided a buffer around the CMAQ/emissions modeling domains by at least 6 grid cells in each direction. These grids were based on a LCP using the same projection as adopted by the RPOs. The LCP parameters are listed in **Table 4-2**.

**Table 4-2 Lambert Conformal Projection Definition for the GNB Modeling Grid**

| Parameter | **Value** |
|---|---|
| Projection | Lambert-Conformal |
| 1st True Latitude | 33 degrees N |
| 2nd True Latitude | 45 degrees N |
| Central Longitude | -97 degrees W |
| Central Latitude | 40 degrees N |

There was a possibility of boundary “noise” effects resulting from boundary conditions coming into dynamic balance with the MM5 algorithms. The 12-km MM5 domain, with the 12-km CMAQ domain in red, is presented in **Figure 4-6**. The larger MM5 domain was designed to sequester such errors from the air quality simulation. The buffer region used in the current study exceeded the USEPA suggestion of at least 5 grid cell buffers at each boundary.

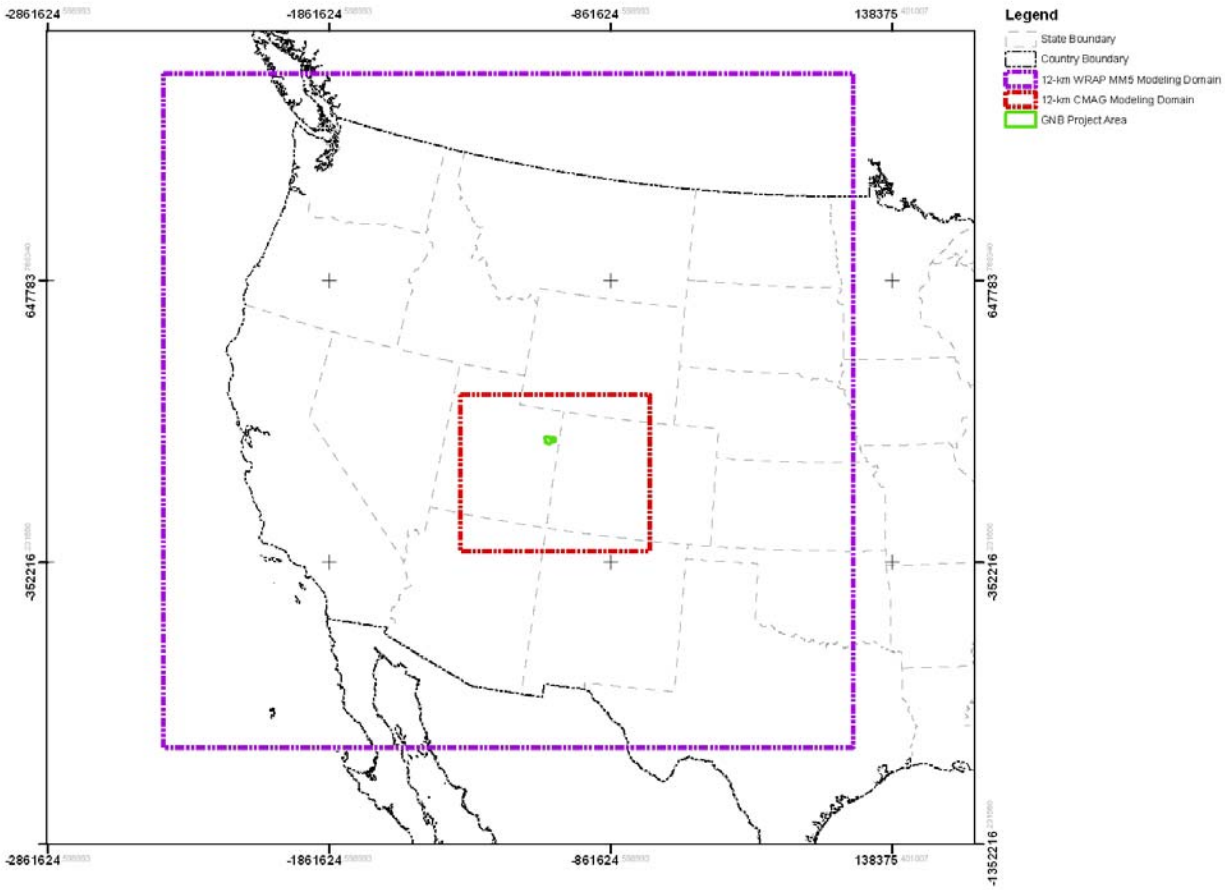



**Figure 4-6 12-km WRAP MM5 with 12-km CMAQ Domain in the GNB Study**

**Table 4-3** lists the number of rows and columns (i.e., the number of grid cells in the east-west and north-south directions, respectively) and the definition of the X and Y origin (i.e., the southwest corner) for the 36-/12-km domains used in the CMAQ and the SMOKE models for the current study.

**Table 4-3 Grid Definitions for SMOKE and CMAQ**

| Grid Resolution | East-west Grid Cells | North-south Grid Cells | X-origin (km) | Y-origin (km) |
|---|---|---|---|---|
| 36 km grid | 148 | 112 | -2736.0 | -2088.0 |
| 12 km grid | 53 | 47 | -1368.0 | -288.0 |

#### 4.2.2.2 Vertical Modeling Structure

The CMAQ vertical structure was primarily defined by the vertical grid used in the MM5 modeling. The MM5 model employs a terrain-following coordinate system defined by pressure, using multiple layers that extend from the surface to 100 millibars (mb), which is approximately 15 km above ground level. A layer-averaging scheme was adopted for CMAQ simulations to reduce the air quality computational time. The effects of layer averaging were evaluated by WRAP and VISTAS and found to have a relatively minor effect on the model performance metrics when both 34-layer and 19-layer CMAQ model simulations were compared to ambient monitoring data (Morris et al. 2004). For the GNB ozone modeling, 19 vertical layers were used. **Table 4-4** lists

the mapping from the MM5 vertical layer structure to the CMAQ vertical layers. This MM5 structure was taken from the WRAP, VISTAS, and CENRAP RPO configuration, and the same CMAQ structure also was being used in modeling by the RPOs. Note that the MM5 and CMAQ models both used a terrain following "sigma" coordinate system so that the model heights will be compressed over elevated terrain.

**Table 4-4 Vertical Layer Definition for MM5 Simulations and Approach for Reducing CMAQ Layers by Collapsing Multiple MM5 Layers**

| MM5 | | | | | CMAQ | | | |
|---|---|---|---|---|---|---|---|---|
| **Layer** | **Sigma** | **Pressure (mb)** | **Height (m)** | **Depth (m)** | **Layer** | **Pressure (mb)** | **Height (m)** | **Depth (m)** |
| 34 (top) | 0.000 | 100 | 18123 | 2856 | 19 | 100 | 18123 | 9160 |
| 33 | 0.050 | 145 | 15267 | 2097 | | | | |
| 32 | 0.100 | 190 | 13170 | 1659 | | | | |
| 31 | 0.150 | 235 | 11510 | 1374 | | | | |
| 30 | 0.200 | 280 | 10136 | 1173 | | | | |
| 39 | 0.250 | 325 | 8963 | 1024 | 18 | 325 | 8963 | 3492 |
| 28 | 0.300 | 370 | 7938 | 909 | | | | |
| 27 | 0.350 | 415 | 7030 | 817 | | | | |
| 26 | 0.400 | 460 | 6213 | 742 | | | | |
| 25 | 0.450 | 505 | 5471 | 680 | 17 | 505 | 5471 | 1890 |
| 24 | 0.500 | 550 | 4791 | 627 | | | | |
| 23 | 0.550 | 595 | 4163 | 582 | | | | |
| 22 | 0.600 | 640 | 3581 | 543 | 16 | 640 | 3581 | 1053 |
| 21 | 0.650 | 685 | 3038 | 509 | | | | |
| 20 | 0.700 | 730 | 2528 | 386 | 15 | 730 | 2528 | 664 |
| 19 | 0.740 | 766 | 2142 | 278 | | | | |
| 18 | 0.770 | 793 | 1864 | 269 | 14 | 793 | 1864 | 443 |
| 17 | 0.800 | 820 | 1596 | 174 | | | | |
| 16 | 0.820 | 838 | 1421 | 171 | 13 | 838 | 1421 | 338 |
| 15 | 0.840 | 856 | 1251 | 167 | | | | |
| 14 | 0.860 | 874 | 1083 | 164 | 12 | 874 | 1083 | 163 |
| 13 | 0.880 | 892 | 920 | 161 | 11 | 892 | 920 | 161 |
| 12 | 0.900 | 910 | 759 | 79 | 10 | 910 | 759 | 158 |
| 11 | 0.910 | 919 | 680 | 78 | | | | |
| 10 | 0.920 | 928 | 601 | 78 | 9 | 928 | 601 | 155 |
| 9 | 0.930 | 937 | 524 | 77 | | | | |
| 8 | 0.940 | 946 | 447 | 76 | 8 | 946 | 447 | 76 |
| 7 | 0.950 | 955 | 371 | 75 | 7 | 955 | 371 | 76 |
| 6 | 0.960 | 964 | 295 | 75 | 6 | 964 | 295 | 75 |
| 5 | 0.970 | 973 | 220 | 74 | 5 | 973 | 220 | 74 |
| 4 | 0.980 | 982 | 146 | 37 | 4 | 982 | 146 | 37 |
| 3 | 0.985 | 987 | 109 | 37 | 3 | 987 | 109 | 37 |
| 2 | 0.990 | 991 | 73 | 36 | 2 | 991 | 73 | 36 |
| 1 | 0.995 | 996 | 36 | 36 | 1 | 996 | 36 | 36 |
| 0 (ground) | 1.000 | 1000 | 0 | 0 | 0 | 0 | 0 | 0 |

### 4.2.3 Model Input Preparation Procedures

This and the following subsections describe the procedures used in developing the meteorological, emissions, and air quality inputs to the CMAQ model for the ozone modeling study on the 36- and 12-km grids. The

development of the CMAQ meteorological and emissions inputs are discussed together with the science options recommended for the CMAQ model. The procedures for developing the initial and boundary conditions and photolysis rates also are discussed along with the model application procedures.

The procedures set forth here are consistent with USEPA guidance (USEPA 2007, 2005b, 1991), other recent 8-hour ozone modeling studies conducted for various state and local agencies using these or other state-of-science modeling tools (e.g., Morris et al. 2004; Tesche et al. 2005, 2003), as well as the methods used by USEPA in support of the recent Clean Air Interstate Rule (USEPA 2005c) and the Clean Air Mercury Rule (USEPA 2005d).

#### 4.2.3.1 Meteorological Inputs

Annual 36-/12-km MM5 simulations for 2005 (McNally and Schewe 2006) and 2006 (McNally and Schewe 2008) were used to provide meteorological inputs to the CMAQ and SMOKE models. The MM5 configurations were based on the WRAP 2002 simulation (Kemball-Cook et al. 2004), which was based on an extensive review of available MM5 physical and dynamical options and has been the basis of many subsequent MM5 applications in the region. The WRAP did a fairly extensive study to determine the optimal configuration for the MM5 modeling system. One of the choices they made was to use the Betts-Miller Cumulus Parameterization. Betts-Miller was developed to parameterize tropical convection, which improved the precipitation skill of the model.

#### 4.2.3.2 Emission Inputs

In order to simulate atmospheric ozone levels, it was necessary to develop emissions estimates for all other emission sources (i.e., industrial, electric generation, motor vehicle, biogenic) in addition to the emissions from the proposed project. The foundation datasets for the emissions development were based on the emissions data developed by WRAP. Details on the emissions input preparation are presented in Chapter 3.0. The emissions were processed into CMAQ-ready files using SMOKE 2.2 for both the 36- and 12-km grids. SMOKE 2.2 was used because several of the WRAP-developed emissions files are not directly compatible with the newest version of SMOKE (i.e., Version 2.4).

### 4.2.4 CMAQ Science and Input Configurations

This section describes the model configuration and science options that were used in this ozone modeling effort. **Table 4-5** summarizes the CMAQ configuration that was used in the study. The latest version of CMAQ (Version 4.6) was used for ozone modeling.

As indicated in the CMAQ model setup defined in **Table 4-5**, two grids were employed. CMAQ was initially run for the 2005 and 2006 Baseline on the 36-km continental U.S. grid for calendar year 2005 and 2006 and was then run on the 12-km grid utilizing the initial and boundary conditions from the 36-km CMAQ simulation.

CMAQ inputs were as follows:

- Meteorological Inputs: The MM5-derived meteorological fields were prepared for CMAQ using MCIP 3.3.
- Initial/Boundary Conditions (IC/BCs): The IC/BCs for the 36-km continental U.S. simulation were based on the latest available information. Currently, the RPOs use IC/BC's for the same domain based on a 2002 GEOS-CHEM global chemistry model simulation. Boundary and initial conditions for the 12-km nest were generated from the 36-km CMAQ nest using the CMAQ ICON and BCON processors.

## Table 4-5 CMAQ Model Configuration

| Science Options | Configuration | Details/Comments |
|---|---|---|
| Model Code | CMAQ (version 4.6) | USEPA 1999 |
| Horizontal Grid Mesh | 36/12 km | 36 km covering continental U.S; 12 km covering Eastern Utah and Western Colorado |
| 36 km grid | 148 x 112 cells | RPO National Grid |
| 12 km grid | 53 x 47 cells | |
| Vertical Grid Mesh | 19 Layers | First 8 layers synchronized with MM5 |
| Grid Interaction | One-way nesting | |
| Initial Conditions | 15 days full spin-up | Separately run 4 quarters of 2006 |
| Boundary Conditions | GEOS-CHEM annual run | 2002 GEOS-CHEM run |
| ***Emissions*** | | |
| Baseline Emissions Processing | See SMOKE (Version 2.2) model configuration | MM5 Meteorology input to SMOKE, CMAQ |
| Dust Transport Fraction | Applied in emissions before SMOKE | |
| $NH_3$ Inventory Adjustment | Applied in emissions before SMOKE | |
| Sub-grid-scale Plumes | No Plume-in-Grid | |
| ***Chemistry*** | | |
| Gas Phase Chemistry | CB-05 | with Isoprene updates |
| Aerosol Chemistry | AE3/ISORROPIA | |
| Secondary Organic Aerosols | Secondary Organic Aerosol Model | Shell et al. (2001) |
| Aerosol Mass Conservation Patch | Yes | |
| Cloud Chemistry | RADM-type aqueous chemistry | Includes subgrid cloud processes |
| $N_2O_5$ Reaction Probability | 0.01 – 0.001 | |
| ***Horizontal Transport*** | | |
| Eddy Diffusivity Scheme | K-theory with $K_h$ grid size dependence | Multiscale Smagorinsky (1963) approach |
| ***Vertical Transport*** | | |
| Eddy Diffusivity Scheme | K-theory | |
| Diffusivity Lower Limit | Kzmin = 0.1 | |
| Planetary Boundary Layer | No Patch[1] | |
| Deposition Scheme | Aero_dep | Directly linked to Pleim-Xiu Land Surface Model parameters |
| ***Numerics*** | | |
| Gas Phase Chemistry Solver | Euler Backward Iterative solver | Hertel et al. (1993) EPI solver ~ 2x faster than MEBI |
| Horizontal Advection Scheme | Piecewise Parabolic Method scheme | |
| ***Other*** | | |
| Meteorological Processor | MCIP version 3-3 | |
| Simulation Periods | Annual 2006 | |
| Integration Time Step | Internally Computed | 15 minute coupling time step |
| Time zone | GMT | |
| Platform | Dual Processor/Dual Core AMD Opteron | |
| Run-Time (expected) | 7-10 days | Platform Dependent |

[1] Patch means applying a mosaic scheme based on land-use, which is not normally done for CMAQ. The terminology is not the same as used for a software fix.

- Photolysis Rates: The modeling used the photolysis inputs as well as the albedo/haze/ozone/snow inputs for CMAQ based on Total Ozone Mapping Spectrometer data using the CMAQ JPROC processor.
- Spin-Up Initialization: The model was run in quarters using a nominal 15-day spin-up from the previous quarter for the 36-km grid and a nominal 4-day spin-up from the previous quarter for the 12-km grid.

## 4.3 AERMOD Near-field Modeling

The near-field ambient air quality impacts on $NO_2$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$ were assessed in the vicinity of the proposed project using USEPA's guideline model of assessing near-field impacts, AERMOD (Version 07026). AERMOD was executed using the USEPA-default recommended settings. Emissions sources that were associated with the project development and included in the near-field AERMOD analysis consisted of activities associated with drill rigs, compressor stations, single pad construction, and the actual producing well. These operations require the use of diesel engines with the capability of producing air emissions, which could potentially have an impact on surrounding air quality.

AERMOD (USEPA 2004) was adopted by USEPA in a final rule (Federal Register November 9, 2005) that replaced the ISC model with AERMOD, effective on December 9, 2005. The AERMOD model was developed by the AERMIC work group (the American Meteorological Society/USEPA Regulatory Model Improvement Committee) and was intended to incorporate improved understanding of PBL meteorology into air dispersion calculations. The current version of AERMOD is 07026 and includes the PRIME (Plume Rise Model Enhancement) building downwash algorithms. The AERMOD modeling system consists of two preprocessors and the dispersion model. AERMET is the meteorological preprocessor component and AERMAP is the terrain pre-processor component that characterizes the terrain and generates receptor elevations along with critical hill heights for those receptors. The AERMOD model runs reported in this section used the 5-year meteorological database as discussed in Section 4.3.3.

### 4.3.1 Near-field Modeling Approach

The near-field impacts were assessed to quantify air quality impacts related to the density of well pad development and drill rig operations within a hypothetical designated area (e.g., a section/township/range). Near-field impacts were addressed for $NO_X$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$ within the immediate vicinity of these development areas. The AERMOD modeling analysis consisted of three phases: 1) single source impact analysis, 2) well pad production analysis, and 3) well drilling analysis.

#### 4.3.1.1 Single Source Impact Analysis

The single source impact analysis was designed to assess the near-field impacts from each type of project source individually. AERMOD was run for each of the following types of project sources: 1) a compressor station, 2) a drill rig, and 3) a production well. A uniform polar grid of receptors was placed in a radial fashion around the modeled source every 100 m starting at 100 m downwind out to 2,000 m with radials every 10°. **Figure 4-7** shows the source/receptor setup used for the single source impact analysis, and **Table 4-6** lists the emission and modeling parameters for each source assessed.

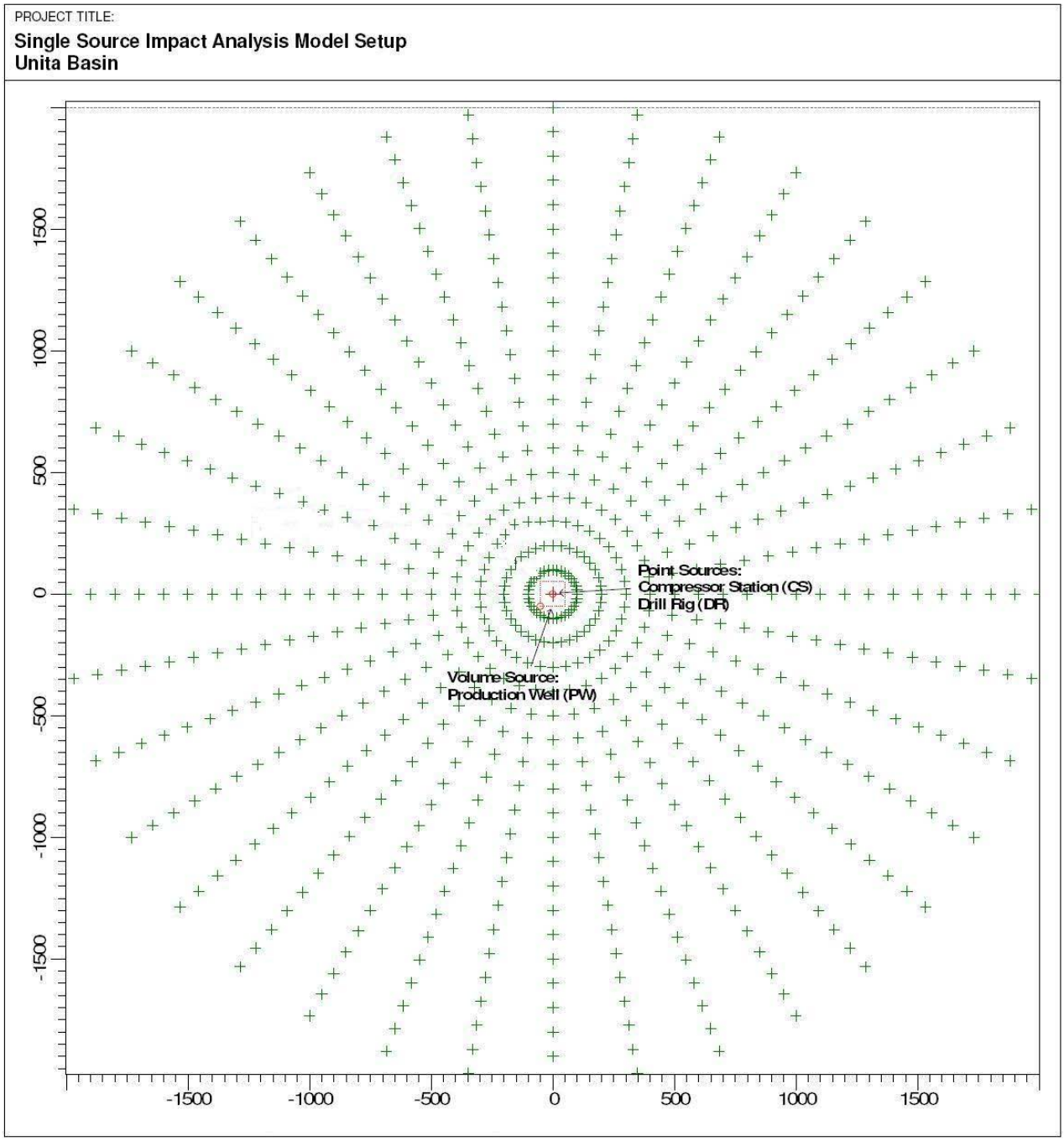



**Figure 4-7 Single Source Impact Analysis Model Setup and Receptor Location**

## Table 4-6 Project Source Modeling Parameters and Emission Rates

**Point Source Parameters**

| | | Operating | Emission Rate per Activity (g/s) | | | | | | | | | Stack Parameters[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hours | $NO_X$ | CO | | $SO_2$ | | | $PM_{10}$ | $PM_{2.5}$ | | Stack | H | V | T | D |
| ID | Activity | Per Day | Annual | 1-hr | 8-hr | 3-hr | 24-hr | Annual | 24-hr | 24-hr | Annual | Orientation | (m) | (m/s) | (K) | (m) |
| CS | Compressor Station | 24 | 1.68 | 0.19 | 0.19 | 0.012 | 0.012 | 0.012 | 0.14 | 0.14 | 0.14 | Vertical | 10.0 | 51.1 | 755 | 0.3 |
| DR | Drilling | 24 | 0.05 | 1.23 | 1.23 | 0.003 | 0.003 | 0.0001 | 0.012 | 0.012 | 0.0005 | Vertical | 6.1 | 25.0 | 700 | 0.2 |

**Volume Source Parameters**

| | | Operating | Emission Rate per Activity (g/s) | | | | | | | | | Source Dimensions[1] | | | Release Parameters[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hours | $NO_X$ | CO | | $SO_2$ | | | $PM_{10}$ | $PM_{2.5}$ | | Width | Area | H | $\sigma_y$-init | $\sigma_z$-init | $H_r$ |
| ID | Activity | Per Day | Annual | 1-hr | 8-hr | 3-hr | 24-hr | Annual | 24-hr | 24-hr | Annual | (m) | ($m^2$) | (m) | (m) | | |
| PW | Production Well | 24 | 0.0033 | 0.0056 | 0.0056 | 0.00022 | 0.00022 | 0.00011 | 0.0011 | 0.0011 | 0.00072 | 71.1 | 5,058.5 | 5.0 | 16.54 | 2.33 | 2.50 |

[1] Units for dimensions and parameters

H = height

V = vertical exhaust speed

T = temperature

D = diameter

Hr = height of release

Emissions for a compressor station were calculated based on the assumption of 3 separate compressor engines with 1,340 bhp engine capacity, equivalent to 9.38 MMBtu/hour each. Compressor stations were assumed to operate 8,760 hours per year, and used emission factors that were provided in **Tables 3-40** through **3-42**.

Short-term missions for drilling operations were based on the emissions from one well including a drill rig and a rig boiler. **Tables 3-20** and **3-21** provide a summary of short-term and annual emissions from these sources. Fugitive emissions from well drilling and completion road traffic were not included because of the dispersed and temporary nature of the source. For addressing impacts, the wells were aggregated as discussed above.

Emissions from production wells included the separator heater for short-term emissions (**Table 3-28**) and included both that unit and the fugitive emissions from production traffic for annual emissions (**Tables 3-28** and **3-31**). For modeling impacts, the wells were aggregated over a square mile, as discussed above.

For the single source near-field analysis, building downwash and receptor terrain elevations were ignored largely due to the uncertainty in location and orientation of each source relative to terrain and buildings. These assumptions should not have a measurable impact on the overall modeling results because the terrain within the immediate vicinity of these sources likely would be relatively flat and there are few buildings or structures associated with these project sources.

Modeling results for the AERMOD single source impact analysis were tabulated for $NO_2$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$. No distinction was made between the short-term and annual modeling scenarios because it was assumed that these sources could operate 8,760 hours per year. The results of this analysis were reported in Section 5.3.

#### 4.3.1.2 Well Pad Production Analysis

The well pad production analysis was designed to assess air quality impacts related to the density of well pad production within a hypothetical square mile section/township/range for three production density levels. Well pad density was assessed at 10-acre spacing, 20-acre spacing, and 40-acre spacing. For example, the 10-acre spacing well pad production scenario contained producing well pads that were spaced uniformly at 10-acre intervals throughout the hypothetical square mile section. For each well pad scenario, a compressor station was placed in the middle of each producing field of well pads.

This design allowed for the allocation of the following number of producing wells per scenario:

- 10-acre spacing → 64 production wells, 1 compressor station;
- 20-acre spacing → 32 production wells, 1 compressor station; and
- 40-acre spacing → 16 production wells, 1 compressor station.

The production wells were evenly spaced throughout the hypothetical square mile section centered on the compressor station. Uniformly spaced Cartesian receptors were placed throughout the hypothetical square mile section at 100-m intervals. Each source had a 100-m buffer to the nearest receptor point to minimize the impact of extremely localized high model predictions. **Figures 4-8** through **4-10** depict the source/receptor model setup for each of the three well pad production scenarios. The compressor station and production well emissions and modeling parameters used to develop each well pad production scenario are provided in **Table 4-6**.

As in the single source near-field analysis, building downwash and receptor terrain elevations were ignored largely due to the uncertainty in location and orientation of each source relative to terrain and buildings. These assumptions should not have an impact on the overall modeling results because the terrain within the immediate vicinity of these sources likely would be relatively flat and there are few buildings or structures associated with these project sources.

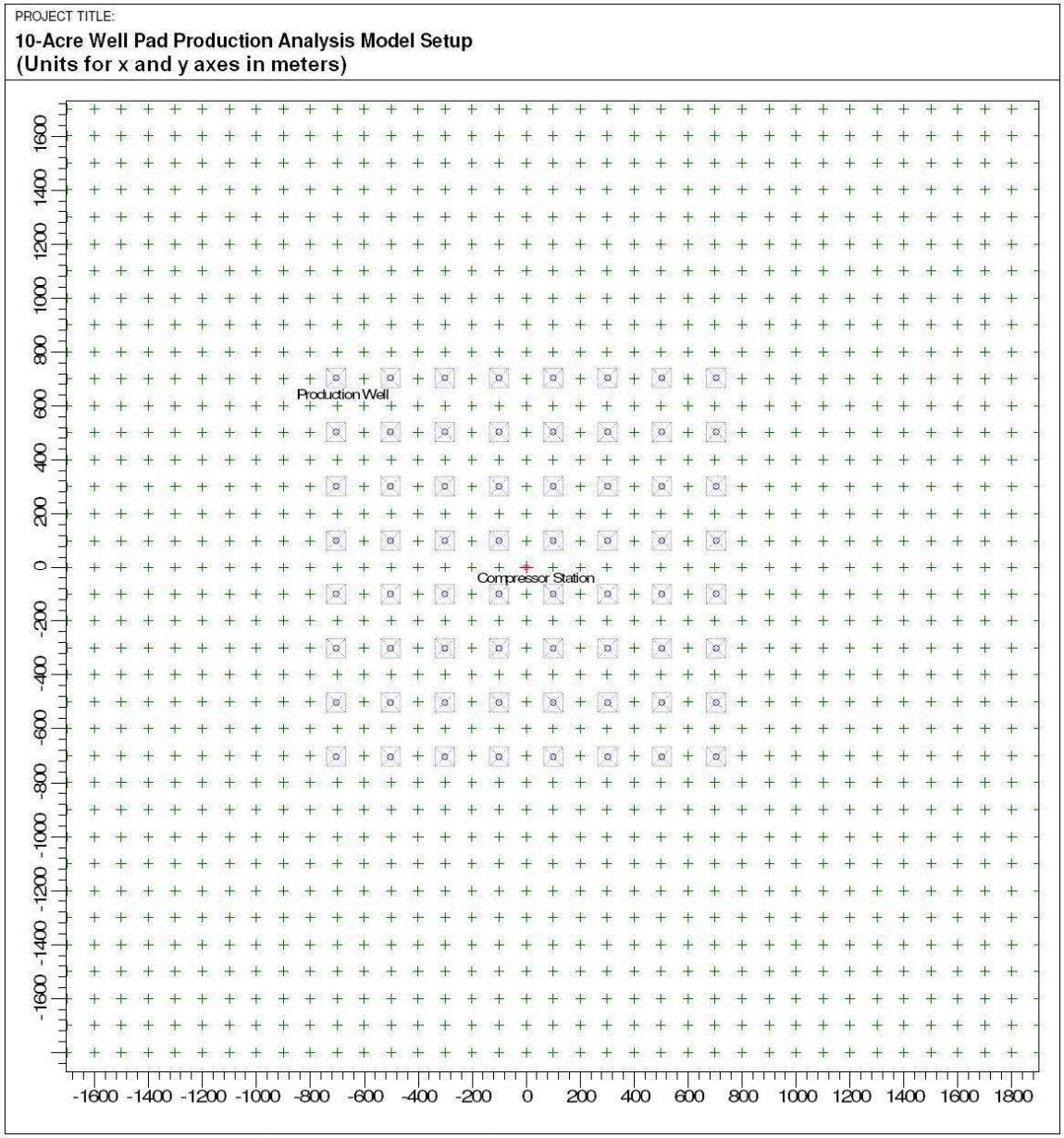



**Figure 4-8 10-Acre Well Pad Production Analysis Model Setup and Receptor Location**

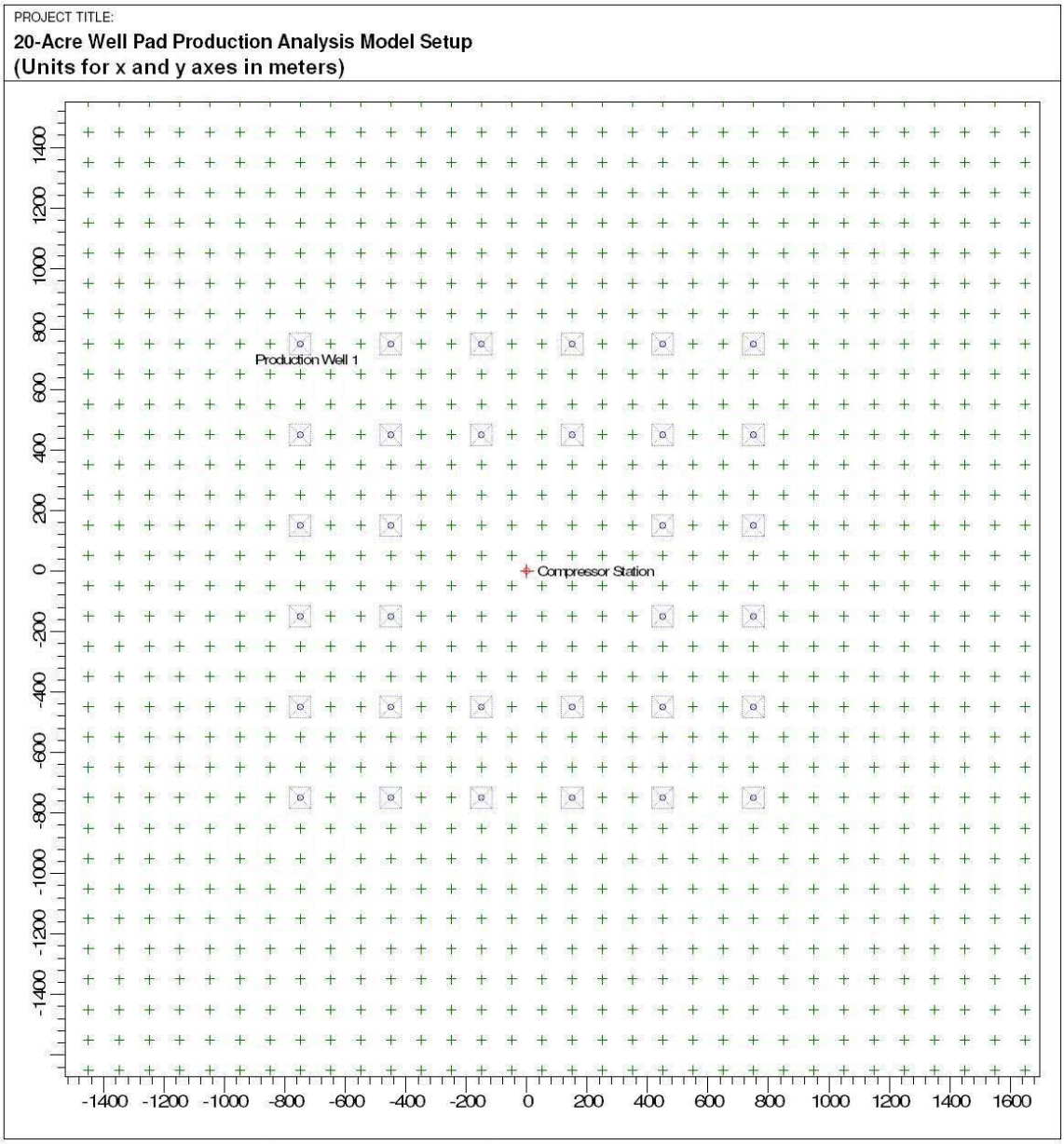



**Figure 4-9 20-Acre Well Pad Production Analysis Model Setup and Receptor Location**

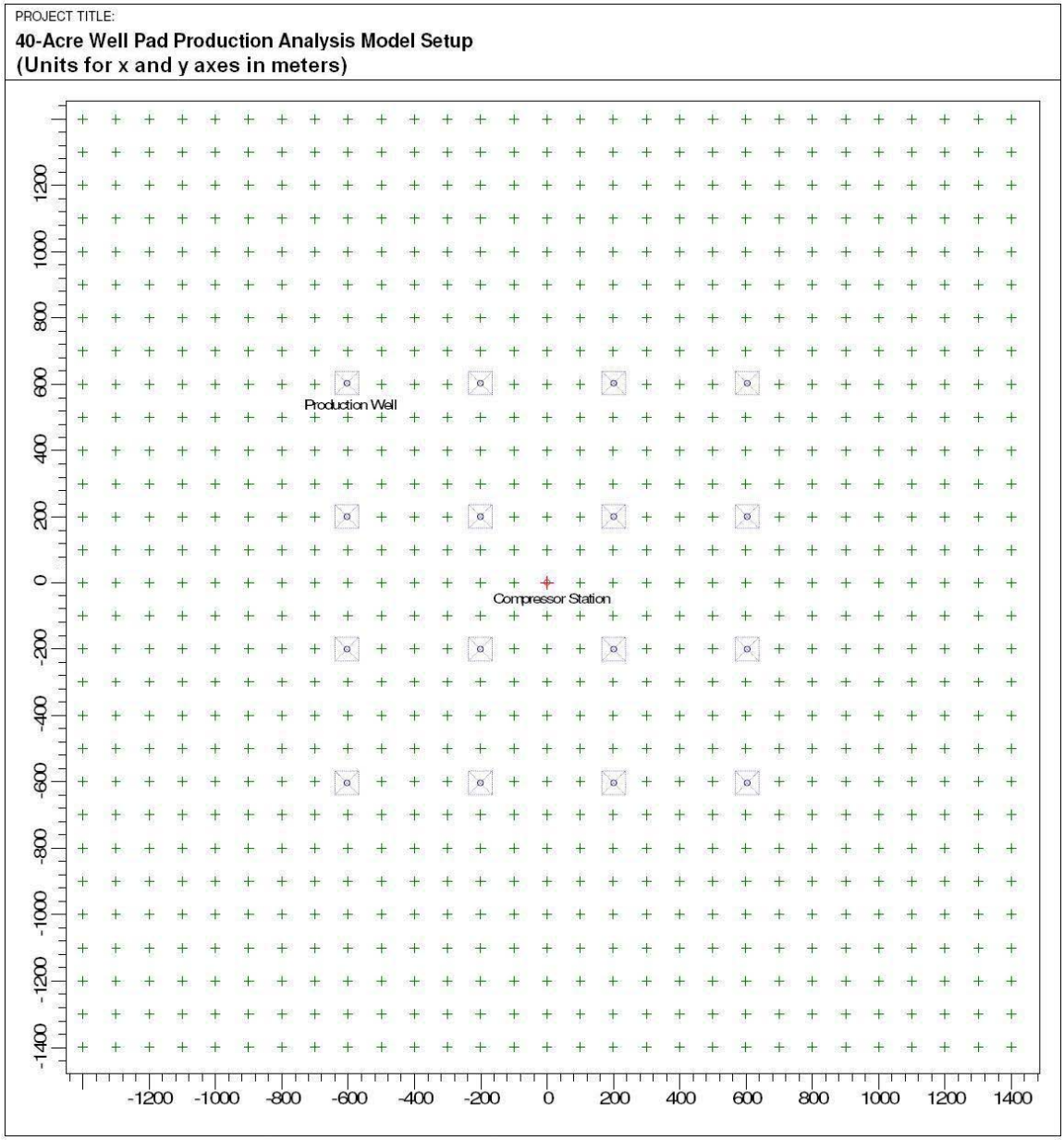



**Figure 4-10 40-Acre Well Pad Production Analysis Model Setup and Receptor Location**

Modeling results for the AERMOD well pad production analysis were tabulated for $NO_2$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$. No distinction was made between the short-term and annual modeling scenarios because it was assumed that these sources could operate 8,760 hours per year. The results of this analysis were reported in Chapter 5.0.

#### 4.3.1.3 Well Drilling Analysis

The well drilling analysis was designed to assess air quality impacts related to the drilling operations at the well pad site. These drilling activities included emissions from the actual operation of the drill rig engine.

For the well drilling analysis, short-term modeling was conducted using a single drill rig while the annual modeling included a sequence of five uniformly spaced drill rigs throughout the section. This scenario was based on the assumption that only 1 location would be undergoing drilling at any time in a given 24-hour period.

Uniformly spaced Cartesian receptors were placed throughout the hypothetical section at 100-m intervals. Each source had a 100-m buffer to the nearest receptor point to minimize the impact of extremely localized high model predictions. **Figures 4-11** and **4-12** show examples of the source/receptor model setup for the short-term and annual well pad construction analysis, respectively. **Table 4-6** provides modeling parameters and emission rates for drilling, which includes emissions from the drill rig, single pad construction, and drilling/completion mobile equipment emissions.

As in the previous analyses, building downwash and receptor terrain elevations were ignored largely due to the uncertainty in location and orientation of each source relative to terrain and buildings. These assumptions should not have an impact on the overall modeling results because the terrain within the immediate vicinity of these sources likely would be relatively flat and there are few buildings or structures associated with these project sources.

Modeling results for the AERMOD well pad construction analysis were tabulated for $NO_X$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$. The results of this analysis are reported in Section 5.3.

### 4.3.2 Meteorological Data Development

Meteorological data required for AERMOD included hourly values of wind speed, wind direction, and ambient temperature. Since the AERMOD dispersion algorithms were based on atmospheric boundary layer dispersion theory, additional boundary layer variables were derived by parameterization formulas, which were computed by the AERMOD meteorological preprocessor, AERMET. These parameters included sensible heat flux, surface friction velocity, convective velocity scale, vertical potential temperature gradient, convective and mechanical mixing heights, Monin-Obukhov length, surface roughness length, Bowen ratio, and albedo.

The AERMET meteorological pre-processor (Version 06341) was used to process 5 years of meteorological data into a format required by AERMOD. Boundary layer parameters used by AERMOD, which also were required as input to the AERMET processor, include albedo, Bowen ratio, and surface roughness. The land classifications and associated boundary layer parameters were determined following the guidelines provided by the USEPA AERMOD Implementation Guide, updated as of January 9, 2008. In accordance with this guide, the input boundary layer parameters to AERMET were determined using the AERSURFACE meteorological processor, as applied to the meteorological measurement site (Vernal Municipal Airport).

AERMET was used to combine 5 years (2003 to 2007) of surface observations from data from Vernal Municipal Airport, Utah, with twice daily sounding data from Salt Lake City, Utah. The overall annual wind rose for 10-m for the Vernal site is provided in **Figure 2-1**.

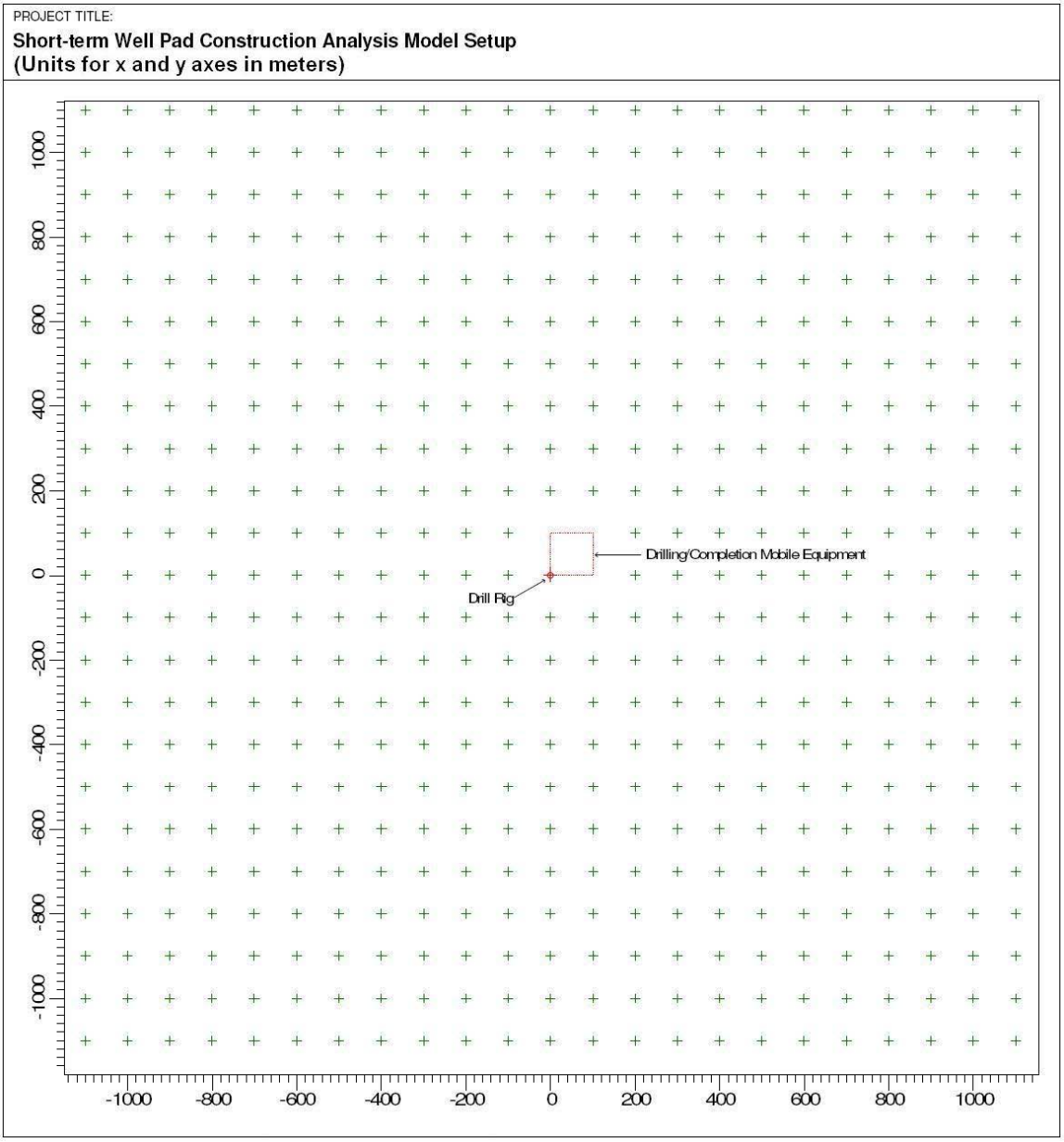



**Figure 4-11 Short-term Drill Rig Analysis Model Setup and Receptor Location**

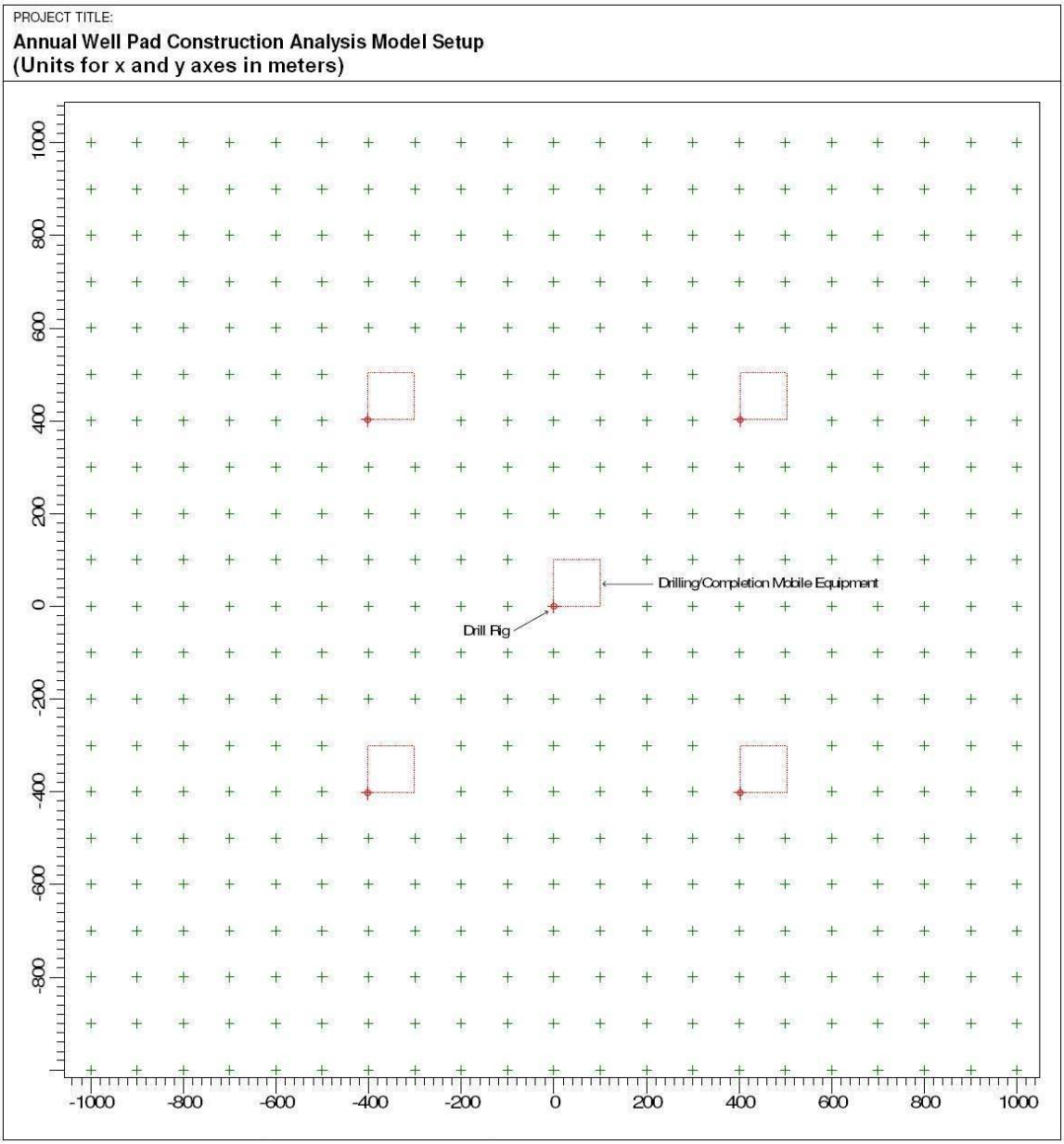



**Figure 4-12 Annual Drill Rig Analysis Model Setup and Receptor Location**

# 5.0 Assessment and Reporting of Air Quality Impacts

The overall objective of this air quality impact analysis is to evaluate impacts to air quality and AQRVs for the Projected Baseline, Proposed Action, and Optimal Recovery Alternative. The analysis compares the predicted impacts to established significance thresholds, air quality standards and other environmental parameters. Projected Baseline emissions are included in both the Proposed Action and Optimal Recovery Alternative modeling efforts.

To evaluate the significance of proposed air quality impacts, the results of air quality modeling and post-processing were compared with applicable standards and criteria and reported as described in the following subsections. Modeled results are provided to further identify impacts in support of the NEPA analysis for the proposed project.

## 5.1 CALPUFF Impact Assessment for Class I and Sensitive Class II Areas

The CALPUFF model used data from the meteorological year 2006 to produce hourly values of pollutant concentrations at each receptor location for each of the following model scenarios:

- 2018 Projected Baseline – 2018 projected future emissions;
- 2017 Proposed Action – 2018 Projected Baseline emissions with project emissions from the proposed development alternative in 2017; and
- 2026 Optimal Recovery Alternative – 2018 Projected Baseline emissions with project emissions from the maximum recovery alternative action in 2026.

The hourly CALPUFF concentrations were processed using POSTUTIL and CALPOST to compute 3-hour, 24-hour, and annual average concentration levels for the applicable pollutants and averaging periods. Regional haze estimates were produced for daily intervals, while total sulfur and nitrogen deposition fluxes were computed based on an average from the entire annual model simulation. Concentrations of $NO_2$, $SO_2$, $PM_{10}$, $PM_{2.5}$, sulfur and nitrogen deposition, as well as regional haze (aerosol light extinction) were predicted at selected receptor locations as described in Section 4.1.2.

### 5.1.1 Ambient Air Quality Impact Assessment – Criteria Pollutants

The CALPUFF modeled air concentrations of $NO_X$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ predicted at the Class I and sensitive Class II areas were calculated for each of the three emissions scenarios: the 2018 Projected Baseline, the 2017 Proposed Action, and the 2026 Optimal Recovery Alternative scenarios.

The CALPUFF modeled concentrations were calculated and compared with the allowable PSD increments for informational purposes only. This comparison to the PSD Class I and II increments was done because these increments represent a convenient means to evaluate the amount of air quality change due to the proposed project. This comparison does not represent a regulatory PSD increment consumption analysis since it involves other non-increment-affecting sources.

In addition to comparing the CALPUFF modeled concentration to the PSD increments, a comparison also was made to the applicable health- and welfare-related NAAQS and SAAQS. The ambient ratio method, which assumes a conversion rate of 75 percent of $NO_X$ to $NO_2$, was used according to USEPA guidance (40 CFR 51, Appendix W).

The modeling results for criteria pollutant impacts from CALPUFF are presented in **Tables 5-1** and **5-2** for the projected action alternative scenarios at each identified Class I or sensitive Class II National Park (NP), Wilderness Area (WA), National Wildlife Refuge (NWR), and National Monument (NM). Results are

presented for the total modeled impact from all sources along with the breakdown of project and non-project sources. The impacts from non-project sources represent the 2018 Projected Baseline modeled scenario as if the project would not be built. The modeled concentrations presented in these tables for the separate source groups are not additive in each row for "all sources." The maximum concentration that was modeled for any one source group can occur at a different time and in a different location than for all sources. The results for "all sources" represent only the combined impact of the whole group, not the sum of the separate maximum impacts. Each table presents the highest modeled criteria pollutant concentration ($NO_X$, $SO_2$, $PM_{10}$, and $PM_{2.5}$) for all receptors in each of the designated areas.

**Table 5-1 2017 Proposed Action CALPUFF Modeled Concentrations – Criteria Pollutants**

| Area | Pollutant | Averaging Period | Maximum Modeled Concentrations | | | PSD Class I / Class II Increment (μg/m³) | NAAQS (μg/m³) |
|---|---|---|---|---|---|---|---|
| | | | All Sources (Project + Non-Project) (μg/m³) | Project Sources (μg/m³) | Non-Project Sources (μg/m³) | | |
| **Class I Areas** | | | | | | | |
| Arches NP | $NO_X$ | Annual | 1.861 | 0.001 | 1.860 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 4.873 | 0.005 | 4.873 | 25 | 1300 |
| | | 24-hr | 1.663 | 0.001 | 1.663 | 5 | 365 |
| | | Annual | 0.341 | 0.0001 | 0.341 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 7.555 | 0.101 | 7.552 | 8 | 150 |
| | | Annual | 2.312 | 0.008 | 2.305 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.479 | 0.055 | 2.479 | -- | 35 |
| | | Annual | 0.497 | 0.004 | 0.493 | -- | 15 |
| Black Canyon of the Gunnison NP | $NO_X$ | Annual | 2.220 | 0.0005 | 2.219 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 3.181 | 0.002 | 3.181 | 25 | 1300 |
| | | 24-hr | 1.533 | 0.001 | 1.533 | 5 | 365 |
| | | Annual | 0.468 | 0.00003 | 0.468 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 25.487 | 0.069 | 25.486 | 8 | 150 |
| | | Annual | 9.323 | 0.004 | 9.319 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.333 | 0.044 | 1.320 | -- | 35 |
| | | Annual | 0.354 | 0.002 | 0.352 | -- | 15 |
| Canyonlands NP | $NO_X$ | Annual | 0.781 | 0.001 | 0.781 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 5.658 | 0.004 | 5.658 | 25 | 1300 |
| | | 24-hr | 2.138 | 0.001 | 2.138 | 5 | 365 |
| | | Annual | 0.499 | 0.0001 | 0.499 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 5.509 | 0.092 | 5.509 | 8 | 150 |
| | | Annual | 1.520 | 0.005 | 1.515 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.608 | 0.046 | 2.607 | -- | 35 |
| | | Annual | 0.387 | 0.003 | 0.385 | -- | 15 |
| Capitol Reef NP | $NO_X$ | Annual | 0.481 | 0.0003 | 0.481 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 9.287 | 0.002 | 9.287 | 25 | 1300 |
| | | 24-hr | 2.564 | 0.001 | 2.564 | 5 | 365 |
| | | Annual | 0.503 | 0.00002 | 0.503 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 4.320 | 0.074 | 4.319 | 8 | 150 |
| | | Annual | 1.307 | 0.002 | 1.305 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.723 | 0.042 | 2.722 | -- | 35 |
| | | Annual | 0.345 | 0.001 | 0.344 | -- | 15 |
| Mesa Verde NP | $NO_X$ | Annual | 17.825 | 0.00003 | 17.825 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 60.331 | 0.001 | 60.331 | 25 | 1300 |
| | | 24-hr | 13.674 | 0.0003 | 13.674 | 5 | 365 |
| | | Annual | 0.723 | 0.00001 | 0.723 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 28.205 | 0.042 | 28.205 | 8 | 150 |
| | | Annual | 8.099 | 0.001 | 8.097 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 5.048 | 0.025 | 5.048 | -- | 35 |
| | | Annual | 0.667 | 0.001 | 0.666 | -- | 15 |
| Eagles Nest WA | $NO_X$ | Annual | 2.167 | 0.0003 | 2.166 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 5.643 | 0.001 | 5.643 | 25 | 1300 |
| | | 24-hr | 1.078 | 0.001 | 1.078 | 5 | 365 |
| | | Annual | 0.353 | 0.00003 | 0.353 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 24.576 | 0.053 | 24.576 | 8 | 150 |
| | | Annual | 6.825 | 0.004 | 6.822 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.376 | 0.031 | 1.349 | -- | 35 |

## Table 5-1 2017 Proposed Action CALPUFF Modeled Concentrations – Criteria Pollutants

| Area | Pollutant | Averaging Period | Maximum Modeled Concentrations | | | PSD Class I / Class II Increment ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| | | | All Sources (Project + Non-Project) ($\mu g/m^3$) | Project Sources ($\mu g/m^3$) | Non-Project Sources ($\mu g/m^3$) | | |
| | | Annual | 0.307 | 0.002 | 0.305 | -- | 15 |
| Flat Tops WA | $NO_X$ | Annual | 0.899 | 0.001 | 0.898 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 7.188 | 0.003 | 7.188 | 25 | 1300 |
| | | 24-hr | 1.184 | 0.001 | 1.184 | 5 | 365 |
| | | Annual | 0.211 | 0.0001 | 0.211 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 8.093 | 0.084 | 8.088 | 8 | 150 |
| | | Annual | 2.436 | 0.009 | 2.431 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.486 | 0.049 | 1.437 | -- | 35 |
| | | Annual | 0.261 | 0.004 | 0.258 | -- | 15 |
| La Garita WA | $NO_X$ | Annual | 1.010 | 0.0001 | 1.010 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 3.882 | 0.001 | 3.882 | 25 | 1300 |
| | | 24-hr | 0.919 | 0.0003 | 0.919 | 5 | 365 |
| | | Annual | 0.070 | 0.00001 | 0.070 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 2.697 | 0.022 | 2.685 | 8 | 150 |
| | | Annual | 0.956 | 0.001 | 0.955 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.067 | 0.011 | 1.059 | -- | 35 |
| | | Annual | 0.393 | 0.001 | 0.393 | -- | 15 |
| Maroon Bells-Snowmass WA | $NO_X$ | Annual | 1.190 | 0.0005 | 1.190 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 2.640 | 0.001 | 2.640 | 25 | 1300 |
| | | 24-hr | 0.783 | 0.0004 | 0.783 | 5 | 365 |
| | | Annual | 0.198 | 0.00004 | 0.198 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 9.863 | 0.059 | 9.863 | 8 | 150 |
| | | Annual | 3.272 | 0.004 | 3.269 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.278 | 0.036 | 1.264 | -- | 35 |
| | | Annual | 0.301 | 0.002 | 0.298 | -- | 15 |
| Mount Zirkel WA | $NO_X$ | Annual | 2.613 | 0.001 | 2.612 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 8.309 | 0.002 | 8.309 | 25 | 1300 |
| | | 24-hr | 2.613 | 0.001 | 2.613 | 5 | 365 |
| | | Annual | 0.582 | 0.0001 | 0.582 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 21.251 | 0.090 | 21.239 | 8 | 150 |
| | | Annual | 8.102 | 0.006 | 8.096 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.701 | 0.042 | 1.695 | -- | 35 |
| | | Annual | 0.412 | 0.003 | 0.409 | -- | 15 |
| Weminuche WA | $NO_X$ | Annual | 2.167 | 0.00004 | 2.167 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 10.430 | 0.001 | 10.430 | 25 | 1300 |
| | | 24-hr | 2.749 | 0.0003 | 2.749 | 5 | 365 |
| | | Annual | 0.239 | 0.00001 | 0.239 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 12.917 | 0.022 | 12.917 | 8 | 150 |
| | | Annual | 4.871 | 0.001 | 4.870 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.824 | 0.011 | 1.824 | -- | 35 |
| | | Annual | 0.675 | 0.001 | 0.674 | -- | 15 |
| West Elk WA | $NO_X$ | Annual | 1.388 | 0.0003 | 1.388 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 2.143 | 0.001 | 2.143 | 25 | 1300 |
| | | 24-hr | 0.778 | 0.0004 | 0.778 | 5 | 365 |
| | | Annual | 0.222 | 0.00003 | 0.222 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 12.271 | 0.061 | 12.271 | 8 | 150 |
| | | Annual | 5.372 | 0.003 | 5.369 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.310 | 0.038 | 1.296 | -- | 35 |
| | | Annual | 0.248 | 0.002 | 0.247 | -- | 15 |
| **Class II Areas** | | | | | | | |
| Colorado NM (Class I for $SO_2$) | $NO_X$ | Annual | 1.707 | 0.002 | 1.706 | 25 | 100 |
| | $SO_2$ | 3-hr | 7.494 | 0.003 | 7.494 | 25 | 1300 |
| | | 24-hr | 1.640 | 0.001 | 1.640 | 5 | 365 |
| | | Annual | 0.501 | 0.0001 | 0.501 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 35.109 | 0.113 | 35.100 | 30 | 150 |
| | | Annual | 9.995 | 0.009 | 9.988 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.576 | 0.069 | 2.554 | -- | 35 |
| | | Annual | 0.496 | 0.004 | 0.492 | -- | 15 |

## Table 5-1 2017 Proposed Action CALPUFF Modeled Concentrations – Criteria Pollutants

| Area | Pollutant | Averaging Period | Maximum Modeled Concentrations | | | PSD Class I / Class II Increment ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| | | | All Sources (Project + Non-Project) ($\mu g/m^3$) | Project Sources ($\mu g/m^3$) | Non-Project Sources ($\mu g/m^3$) | | |
| Dinosaur NM (Class I for $SO_2$) | $NO_X$ | Annual | 4.900 | 0.142 | 4.758 | 25 | 100 |
| | $SO_2$ | 3-hr | 5.633 | 0.058 | 5.633 | 25 | 1300 |
| | | 24-hr | 1.703 | 0.018 | 1.701 | 5 | 365 |
| | | Annual | 0.338 | 0.003 | 0.336 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 16.522 | 1.473 | 15.577 | 30 | 150 |
| | | Annual | 4.856 | 0.213 | 4.643 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 7.104 | 0.693 | 6.706 | -- | 35 |
| | | Annual | 1.178 | 0.099 | 1.079 | -- | 15 |
| Flaming Gorge NRA | $NO_X$ | Annual | 9.064 | 0.495 | 8.568 | 25 | 100 |
| | $SO_2$ | 3-hr | 52.061 | 0.190 | 52.061 | 512 | 1300 |
| | | 24-hr | 12.477 | 0.047 | 12.477 | 91 | 365 |
| | | Annual | 2.362 | 0.008 | 2.362 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 50.463 | 3.225 | 50.460 | 30 | 150 |
| | | Annual | 17.694 | 0.582 | 17.690 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 7.559 | 1.197 | 6.883 | -- | 35 |
| | | Annual | 2.464 | 0.245 | 2.219 | -- | 15 |
| High Uintah WA | $NO_X$ | Annual | 1.163 | 0.001 | 1.162 | 25 | 100 |
| | $SO_2$ | 3-hr | 7.371 | 0.004 | 7.371 | 512 | 1300 |
| | | 24-hr | 1.976 | 0.002 | 1.976 | 91 | 365 |
| | | Annual | 0.158 | 0.0001 | 0.158 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 23.809 | 0.255 | 23.778 | 30 | 150 |
| | | Annual | 4.673 | 0.013 | 4.662 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.667 | 0.148 | 2.664 | -- | 35 |
| | | Annual | 0.351 | 0.007 | 0.343 | -- | 15 |
| Holy Cross WA | $NO_X$ | Annual | 8.487 | 0.0003 | 8.487 | 25 | 100 |
| | $SO_2$ | 3-hr | 5.711 | 0.001 | 5.711 | 512 | 1300 |
| | | 24-hr | 2.191 | 0.0005 | 2.191 | 91 | 365 |
| | | Annual | 1.033 | 0.00003 | 1.033 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 64.425 | 0.037 | 64.425 | 30 | 150 |
| | | Annual | 27.202 | 0.004 | 27.199 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.728 | 0.022 | 1.727 | -- | 35 |
| | | Annual | 0.621 | 0.002 | 0.619 | -- | 15 |
| Hunter Frying Pan WA | $NO_X$ | Annual | 3.476 | 0.0002 | 3.476 | 25 | 100 |
| | $SO_2$ | 3-hr | 3.263 | 0.001 | 3.263 | 512 | 1300 |
| | | 24-hr | 1.285 | 0.0003 | 1.285 | 91 | 365 |
| | | Annual | 0.572 | 0.00003 | 0.572 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 10.795 | 0.035 | 10.790 | 30 | 150 |
| | | Annual | 4.950 | 0.003 | 4.948 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.303 | 0.022 | 1.288 | -- | 35 |
| | | Annual | 0.393 | 0.002 | 0.392 | -- | 15 |
| Raggeds WA | $NO_X$ | Annual | 1.879 | 0.0003 | 1.879 | 25 | 100 |
| | $SO_2$ | 3-hr | 2.039 | 0.001 | 2.039 | 512 | 1300 |
| | | 24-hr | 0.665 | 0.0004 | 0.665 | 91 | 365 |
| | | Annual | 0.161 | 0.00003 | 0.161 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 11.613 | 0.059 | 11.608 | 30 | 150 |
| | | Annual | 4.499 | 0.004 | 4.496 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.200 | 0.036 | 1.185 | -- | 35 |
| | | Annual | 0.245 | 0.002 | 0.244 | -- | 15 |
| Browns Park NWR | $NO_X$ | Annual | 0.672 | 0.011 | 0.663 | 25 | 100 |
| | $SO_2$ | 3-hr | 3.151 | 0.009 | 3.151 | 512 | 1300 |
| | | 24-hr | 0.720 | 0.002 | 0.720 | 91 | 365 |
| | | Annual | 0.174 | 0.0003 | 0.173 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 3.302 | 0.248 | 3.123 | 30 | 150 |
| | | Annual | 1.095 | 0.033 | 1.067 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.494 | 0.136 | 1.456 | -- | 35 |
| | | Annual | 0.325 | 0.017 | 0.308 | -- | 15 |

## Table 5-2 2026 Optimal Recovery Alternative CALPUFF Modeled Concentrations – Criteria Pollutants

| Area | Pollutant | Averaging Period | Maximum Modeled Concentrations | | | PSD Class I / Class II Increment ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| | | | All Sources (Project + Non-Project) ($\mu g/m^3$) | Project Sources ($\mu g/m^3$) | Non-Project Sources ($\mu g/m^3$) | | |
| **Class I Areas** | | | | | | | |
| Arches NP | $NO_X$ | Annual | 1.862 | 0.003 | 1.860 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 4.873 | 0.013 | 4.873 | 25 | 1300 |
| | | 24-hr | 1.663 | 0.003 | 1.663 | 5 | 365 |
| | | Annual | 0.341 | 0.0002 | 0.341 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 7.559 | 0.237 | 7.552 | 8 | 150 |
| | | Annual | 2.322 | 0.019 | 2.305 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.479 | 0.107 | 2.479 | -- | 35 |
| | | Annual | 0.501 | 0.008 | 0.493 | -- | 15 |
| Black Canyon of the Gunnison NP | $NO_X$ | Annual | 2.220 | 0.001 | 2.219 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 3.181 | 0.006 | 3.181 | 25 | 1300 |
| | | 24-hr | 1.533 | 0.002 | 1.533 | 5 | 365 |
| | | Annual | 0.468 | 0.0001 | 0.468 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 25.488 | 0.151 | 25.486 | 8 | 150 |
| | | Annual | 9.328 | 0.009 | 9.319 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.344 | 0.083 | 1.320 | -- | 35 |
| | | Annual | 0.356 | 0.004 | 0.352 | -- | 15 |
| Canyonlands NP | $NO_X$ | Annual | 0.782 | 0.001 | 0.781 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 5.658 | 0.012 | 5.658 | 25 | 1300 |
| | | 24-hr | 2.138 | 0.003 | 2.138 | 5 | 365 |
| | | Annual | 0.500 | 0.0001 | 0.499 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 5.509 | 0.212 | 5.509 | 8 | 150 |
| | | Annual | 1.527 | 0.013 | 1.515 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.608 | 0.091 | 2.607 | -- | 35 |
| | | Annual | 0.390 | 0.005 | 0.385 | -- | 15 |
| Capitol Reef NP | $NO_X$ | Annual | 0.481 | 0.001 | 0.481 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 9.287 | 0.005 | 9.287 | 25 | 1300 |
| | | 24-hr | 2.564 | 0.002 | 2.564 | 5 | 365 |
| | | Annual | 0.503 | 0.0001 | 0.503 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 4.321 | 0.169 | 4.319 | 8 | 150 |
| | | Annual | 1.309 | 0.006 | 1.305 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.723 | 0.083 | 2.722 | -- | 35 |
| | | Annual | 0.346 | 0.002 | 0.344 | -- | 15 |
| Mesa Verde NP | $NO_X$ | Annual | 17.825 | 0.0001 | 17.825 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 60.331 | 0.002 | 60.331 | 25 | 1300 |
| | | 24-hr | 13.674 | 0.001 | 13.674 | 5 | 365 |
| | | Annual | 0.723 | 0.00003 | 0.723 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 28.205 | 0.095 | 28.205 | 8 | 150 |
| | | Annual | 8.100 | 0.003 | 8.097 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 5.048 | 0.049 | 5.048 | -- | 35 |
| | | Annual | 0.667 | 0.001 | 0.666 | -- | 15 |
| Eagles Nest WA | $NO_X$ | Annual | 2.167 | 0.0005 | 2.166 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 5.643 | 0.004 | 5.643 | 25 | 1300 |
| | | 24-hr | 1.078 | 0.001 | 1.078 | 5 | 365 |
| | | Annual | 0.353 | 0.0001 | 0.353 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 24.576 | 0.115 | 24.576 | 8 | 150 |
| | | Annual | 6.830 | 0.009 | 6.822 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.401 | 0.059 | 1.349 | -- | 35 |
| | | Annual | 0.309 | 0.004 | 0.305 | -- | 15 |

**Table 5-2 2026 Optimal Recovery Alternative CALPUFF Modeled Concentrations – Criteria Pollutants**

| Area | Pollutant | Averaging Period | Maximum Modeled Concentrations | | | PSD Class I / Class II Increment ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| | | | All Sources (Project + Non-Project) ($\mu g/m^3$) | Project Sources ($\mu g/m^3$) | Non-Project Sources ($\mu g/m^3$) | | |
| Flat Tops WA | $NO_X$ | Annual | 0.899 | 0.002 | 0.898 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 7.189 | 0.007 | 7.188 | 25 | 1300 |
| | | 24-hr | 1.184 | 0.002 | 1.184 | 5 | 365 |
| | | Annual | 0.211 | 0.0002 | 0.211 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 8.099 | 0.190 | 8.088 | 8 | 150 |
| | | Annual | 2.444 | 0.020 | 2.431 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.532 | 0.095 | 1.437 | -- | 35 |
| | | Annual | 0.263 | 0.009 | 0.258 | -- | 15 |
| La Garita WA | $NO_X$ | Annual | 1.011 | 0.0001 | 1.010 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 3.882 | 0.002 | 3.882 | 25 | 1300 |
| | | 24-hr | 0.919 | 0.001 | 0.919 | 5 | 365 |
| | | Annual | 0.094 | 0.00003 | 0.094 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 2.711 | 0.056 | 2.685 | 8 | 150 |
| | | Annual | 0.958 | 0.003 | 0.955 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.075 | 0.022 | 1.059 | -- | 35 |
| | | Annual | 0.394 | 0.001 | 0.393 | -- | 15 |
| Maroon Bells-Snowmass WA | $NO_X$ | Annual | 1.191 | 0.001 | 1.190 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 2.640 | 0.004 | 2.640 | 25 | 1300 |
| | | 24-hr | 0.783 | 0.001 | 0.783 | 5 | 365 |
| | | Annual | 0.198 | 0.0001 | 0.198 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 9.863 | 0.130 | 9.863 | 8 | 150 |
| | | Annual | 3.275 | 0.010 | 3.269 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.293 | 0.070 | 1.264 | -- | 35 |
| | | Annual | 0.303 | 0.005 | 0.298 | -- | 15 |
| Mountt Zirkel WA | $NO_X$ | Annual | 2.613 | 0.001 | 2.612 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 8.309 | 0.004 | 8.309 | 25 | 1300 |
| | | 24-hr | 2.613 | 0.002 | 2.613 | 5 | 365 |
| | | Annual | 0.582 | 0.0001 | 0.582 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 21.266 | 0.210 | 21.239 | 8 | 150 |
| | | Annual | 8.110 | 0.014 | 8.096 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.706 | 0.083 | 1.695 | -- | 35 |
| | | Annual | 0.415 | 0.006 | 0.409 | -- | 15 |
| Weminuche WA | $NO_X$ | Annual | 2.167 | 0.0001 | 2.167 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 10.430 | 0.002 | 10.430 | 25 | 1300 |
| | | 24-hr | 2.749 | 0.001 | 2.749 | 5 | 365 |
| | | Annual | 0.239 | 0.00003 | 0.239 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 12.917 | 0.055 | 12.917 | 8 | 150 |
| | | Annual | 4.873 | 0.003 | 4.870 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.824 | 0.022 | 1.824 | -- | 35 |
| | | Annual | 0.675 | 0.001 | 0.674 | -- | 15 |
| West Elk WA | $NO_X$ | Annual | 1.388 | 0.001 | 1.388 | 2.5 | 100 |
| | $SO_2$ | 3-hr | 2.143 | 0.003 | 2.143 | 25 | 1300 |
| | | 24-hr | 0.778 | 0.001 | 0.778 | 5 | 365 |
| | | Annual | 0.222 | 0.0001 | 0.222 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 12.271 | 0.134 | 12.271 | 8 | 150 |
| | | Annual | 5.375 | 0.008 | 5.369 | 4 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.325 | 0.072 | 1.296 | -- | 35 |
| | | Annual | 0.249 | 0.003 | 0.247 | -- | 15 |

## Table 5-2 2026 Optimal Recovery Alternative CALPUFF Modeled Concentrations – Criteria Pollutants

| Area | Pollutant | Averaging Period | Maximum Modeled Concentrations | | | PSD Class I / Class II Increment ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| | | | All Sources (Project + Non-Project) ($\mu g/m^3$) | Project Sources ($\mu g/m^3$) | Non-Project Sources ($\mu g/m^3$) | | |
| **Class II Areas** | | | | | | | |
| Colorado NM (Class I for $SO_2$) | $NO_X$ | Annual | 1.708 | 0.003 | 1.706 | 25 | 100 |
| | $SO_2$ | 3-hr | 7.494 | 0.009 | 7.494 | 25 | 1300 |
| | | 24-hr | 1.640 | 0.002 | 1.640 | 5 | 365 |
| | | Annual | 0.501 | 0.0002 | 0.501 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 35.123 | 0.245 | 35.100 | 30 | 150 |
| | | Annual | 10.005 | 0.021 | 9.988 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.579 | 0.130 | 2.554 | -- | 35 |
| | | Annual | 0.499 | 0.009 | 0.492 | -- | 15 |
| Dinosaur NM (Class I for $SO_2$) | $NO_X$ | Annual | 5.021 | 0.263 | 4.758 | 25 | 100 |
| | $SO_2$ | 3-hr | 5.634 | 0.149 | 5.633 | 25 | 1300 |
| | | 24-hr | 1.707 | 0.046 | 1.701 | 5 | 365 |
| | | Annual | 0.341 | 0.007 | 0.336 | 2 | 80 |
| | $PM_{10}$ | 24-hr | 17.773 | 3.291 | 15.577 | 30 | 150 |
| | | Annual | 5.151 | 0.507 | 4.643 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 7.503 | 1.330 | 6.706 | -- | 35 |
| | | Annual | 1.276 | 0.197 | 1.079 | -- | 15 |
| Flaming Gorge NRA | $NO_X$ | Annual | 9.503 | 0.935 | 8.568 | 25 | 100 |
| | $SO_2$ | 3-hr | 52.061 | 0.489 | 52.061 | 512 | 1300 |
| | | 24-hr | 12.477 | 0.119 | 12.477 | 91 | 365 |
| | | Annual | 2.362 | 0.022 | 2.362 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 50.468 | 7.358 | 50.460 | 30 | 150 |
| | | Annual | 17.698 | 1.382 | 17.690 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 8.593 | 2.265 | 6.883 | -- | 35 |
| | | Annual | 2.716 | 0.497 | 2.219 | -- | 15 |
| High Uintah WA | $NO_X$ | Annual | 1.164 | 0.003 | 1.162 | 25 | 100 |
| | $SO_2$ | 3-hr | 7.371 | 0.010 | 7.371 | 512 | 1300 |
| | | 24-hr | 1.976 | 0.004 | 1.976 | 91 | 365 |
| | | Annual | 0.158 | 0.0002 | 0.158 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 23.849 | 0.571 | 23.778 | 30 | 150 |
| | | Annual | 4.687 | 0.030 | 4.662 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 2.671 | 0.290 | 2.664 | -- | 35 |
| | | Annual | 0.358 | 0.015 | 0.343 | -- | 15 |
| Holy Cross WA | $NO_X$ | Annual | 8.487 | 0.001 | 8.487 | 25 | 100 |
| | $SO_2$ | 3-hr | 5.711 | 0.003 | 5.711 | 512 | 1300 |
| | | 24-hr | 2.191 | 0.001 | 2.191 | 91 | 365 |
| | | Annual | 1.033 | 0.0001 | 1.033 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 64.425 | 0.087 | 64.425 | 30 | 150 |
| | | Annual | 27.206 | 0.009 | 27.199 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.729 | 0.043 | 1.727 | -- | 35 |
| | | Annual | 0.623 | 0.004 | 0.619 | -- | 15 |
| Hunter Frying Pan WA | $NO_X$ | Annual | 3.476 | 0.0004 | 3.476 | 25 | 100 |
| | $SO_2$ | 3-hr | 3.263 | 0.003 | 3.263 | 512 | 1300 |
| | | 24-hr | 1.285 | 0.001 | 1.285 | 91 | 365 |
| | | Annual | 0.572 | 0.0001 | 0.572 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 10.804 | 0.079 | 10.790 | 30 | 150 |
| | | Annual | 4.953 | 0.007 | 4.948 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.317 | 0.042 | 1.288 | -- | 35 |
| | | Annual | 0.395 | 0.003 | 0.392 | -- | 15 |

**Table 5-2 2026 Optimal Recovery Alternative CALPUFF Modeled Concentrations – Criteria Pollutants**

| Area | Pollutant | Averaging Period | Maximum Modeled Concentrations | | | PSD Class I / Class II Increment ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| | | | All Sources (Project + Non-Project) ($\mu g/m^3$) | Project Sources ($\mu g/m^3$) | Non-Project Sources ($\mu g/m^3$) | | |
| Raggeds WA | $NO_X$ | Annual | 1.879 | 0.001 | 1.879 | 25 | 100 |
| | $SO_2$ | 3-hr | 2.039 | 0.004 | 2.039 | 512 | 1300 |
| | | 24-hr | 0.665 | 0.001 | 0.665 | 91 | 365 |
| | | Annual | 0.161 | 0.0001 | 0.161 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 11.620 | 0.128 | 11.608 | 30 | 150 |
| | | Annual | 4.503 | 0.009 | 4.496 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.214 | 0.069 | 1.185 | -- | 35 |
| | | Annual | 0.247 | 0.004 | 0.244 | -- | 15 |
| Browns Park NWR | $NO_X$ | Annual | 0.679 | 0.020 | 0.663 | 25 | 100 |
| | $SO_2$ | 3-hr | 3.151 | 0.024 | 3.151 | 512 | 1300 |
| | | 24-hr | 0.722 | 0.006 | 0.720 | 91 | 365 |
| | | Annual | 0.174 | 0.001 | 0.173 | 20 | 80 |
| | $PM_{10}$ | 24-hr | 3.529 | 0.564 | 3.123 | 30 | 150 |
| | | Annual | 1.133 | 0.078 | 1.067 | 17 | 50 |
| | $PM_{2.5}$ | 24-hr | 1.549 | 0.265 | 1.456 | -- | 35 |
| | | Annual | 0.341 | 0.033 | 0.308 | -- | 15 |

As shown in **Tables 5-1** and **5-2**, project-related impacts on air quality in the Class I areas were very small. The maximum modeled impacts to Class I areas from the Proposed Action and Optimal Recovery Alternative occur at Arches National Park. The projected 24-hour $PM_{10}$ maximum impact was 0.1 $\mu g/m^3$ for the Proposed Action and 0.237 $\mu g/m^3$ for the Optimal Recovery Alternative. Projected impacts for all other pollutants at the Class I areas for both scenarios were estimated at 0.2 $\mu g/m^3$ or less.

For the listed Class II areas, the maximum modeled impacts from the Proposed Action and the Optimal Recovery Alternative occurred at the Flaming Gorge National Recreation Area and at Dinosaur National Monument. The maximum 24-hour $PM_{10}$ impacts from the Proposed Action at the two areas were 3.2 and 1.5 $\mu g/m^3$, respectively. For the Optimal Recovery Alternative, the project-related impacts at these two areas were 7.4 and 3.3 $\mu g/m^3$, respectively. Project-related impacts for all other pollutants at all the other Class II areas listed were less than 1 $\mu g/m^3$.

When added to the background concentrations, all cumulative impacts at all Class I and Class II areas were below the established NAAQS.

### 5.1.2 Impact Assessment Air Quality Related Values – Regional Haze

For each modeled scenario, the model results provided estimated maximum visibility degradation (regional haze) at the listed Class I areas and specified Class II areas. The results identify contributions from model sources using a measure of visibility impairment in terms of percent change in extinction, or dv, relative to natural background conditions. The predicted regional haze results were compared with the threshold of 10 percent of the reference background visibility, or 1.0 dv, for the impairment attributable to cumulative impacts from multiple sources.

Two separate post-processing visibility analyses were used to assess regional haze impacts at the Class I areas and specified Class II areas of concern. The primary method (Method 6) is most widely implemented for visibility analyses under USEPA's BART guideline and is consistent with the same approach that is applied to visibility analyses under the final regional haze rule. The secondary method provided for comparison is the standard "FLAG method" (Method 2), as proposed by FLAG (2000).

The post-processing algorithm, CALPOST Method 6, was used with annual average background air quality data from Appendix B of USEPA's "Guidance for Tracking Progress Under the Regional Haze Rule" (USEPA 2003) for each Class I area. This method used site-specific monthly function of relative humidity (f[RH]) values to calculate the scattering efficiency of the hygroscopic component (i.e., ammonium sulfate and/or nitrate) of the annual average background concentrations, and thus, generated monthly background extinction values for each Class I area. The same procedure was used to calculate the hourly modeled extinction values that correspond to the hourly modeled CALPUFF concentrations and the same monthly f(RH) values. This method then calculated each day's 24-hour average maximum percent change in extinction, expressed in dv, over all the receptors for each Class I area.

The applicable site-specific monthly relative humidity adjustment factors were taken from Table A-3 in Appendix A in the "Guidance for Tracking Progress Under the Regional Haze Rule" (USEPA 2003). This method was consistent with USEPA's methodology in modeling of BART-eligible sources. The 98th percentile predicted visibility extinction impact was used as the indicator of impact on visibility in a given Class I area.

Results also were provided for an alternate method for visibility analysis (Method 2). Under this method, the FLAG-recommended speciated annual average hygroscopic and non-hygroscopic concentrations were used to describe the background air quality for each Class I area. However, unlike Method 6, Method 2 uses hourly relative humidity from the CALMET files to determine the daily average f(RH) value. These f(RH) values were used in a similar manner within CALPOST to calculate each day's 24-hour average maximum percent change in extinction, expressed in dv, over all the receptors for each Class I area.

**Tables 5-3** and **5-4** provide the results from both Method 6 (primary) and Method 2 (secondary) for each of the modeled scenarios for each listed area. Method 6 results are presented in terms of number of days when modeled change from the specified background in dv is greater than both 0.5 and 1.0 dv, along with the maximum modeled and eighth highest change in dv for each Class I and Class II area of concern. Method 2 results are presented in terms of number of days when modeled percent change in extinction is greater than both 5 and 10 percent of the specified background, along with the maximum modeled change in extinction for each Class I and Class II area of concern.

Results are presented for the total modeled impact from all sources along with the breakdown of project and non-project sources. The impacts from non-project sources represent the 2018 Projected Baseline modeled scenario as if the project would not be built.

Results of the regional haze analysis show that for the Method 6 analysis of impacts from project sources at Class I areas, there were no days with an incremental increase above 0.5 dv for either scenario. For the Proposed Action, the maximum eighth highest value was 0.13 dv (1.3 percent increase in extinction) at Arches National Park. For the Optimal Recovery Alternative, the maximum eighth highest value was 0.25 dv, also at Arches National Park. These projected impacts were less than 1.0 dv for regional haze impacts at Class I areas. Results of the Method 2 analysis for the Proposed Action showed no impacts above 0.5 dv at any Class I areas; and for the Optimal Recovery analysis, results showed only 2 days with impacts above 0.5 dv at Class I areas.

The results of the simulations under the Proposed Action scenario show that there were no days with a contribution to visibility impacts greater than 5 percent in extinction (0.5 dv) at listed Class I areas for either the Method 2 or Method 6 analysis. The conclusion is that the Proposed Action would not contribute to an impact on visibility at these sites. The modeling results at the listed sensitive Class II areas show the highest impacts at Flaming Gorge National Recreation Area and Dinosaur National Monument. However, the FLAG guidance provides no guidance or visibility thresholds for Class II areas. Results from Method 6 show that up to 102 days would be impacted with greater than 10 percent increase in extinction at Flaming Gorge. The same analysis shows the eighth highest increase in extinction for the Proposed Action at 32.6 percent. At Dinosaur National Monument, the model predicted 32 days per year with an impact above 10 percent and an eighth highest increase in light extinction of 16.6 percent. Except at Flaming Gorge National Recreation

## Table 5-3 2017 Proposed Action CALPUFF Modeled Results – Regional Haze

| Area | All Sources (Project + Non-Project) | | | | Project Sources | | | | Non-Project Sources | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest |
| | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ |
| ***Method 6, Annual Average Natural Conditions Background*** | | | | | | | | | | | | |
| **Class I Areas** | | | | | | | | | | | | |
| Arches NP | 359 | 311 | 118.47 | 82.29 | 0 | 0 | 2.56 | 1.30 | 359 | 311 | 118.47 | 81.84 |
| Black Canyon of the Gunnison NP | 365 | 364 | 133.96 | 105.94 | 0 | 0 | 1.76 | 0.49 | 365 | 364 | 133.94 | 105.92 |
| Canyonlands NP | 328 | 236 | 106.52 | 68.85 | 0 | 0 | 1.98 | 1.12 | 328 | 236 | 106.50 | 68.85 |
| Capitol Reef NP | 327 | 223 | 110.77 | 74.75 | 0 | 0 | 1.79 | 0.80 | 327 | 223 | 110.75 | 74.75 |
| Mesa Verde NP | 365 | 365 | 155.14 | 122.13 | 0 | 0 | 0.80 | 0.16 | 365 | 365 | 155.13 | 122.10 |
| Eagles Nest WA | 365 | 359 | 107.04 | 83.71 | 0 | 0 | 1.17 | 0.53 | 365 | 359 | 107.04 | 83.71 |
| Flat Tops WA | 365 | 348 | 55.02 | 45.70 | 0 | 0 | 1.86 | 1.01 | 365 | 348 | 54.72 | 45.58 |
| La Garita WA | 365 | 354 | 49.43 | 33.36 | 0 | 0 | 0.42 | 0.21 | 365 | 354 | 49.14 | 33.35 |
| Maroon Bells-Snowmass W | 365 | 360 | 67.48 | 54.52 | 0 | 0 | 1.32 | 0.56 | 365 | 360 | 67.35 | 53.26 |
| Mount Zirkel WA | 365 | 365 | 125.44 | 100.78 | 0 | 0 | 1.65 | 0.74 | 365 | 365 | 125.21 | 100.73 |
| Weminuche WA | 365 | 365 | 104.32 | 84.87 | 0 | 0 | 0.34 | 0.16 | 365 | 365 | 104.32 | 84.87 |
| West Elk WA | 365 | 365 | 74.35 | 57.74 | 0 | 0 | 1.48 | 0.47 | 365 | 365 | 74.35 | 56.75 |
| **Class II Areas** | | | | | | | | | | | | |
| Colorado NM | 364 | 361 | 158.52 | 138.59 | 0 | 0 | 2.67 | 1.00 | 364 | 361 | 158.41 | 138.00 |
| Dinosaur NM | 365 | 364 | 166.24 | 131.74 | 73 | 32 | 30.54 | 16.60 | 365 | 363 | 147.81 | 123.53 |
| Flaming Gorge NRA | 365 | 365 | 280.99 | 240.99 | 150 | 102 | 41.89 | 32.57 | 365 | 365 | 256.70 | 221.14 |
| High Uintah WA | 365 | 363 | 121.35 | 73.02 | 2 | 0 | 5.70 | 3.53 | 365 | 363 | 120.67 | 72.78 |
| Holy Cross WA | 365 | 365 | 318.99 | 243.94 | 0 | 0 | 0.79 | 0.44 | 365 | 365 | 318.99 | 243.78 |
| Hunter Frying Pan WA | 365 | 365 | 77.30 | 60.17 | 0 | 0 | 0.79 | 0.41 | 365 | 365 | 76.76 | 60.08 |
| Raggeds WA | 365 | 362 | 64.91 | 44.85 | 0 | 0 | 1.34 | 0.51 | 365 | 362 | 64.41 | 44.84 |
| Browns Park NWR | 313 | 206 | 62.58 | 46.90 | 1 | 0 | 5.12 | 3.24 | 313 | 201 | 61.13 | 45.03 |

## Table 5-3 2017 Proposed Action CALPUFF Modeled Results – Regional Haze

| Area | All Sources (Project + Non-Project) | | | | Project Sources | | | | Non-Project Sources | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest |
| | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ |
| ***Method 2, Background*** | | | | | | | | | | | | |
| **Class I Areas** | | | | | | | | | | | | |
| Arches NP | 359 | 305 | 186.94 | NA | 0 | 0 | 2.29 | NA | 359 | 305 | 186.94 | NA |
| Black Canyon of the Gunnison NP | 365 | 364 | 140.95 | NA | 0 | 0 | 2.92 | NA | 365 | 364 | 138.03 | NA |
| Canyonlands NP | 319 | 215 | 83.92 | NA | 0 | 0 | 1.57 | NA | 319 | 214 | 83.85 | NA |
| Capitol Reef NP | 326 | 232 | 127.25 | NA | 0 | 0 | 2.21 | NA | 326 | 232 | 127.23 | NA |
| Mesa Verde NP | 365 | 365 | 175.00 | NA | 0 | 0 | 1.14 | NA | 365 | 365 | 174.99 | NA |
| Eagles Nest WA | 365 | 359 | 117.69 | NA | 0 | 0 | 1.56 | NA | 365 | 359 | 117.56 | NA |
| Flat Tops WA | 365 | 348 | 79.58 | NA | 0 | 0 | 2.68 | NA | 365 | 348 | 79.11 | NA |
| La Garita WA | 365 | 354 | 48.05 | NA | 0 | 0 | 0.63 | NA | 365 | 354 | 48.05 | NA |
| Maroon Bells-Snowmass WA | 365 | 362 | 95.64 | NA | 0 | 0 | 2.22 | NA | 365 | 362 | 95.64 | NA |
| Mt Zirkel WA | 365 | 365 | 154.57 | NA | 0 | 0 | 2.31 | NA | 365 | 365 | 154.23 | NA |
| Weminuche WA | 365 | 365 | 104.76 | NA | 0 | 0 | 0.54 | NA | 365 | 365 | 104.76 | NA |
| West Elk WA | 365 | 365 | 100.34 | NA | 0 | 0 | 2.57 | NA | 365 | 365 | 100.34 | NA |
| **Class II Areas** | | | | | | | | | | | | |
| Colorado NM | 364 | 359 | 177.98 | NA | 0 | 0 | 3.78 | NA | 364 | 359 | 177.97 | NA |
| Dinosaur NM | 365 | 363 | 245.5 | NA | 82 | 40 | 43.42 | NA | 365 | 362 | 232.1 | NA |
| Flaming Gorge NRA | 365 | 365 | 435.87 | NA | 153 | 104 | 78.88 | NA | 365 | 365 | 356.99 | NA |
| High Uintah WA | 365 | 365 | 180.77 | NA | 6 | 0 | 7.03 | NA | 365 | 365 | 180.17 | NA |
| Holy Cross WA | 365 | 365 | 313.06 | NA | 0 | 0 | 1.37 | NA | 365 | 365 | 313.06 | NA |
| Hunter Frying Pan WA | 365 | 365 | 88.10 | NA | 0 | 0 | 1.43 | NA | 365 | 365 | 87.44 | NA |
| Raggeds WA | 365 | 362 | 74.07 | NA | 0 | 0 | 1.78 | NA | 365 | 362 | 73.53 | NA |
| Browns Park NWR | 310 | 197 | 99.44 | NA | 2 | 0 | 7.76 | NA | 309 | 191 | 94.69 | NA |

## Table 5-4 2026 Optimal Recovery Alternative CALPUFF Modeled Results – Regional Haze

| Area | All Sources (Project + Non-Project) | | | | Project Sources | | | | Non-Project Sources | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest |
| | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ |
| ***Method 6, Annual Average Natural Conditions Background*** | | | | | | | | | | | | |
| **Class I Areas** | | | | | | | | | | | | |
| Arches NP | 359 | 311 | 118.47 | 82.72 | 0 | 0 | 4.99 | 2.51 | 359 | 311 | 118.47 | 81.84 |
| Black Canyon of the Gunnison NP | 365 | 364 | 133.98 | 105.97 | 0 | 0 | 3.31 | 0.99 | 365 | 364 | 133.94 | 105.92 |
| Canyonlands NP | 328 | 236 | 106.54 | 68.85 | 0 | 0 | 3.89 | 2.20 | 328 | 236 | 106.50 | 68.85 |
| Capitol Reef NP | 327 | 223 | 110.78 | 74.75 | 0 | 0 | 3.49 | 1.60 | 327 | 223 | 110.75 | 74.75 |
| Mesa Verde NP | 365 | 365 | 155.14 | 122.17 | 0 | 0 | 1.56 | 0.32 | 365 | 365 | 155.13 | 122.10 |
| Eagles Nest WA | 365 | 359 | 107.04 | 83.71 | 0 | 0 | 2.18 | 1.03 | 365 | 359 | 107.04 | 83.71 |
| Flat Tops WA | 365 | 349 | 55.34 | 45.81 | 0 | 0 | 3.59 | 1.97 | 365 | 348 | 54.72 | 45.58 |
| La Garita WA | 365 | 355 | 49.72 | 33.37 | 0 | 0 | 0.80 | 0.46 | 365 | 354 | 49.14 | 33.35 |
| Maroon Bells-Snowmass WA | 365 | 360 | 67.60 | 54.75 | 0 | 0 | 2.55 | 1.11 | 365 | 360 | 67.35 | 53.26 |
| Mt Zirkel WA | 365 | 365 | 125.65 | 100.83 | 0 | 0 | 3.28 | 1.45 | 365 | 365 | 125.21 | 100.73 |
| Weminuche WA | 365 | 365 | 104.32 | 84.87 | 0 | 0 | 0.65 | 0.32 | 365 | 365 | 104.32 | 84.87 |
| West Elk WA | 365 | 365 | 74.35 | 57.75 | 0 | 0 | 2.80 | 0.92 | 365 | 365 | 74.35 | 56.75 |
| **Class II Areas** | | | | | | | | | | | | |
| Colorado NM | 364 | 361 | 158.64 | 139.15 | 1 | 0 | 5.03 | 1.99 | 364 | 361 | 158.41 | 138.00 |
| Dinosaur NM | 365 | 364 | 187.10 | 146.42 | 129 | 71 | 56.77 | 32.72 | 365 | 363 | 147.81 | 123.53 |
| Flaming Gorge NRA | 365 | 365 | 306.23 | 256.94 | 198 | 156 | 83.70 | 62.37 | 365 | 365 | 256.70 | 221.14 |
| High Uintah WA | 365 | 363 | 122.05 | 73.21 | 11 | 1 | 11.11 | 6.86 | 365 | 363 | 120.67 | 72.78 |
| Holy Cross WA | 365 | 365 | 318.99 | 244.11 | 0 | 0 | 1.52 | 0.85 | 365 | 365 | 318.99 | 243.78 |
| Hunter Frying Pan WA | 365 | 365 | 77.82 | 60.26 | 0 | 0 | 1.54 | 0.81 | 365 | 365 | 76.76 | 60.08 |
| Raggeds WA | 365 | 362 | 65.42 | 45.07 | 0 | 0 | 2.55 | 1.02 | 365 | 362 | 64.41 | 44.84 |
| Browns Park NWR | 313 | 207 | 65.31 | 49.06 | 20 | 0 | 9.92 | 6.19 | 313 | 201 | 61.13 | 45.03 |

## Table 5-4 2026 Optimal Recovery Alternative CALPUFF Modeled Results – Regional Haze

| Area | All Sources (Project + Non-Project) | | | | Project Sources | | | | Non-Project Sources | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest | Days > than | | MAX% Δ | 8th Highest |
| | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ | 5% Δ $B_{ext}$ | 10% Δ $B_{ext}$ | $B_{ext}$ | % Δ $B_{ext}$ |
| ***Method 2, Background*** | | | | | | | | | | | | |
| **Class I Areas** | | | | | | | | | | | | |
| Arches NP | 359 | 305 | 186.94 | NA | 0 | 0 | 4.48 | NA | 359 | 305 | 186.94 | NA |
| Black Canyon of the Gunnison NP | 365 | 364 | 143.44 | NA | 1 | 0 | 5.41 | NA | 365 | 364 | 138.03 | NA |
| Canyonlands NP | 319 | 215 | 83.99 | NA | 0 | 0 | 3.09 | NA | 319 | 214 | 83.85 | NA |
| Capitol Reef NP | 326 | 232 | 127.27 | NA | 0 | 0 | 4.26 | NA | 326 | 232 | 127.23 | NA |
| Mesa Verde NP | 365 | 365 | 175.00 | NA | 0 | 0 | 2.19 | NA | 365 | 365 | 174.99 | NA |
| Eagles Nest WA | 365 | 359 | 117.82 | NA | 0 | 0 | 2.86 | NA | 365 | 359 | 117.56 | NA |
| Flat Tops WA | 365 | 349 | 80.00 | NA | 1 | 0 | 5.10 | NA | 365 | 348 | 79.11 | NA |
| La Garita WA | 365 | 354 | 48.06 | NA | 0 | 0 | 1.19 | NA | 365 | 354 | 48.05 | NA |
| Maroon Bells-Snowmass WA | 365 | 362 | 95.64 | NA | 0 | 0 | 4.23 | NA | 365 | 362 | 95.64 | NA |
| Mt Zirkel WA | 365 | 365 | 154.90 | NA | 0 | 0 | 4.51 | NA | 365 | 365 | 154.23 | NA |
| Weminuche WA | 365 | 365 | 104.77 | NA | 0 | 0 | 1.02 | NA | 365 | 365 | 104.76 | NA |
| West Elk WA | 365 | 365 | 100.34 | NA | 0 | 0 | 4.79 | NA | 365 | 365 | 100.34 | NA |
| **Class II Areas** | | | | | | | | | | | | |
| Colorado NM | 364 | 359 | 177.99 | NA | 1 | 0 | 7.03 | NA | 364 | 359 | 177.97 | NA |
| Dinosaur NM | 365 | 363 | 280.79 | NA | 135 | 81 | 80.32 | NA | 365 | 362 | 232.10 | NA |
| Flaming Gorge NRA | 365 | 365 | 483.51 | NA | 199 | 156 | 126.52 | NA | 365 | 365 | 356.99 | NA |
| High Uintah WA | 365 | 365 | 181.37 | NA | 11 | 6 | 13.68 | NA | 365 | 365 | 180.17 | NA |
| Holy Cross WA | 365 | 365 | 313.06 | NA | 0 | 0 | 2.63 | NA | 365 | 365 | 313.06 | NA |
| Hunter Frying Pan WA | 365 | 365 | 88.73 | NA | 0 | 0 | 2.74 | NA | 365 | 365 | 87.44 | NA |
| Raggeds WA | 365 | 362 | 74.62 | NA | 0 | 0 | 3.34 | NA | 365 | 362 | 73.53 | NA |
| Browns Park NWR | 312 | 202 | 104.36 | NA | 20 | 1 | 14.75 | NA | 309 | 191 | 94.69 | NA |

Area and Dinosaur National Monument, modeled results for all other Class II areas under Method 6 show all of the eighth highest impacts at less than a 10 percent increase in extinction (1.0 dv).

For the Optimal Recovery Alternative, all project impacts were below 10 percent light extinction at all Class I areas. At Class II areas under the Optimal Recovery Alternative, the eighth highest impacts using Method 6 were above 10 percent at Flaming Gorge National Recreation Area and Dinosaur National Monument. The eighth highest increase in light extinction for project-related sources was 62.4 percent at Flaming Gorge National Recreation Area, with 156 days predicted to be greater than 10 percent. At Dinosaur National Monument, the eighth highest increase in light extinction was 32.7 percent, with 71 days predicted to be greater than 10 percent.

### 5.1.3 Acid Deposition and Lake Chemistry

For each modeled scenario, CALPUFF was used to estimate annual wet, dry, and total (wet plus dry) deposition fluxes of total nitrogen and sulfur compounds due to the contributions from the modeled sources at the Class I and Class II areas of concern.

The acid deposition modeling results also were used to provide an additional analysis in terms of the ANC for selected sensitive water bodies. An estimation of potential changes in ANC at several specified sensitive lake receptors was made by following the procedure developed by the USFS Rocky Mountain Region (USFS 2000). **Figure 5-1** shows the location of the sensitive lakes included in the ANC analysis. The guideline post-processing utility program, POSTUTIL, was used to sum all wet and dry fluxes of $NO_3$, $HNO_3$, $NO_x$, $SO_2$, and $SO_4$. The total nitrogen and sulfur deposition were then computed from the summed fluxes. Predicted changes in ANC were then compared with the threshold (10 percent change in ANC for lakes with background ANC values greater than 25 micro equivalents per liter (µeq/l), and no more than a 1 µeq/l change in ANC for lakes with background ANC values equal to or less than 25 µeq/l).

The modeling results for the acid deposition impacts from CALPUFF are presented in **Tables 5-5** and **5-6** for the 2017 Proposed Action and 2026 Optimal Recovery Alternative scenarios, respectively. Each table presents both the annual average total nitrogen and sulfur deposition results for each modeled scenario. Results are presented for the total modeled impact from all sources along with the breakdown of project and non-project sources. The impacts from non-project sources represent the 2018 Projected Baseline modeled scenario as if the project would not be built.

The maximum acid deposition at Class I areas for the Proposed Action is 0.0016 kg/ha-yr at the Flat Tops Wilderness Area, and impacts at other Class I areas generally were 0.001 kg/ha-yr or less. For the Optimal Recovery Alternative, the maximum deposition rate for nitrogen compounds was 0.003 kg/ha-yr at the Flat Tops Wilderness Area, and less for all other Class I areas.

The maximum acid deposition rate at the listed Class II areas was predicted for the Flaming Gorge National Recreation Area. The maximum deposition from the Proposed Action was 0.06 kg/ha-yr. For the Optimal Recovery Alternative, the maximum deposition rate was 0.12 kg/ha-yr for nitrogen compounds.

The results of the acidic neutralizing capacity analysis for the selected lakes are presented in **Table 5-7**. Impacts from project-related sources for both scenarios were less than the 1 percent threshold for all lakes, and the deposition rates were all less than 0.06 micro-equivalents per liter (µeq/l) or less than 0.12 µeq/l at all identified lakes for the Proposed Action and Optimal Recovery Alternative, respectively.

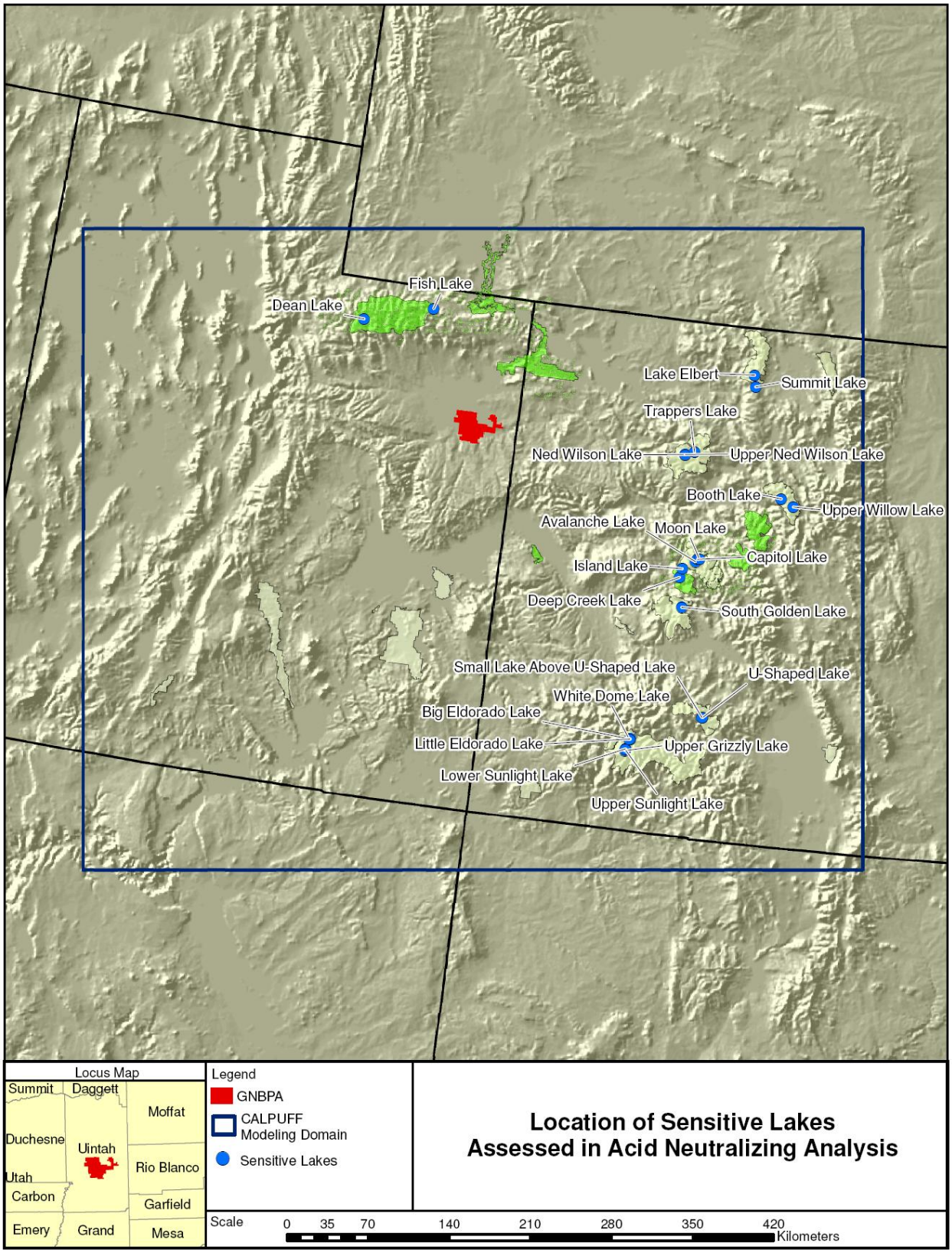



**Figure 5-1 Sensitive Lakes Analyzed in the Acid Neutralizing Capacity Analysis**

## Table 5-5 2017 Proposed Action CALPUFF Modeled Results – Acid Deposition

| Area | Pollutant | Maximum Modeled Deposition | | | Comparative Deposition Value (kg/ha - yr) |
|---|---|---|---|---|---|
| | | All Sources (Project + Non-Project) (kg/ha - yr) | Project Sources (kg/ha - yr) | Non-Project Sources (kg/ha - yr) | |
| **Class I Areas** | | | | | |
| Arches NP | Nitrogen | 0.325 | 0.0010 | 0.324 | 3 |
| | Sulfur | 0.185 | 0.00004 | 0.185 | 5 |
| Black Canyon of the Gunnison NP | Nitrogen | 0.459 | 0.0008 | 0.458 | 3 |
| | Sulfur | 0.241 | 0.00003 | 0.241 | 5 |
| Canyonlands NP | Nitrogen | 0.203 | 0.0005 | 0.202 | 3 |
| | Sulfur | 0.201 | 0.00002 | 0.201 | 5 |
| Capitol Reef NP | Nitrogen | 0.114 | 0.0003 | 0.113 | 3 |
| | Sulfur | 0.143 | 0.00001 | 0.143 | 5 |
| Mesa Verde NP | Nitrogen | 4.956 | 0.0002 | 4.955 | 3 |
| | Sulfur | 0.646 | 0.00001 | 0.646 | 5 |
| Eagles Nest WA | Nitrogen | 0.809 | 0.0011 | 0.808 | 3 |
| | Sulfur | 0.238 | 0.00004 | 0.238 | 5 |
| Flat Tops WA | Nitrogen | 0.267 | 0.0016 | 0.266 | 3 |
| | Sulfur | 0.146 | 0.0001 | 0.146 | 5 |
| La Garita WA | Nitrogen | 0.380 | 0.0003 | 0.379 | 3 |
| | Sulfur | 0.096 | 0.00001 | 0.096 | 5 |
| Maroon Bells-Snowmass WA | Nitrogen | 0.408 | 0.0010 | 0.407 | 3 |
| | Sulfur | 0.163 | 0.00003 | 0.163 | 5 |
| Mt Zirkel WA | Nitrogen | 0.645 | 0.0012 | 0.643 | 3 |
| | Sulfur | 0.304 | 0.00004 | 0.304 | 5 |
| Weminuche WA | Nitrogen | 0.586 | 0.0003 | 0.586 | 3 |
| | Sulfur | 0.213 | 0.00001 | 0.213 | 5 |
| West Elk WA | Nitrogen | 0.273 | 0.0007 | 0.272 | 3 |
| | Sulfur | 0.163 | 0.00002 | 0.163 | 5 |
| **Class II Areas** | | | | | |
| Colorado NM | Nitrogen | 0.440 | 0.0017 | 0.439 | 3 |
| | Sulfur | 0.274 | 0.00007 | 0.273 | 5 |
| Dinosaur NM | Nitrogen | 0.695 | 0.0296 | 0.665 | 3 |
| | Sulfur | 0.204 | 0.0009 | 0.203 | 5 |
| Flaming Gorge NRA | Nitrogen | 1.429 | 0.0619 | 1.429 | 3 |
| | Sulfur | 0.852 | 0.0017 | 0.852 | 5 |
| High Uintah WA | Nitrogen | 0.443 | 0.0015 | 0.442 | 3 |
| | Sulfur | 0.157 | 0.00005 | 0.157 | 5 |
| Holy Cross WA | Nitrogen | 2.603 | 0.0010 | 2.602 | 3 |
| | Sulfur | 0.590 | 0.00003 | 0.590 | 5 |
| Hunter Frying Pan WA | Nitrogen | 1.131 | 0.0007 | 1.130 | 3 |
| | Sulfur | 0.337 | 0.00002 | 0.337 | 5 |
| Raggeds WA | Nitrogen | 0.465 | 0.0008 | 0.464 | 3 |
| | Sulfur | 0.130 | 0.00003 | 0.130 | 5 |
| Browns Park NWR | Nitrogen | 0.237 | 0.0053 | 0.232 | 3 |
| | Sulfur | 0.117 | 0.0002 | 0.117 | 5 |

## Table 5-6 2026 Optimal Recovery Alternative CALPUFF Modeled Results – Acid Deposition

| Area | Pollutant | Maximum Modeled Deposition | | | Comparative Deposition Value (kg/ha - yr) |
|---|---|---|---|---|---|
| | | All Sources (Project + Non-Project) (kg/ha - yr) | Project Sources (kg/ha - yr) | Non-Project Sources (kg/ha - yr) | |
| **Class I Areas** | | | | | |
| Arches NP | Nitrogen | 0.326 | 0.002 | 0.324 | 3 |
| | Sulfur | 0.185 | 0.0001 | 0.185 | 5 |
| Black Canyon of the Gunnison NP | Nitrogen | 0.460 | 0.001 | 0.458 | 3 |
| | Sulfur | 0.241 | 0.0001 | 0.241 | 5 |
| Canyonlands NP | Nitrogen | 0.203 | 0.001 | 0.202 | 3 |
| | Sulfur | 0.201 | 0.0001 | 0.201 | 5 |
| Capitol Reef NP | Nitrogen | 0.114 | 0.001 | 0.113 | 3 |
| | Sulfur | 0.143 | 0.00002 | 0.143 | 5 |
| Mesa Verde NP | Nitrogen | 4.956 | 0.0004 | 4.955 | 3 |
| | Sulfur | 0.647 | 0.00003 | 0.646 | 5 |
| Eagles Nest WA | Nitrogen | 0.810 | 0.002 | 0.808 | 3 |
| | Sulfur | 0.238 | 0.0001 | 0.238 | 5 |
| Flat Tops WA | Nitrogen | 0.269 | 0.003 | 0.266 | 3 |
| | Sulfur | 0.146 | 0.0002 | 0.146 | 5 |
| La Garita WA | Nitrogen | 0.380 | 0.001 | 0.379 | 3 |
| | Sulfur | 0.096 | 0.00004 | 0.096 | 5 |
| Maroon Bells-Snowmass WA | Nitrogen | 0.409 | 0.002 | 0.407 | 3 |
| | Sulfur | 0.163 | 0.0001 | 0.163 | 5 |
| Mount Zirkel WA | Nitrogen | 0.646 | 0.002 | 0.643 | 3 |
| | Sulfur | 0.304 | 0.0001 | 0.304 | 5 |
| Weminuche WA | Nitrogen | 0.587 | 0.001 | 0.586 | 3 |
| | Sulfur | 0.213 | 0.00003 | 0.213 | 5 |
| West Elk WA | Nitrogen | 0.274 | 0.001 | 0.272 | 3 |
| | Sulfur | 0.163 | 0.0001 | 0.163 | 5 |
| **Class II Areas** | | | | | |
| Colorado NM | Nitrogen | 0.441 | 0.003 | 0.439 | 3 |
| | Sulfur | 0.274 | 0.0002 | 0.273 | 5 |
| Dinosaur NM | Nitrogen | 0.721 | 0.055 | 0.665 | 3 |
| | Sulfur | 0.205 | 0.002 | 0.203 | 5 |
| Flaming Gorge NRA | Nitrogen | 1.429 | 0.116 | 1.429 | 3 |
| | Sulfur | 0.852 | 0.005 | 0.852 | 5 |
| High Uintah WA | Nitrogen | 0.444 | 0.003 | 0.442 | 3 |
| | Sulfur | 0.157 | 0.0001 | 0.157 | 5 |
| Holy Cross WA | Nitrogen | 2.604 | 0.002 | 2.602 | 3 |
| | Sulfur | 0.590 | 0.0001 | 0.590 | 5 |
| Hunter Frying Pan WA | Nitrogen | 1.131 | 0.001 | 1.130 | 3 |
| | Sulfur | 0.337 | 0.0001 | 0.337 | 5 |
| Raggeds WA | Nitrogen | 0.466 | 0.002 | 0.464 | 3 |
| | Sulfur | 0.130 | 0.0001 | 0.130 | 5 |
| Browns Park NWR | Nitrogen | 0.241 | 0.010 | 0.232 | 3 |
| | Sulfur | 0.118 | 0.001 | 0.117 | 5 |

## Table 5-7 Modeled Impacts on Acid Sensitive Lakes

| Wilderness Area/Lake | Background ANC (ueq/l) | Number of Samples | Watershed Area (ha) | Annual Averaged Precipitation (m) | ANC(o) (eq) | 2017 Proposed Action | | | | 2026 Optimal Recovery | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Project Only Sources | | All Sources | | Project Sources Only | | All Sources | |
| | | | | | | %ANC Change | Hdep (ueq/l) | %ANC Change | Hdep (ueq/l) | %ANC Change | Hdep (ueq/l) | %ANC Change | Hdep (ueq/l) |
| Eagles Nest Wilderness | | | | | | | | | | | | | |
| Booth Lake | 86.4 | 42 | 54.0 | 0.29 | 9,190.2 | 0.04 | 0.03 | 11.3 | 9.8 | 0.07 | 0.06 | 11.4 | 9.8 |
| Upper Willow Lake | 133.2 | 43 | 124.0 | 0.29 | 32,549.4 | 0.02 | 0.03 | 5.3 | 7.0 | 0.04 | 0.05 | 5.3 | 7.0 |
| Flat Tops Wilderness | | | | | | | | | | | | | |
| Ned Wilson Lake | 39.4 | 193 | 49.2 | 0.26 | 3,312.0 | 0.15 | 0.06 | 34.8 | 13.7 | 0.29 | 0.12 | 34.9 | 13.7 |
| Trappers Lake[1] | 659.4 | 59 | -- | 0.26 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Upper Ned Wilson Lake | 12.9 | 144 | 3.1 | 0.26 | 68.7 | 0.45 | 0.06 | 105.2 | 13.6 | 0.86 | 0.11 | 105.6 | 13.6 |
| La Garita Wilderness | | | | | | | | | | | | | |
| Small Lake Above U-Shaped Lake | 63.3 | 19 | 26.0 | 0.36 | 4,013.3 | 0.04 | 0.02 | 13.7 | 8.7 | 0.07 | 0.05 | 13.7 | 8.7 |
| U-Shaped Lake | 79.3 | 18 | 66.0 | 0.36 | 12,749.8 | 0.03 | 0.02 | 10.8 | 8.5 | 0.06 | 0.05 | 10.8 | 8.5 |
| Maroon Bells-Snowmass Wilderness | | | | | | | | | | | | | |
| Avalanche Lake | 171.0 | 51 | 358.0 | 0.24 | 96,575.6 | 0.02 | 0.04 | 11.8 | 20.2 | 0.04 | 0.07 | 11.9 | 20.3 |
| Capitol Lake | 186.6 | 51 | 139.0 | 0.24 | 40,918.0 | 0.03 | 0.05 | 10.3 | 19.2 | 0.05 | 0.10 | 10.3 | 19.2 |
| Moon Lake (Upper) | 54.3 | 49 | 117.0 | 0.24 | 10,018.8 | 0.10 | 0.05 | 33.6 | 18.2 | 0.19 | 0.10 | 33.6 | 18.3 |
| Mount Zirkel Wilderness | | | | | | | | | | | | | |
| Lake Elbert | 53.8 | 68 | 101.0 | 0.42 | 15,476.4 | 0.01 | 0.01 | 27.1 | 14.6 | 0.03 | 0.01 | 27.1 | 14.6 |
| Summit Lake | 48.0 | 110 | 7.8 | 0.42 | 1,061.9 | 0.02 | 0.01 | 41.8 | 20.0 | 0.03 | 0.01 | 41.8 | 20.1 |
| Weminuche Wilderness | | | | | | | | | | | | | |
| Big Eldorado Lake | 20.4 | 54 | 115.0 | 0.47 | 7,430.2 | 0.03 | 0.01 | 24.8 | 5.1 | 0.06 | 0.01 | 24.8 | 5.1 |
| Little Eldorado Lake | -3.3 | 53 | 48.7 | 0.47 | -509.3 | -0.21 | 0.01 | -153.1 | 5.1 | -0.40 | 0.01 | -153.3 | 5.1 |
| Lower Sunlight Lake | 85.0 | 52 | 96.6 | 0.47 | 26,030.9 | 0.01 | 0.01 | 11.2 | 9.5 | 0.03 | 0.02 | 11.2 | 9.5 |
| Upper Grizzly Lake | 29.9 | 45 | 30.0 | 0.47 | 2,840.5 | 0.07 | 0.02 | 37.2 | 11.1 | 0.13 | 0.04 | 37.2 | 11.1 |
| Upper Sunlight Lake | 28.0 | 51 | 76.9 | 0.47 | 6,823.0 | 0.06 | 0.02 | 35.1 | 9.8 | 0.12 | 0.03 | 35.1 | 9.8 |
| White Dome Lake | 2.1 | 52 | 38.8 | 0.47 | 253.3 | 0.83 | 0.02 | 295.1 | 6.1 | 1.58 | 0.03 | 295.4 | 6.1 |
| West Elk Wilderness | | | | | | | | | | | | | |
| South Golden Lake | 112.6 | 23 | 73.0 | 0.29 | 15,946.8 | 0.03 | 0.03 | 9.1 | 10.3 | 0.05 | 0.06 | 9.2 | 10.3 |
| High Uintas Wilderness | | | | | | | | | | | | | |
| Dean Lake | 51.4 | 7 | 117.0 | 0.41 | 16,569.3 | 0.01 | 0.01 | 17.3 | 8.9 | 0.02 | 0.01 | 17.4 | 8.9 |
| Fish Lake[1] | 104.5 | 6 | -- | 0.41 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Raggeds Wilderness | | | | | | | | | | | | | |
| Deep Creek Lake | 40.0 | 26 | 525.0 | 0.28 | 39,811.9 | 0.03 | 0.01 | 40.2 | 16.1 | 0.05 | 0.02 | 40.3 | 16.1 |
| Island Lake[2] | -- | -- | -- | 0.28 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

[1] For Trappers and Fish lakes, ANC calculations could not be made because the watershed area was not provided in the database from the USFS.

[2] For Island Lake, ANC calculations could not be made because there was no data in the USFS database for this lake.

## 5.2 CMAQ Ozone Impact Assessment

### 5.2.1 CMAQ 2005/2006 Base Case Modeling Results

A group of representatives from the oil and gas industry, along with federal and state air quality agencies, participated in a coordinated analysis of air quality impacts within the Uinta Basin. Under their direction and coordination by the Independent Petroleum Association of the Mountain States (IPAMS), the UBAQS analyzed the impact of projected development on the ambient levels of ozone and other air quality constituents in the region (ENVIRON 2009). The CMAQ modeling that is provided here used emissions and meteorological input data consistent with the UBAQS. While the UBAQS estimated impacts for 2012, this analysis estimated impacts projected for 2017 and 2026 using cumulative development projections through 2018.

**Table 5-8** compares the UBAQS CMAQ 2005 and 2006 base case simulation ozone model performance across AIRS and CASTNet monitoring sites in the 12-km domain with USEPA hourly ozone model performance goals for bias (≤±15 percent) and error (≤35 percent) (USEPA 1991). Presented in **Table 5-8** are the fractional, normalized mean, and mean normalized ozone performance metrics for both bias and error for 2005 and 2006. These were calculated using hourly predicted and observed ozone pairs for which the observed value was above a 60 ppb threshold (USEPA 1991). Bias and error performance statistics in **Table 5-8** are only presented for quarters when there is a minimum of at least 100 predicted and observed hourly ozone pairs available. For the second quarter of 2005 and the first and second quarters of 2006, the UBAQS CMAQ base case ozone performance always achieved the USEPA ozone performance goal. During the third quarters of both 2005 and 2006, the CMAQ ozone bias performance metrics were very near the -15 percent ozone performance goal, with some of the bias metrics achieving the goal and others just outside of the goal. However, the CMAQ error ozone performance metrics for these quarters achieved the ≤35 percent ozone performance goal by more than a factor of two.

**Table 5-8 Ozone Model Performance Bias and Error Statistics**

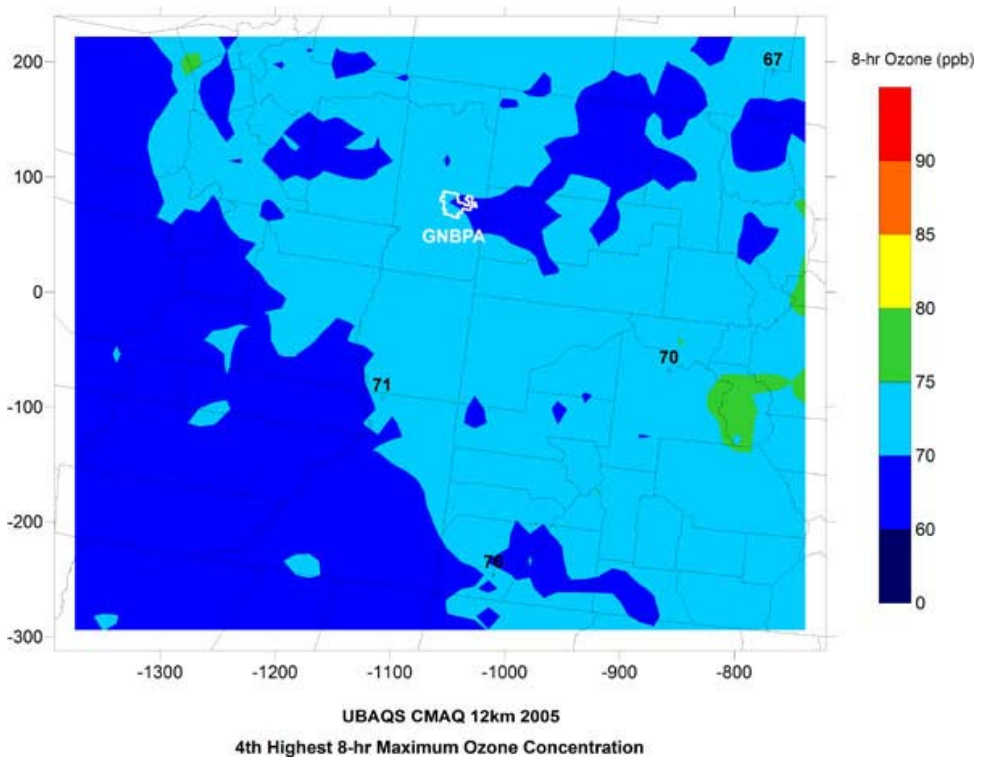
| | Bias (Percent) | | | Error (Percent) | | | |
|---|---|---|---|---|---|---|---|
| Year/Quarter | Fractional | Normalized Mean | Mean Normalized | Fractional | Normalized Mean Gross | Mean Normalized Gross | Number[1] |
| 2005 Quarter 2 | -5.80 | -5.16 | -4.82 | 11.16 | 10.65 | 10.51 | 2,015 |
| 2005 Quarter 3 | -16.75 | -15.04 | -14.89 | 17.52 | 15.82 | 15.70 | 1,388 |
| 2006 Quarter 1 | -5.00 | -4.52 | -4.43 | 8.56 | 8.18 | 8.14 | 278 |
| 2006 Quarter 2 | -4.06 | -3.66 | -3.40 | 9.14 | 8.87 | 8.77 | 3,174 |
| 2006 Quarter 3 | -16.48 | -14.83 | -14.71 | 16.86 | 15.21 | 15.11 | 1,179 |

[1] Number of predicted and observed ozone pairs available. Data shown only for quarters where greater than 100 pairs available for analysis.

The UBAQS CMAQ base case simulations also satisfied the USEPA daily maximum 8-hour ozone concentration performance goal that requires predicted daily maximum 8-hour ozone concentration "near the monitor" to be within ±20 percent of the observed value most of the time (USEPA 1999). Even using the most stringent definition of "near the monitor," which is based on the predicted 8-hour ozone concentration at the monitor, the CMAQ base case predicted daily maximum 8-hour ozone concentration is within ±20 percent of the observed value 90 and 83 percent of the time for the 2005 and 2006 modeling years, respectively.

The 8-hour ozone NAAQS was expressed as the 3-year average of the fourth highest daily maximum 8-hour ozone concentrations. Thus, an important ozone performance issue when analyzing the future year CMAQ absolute modeling results was the fourth highest daily maximum 8-hour ozone concentration in each modeled year. **Figure 5-2** depicts the CMAQ estimated (modeled) fourth highest daily maximum 8-hour ozone concentration and the observed values for 2005 and 2006. Modeled data are shown as the shaded

**2005**




**2006**

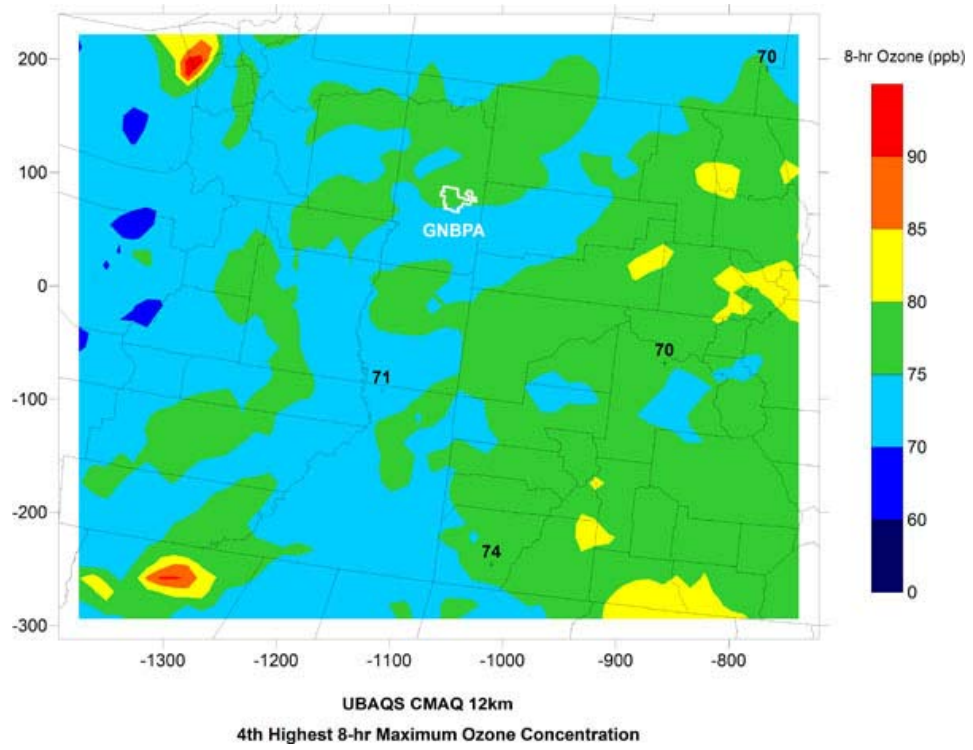



**Figure 5-2 Depiction of Predicted and Observed Fourth highest Daily Maximum 8-hour Ozone Concentrations for 2005 and 2006**

patterns, and observations are shown as whole numbers at their applicable station location. The modeled fourth highest daily maximum 8-hour ozone concentrations were comparable to the observed values; however, at the locations of the ozone monitors, the predicted values were usually higher than the observed values, resulting in an overprediction bias. This bias was greater in 2006 than in 2005 and needs to be accounted for when interpreting the future year absolute model ozone predictions.

### 5.2.2 CMAQ Ozone Impact Assessment of Alternatives

The following subsections present the ozone impacts of the 2018 Projected Baseline, 2017 Proposed Action, and 2026 Optimal Recovery Alternative scenarios using both the USEPA guidance relative impact approach (USEPA 2007) and an absolute impact approach. Considerable caution must be taken in interpreting the modeled project impacts. In traditional CMAQ ozone modeling applications, the model is applied in regions with sufficient ozone and precursor observations to judge the adequacy of the model for use in ozone analysis. In this application, the closest rural monitor with a long enough data record to be used for attainment designation was the Canyonlands site approximately 150 km from the project area. Ozone observations closer to the project (Vernal and Dinosaur National Park) were operated for shorter time periods that did not correspond to the 2005/2006 period being modeled and were not able to be used for the performance evaluation. Without sufficient local monitored ozone data, the base and future year model estimated ozone levels were suspect; however, the comparative modeled ozone levels among the alternatives were considered a reliable evaluation.

#### 5.2.2.1 Results Using USEPA Guidance Ozone Projection Approach

The USEPA metrics for determining attainment of the ozone standard are based on the modeled ozone concentrations at a monitor location. Both the relative and absolute values of ozone modeling were used in this analysis, as discussed below.

#### 5.2.2.2 USEPA Guidance 8-Hour Ozone Projection Procedures

USEPA guidance for projecting future 8-hour ozone concentrations recommends using the photochemical grid model in a relative sense to scale current observed 8-hour design values (USEPA 2007). A design value is defined as a consecutive 3-year average of the fourth highest daily maximum 8-hour ozone concentrations at a monitor. Model scaling factors, referred to as relative response factors (RRFs), were used to scale the observed design values to predict future year design values. RRFs are the ratio of the future year (or the control case) to the current-year modeled 8-hour ozone concentrations near a monitor site. USEPA has defined “near the monitor” to be approximately 15 km from the monitor location. The future-year design value (DVf) is obtained from the current-year design value (DVc) using the relation:

$$DVf = DVc \ x \ RRF$$

The RRFs are calculated for all days in which the current-year modeled 8-hour ozone value is above a threshold. This is done so that the model response to future changes in emissions is considered only on high ozone days of comparable conditions to the days used to produce the DVc. USEPA recommends a threshold between 70 and 85 ppb.

To perform the 8-hour projections, USEPA has developed the Modeled Attainment Test Software (MATS) tool that uses modeling results, 8-hour ozone design values, and follows USEPA guidance (USEPA 2007) to project 8-hour ozone concentrations that reflect the change in emissions from the base case to an alternative emissions scenario.

USEPA modeling guidance procedures (USEPA 2007) recommend using a DVc based on an average of 3-year 8-hour ozone design values that span 5 consecutive years centered on the modeling year (i.e., a weighted average of 5 years of fourth highest daily maximum 8-hour ozone concentrations). For example, for the 2006 base case modeling year used in this analysis, this would mean the DVc at a given monitor would be the weighted average of the fourth highest 8-hour daily maximum ozone at that monitor from the

years 2004, 2005, 2006, 2007, and 2008 using weights of 1, 2, 3, 2, and 1, respectively. To develop RRFs, USEPA guidance recommends using current and future modeling results for all days in which the current year daily maximum 8-hour ozone concentration near the monitor exceeds an ozone threshold value. For a 12-km grid, as in the GNB CMAQ modeling, the maximum modeled daily maximum 8-hour ozone concentration in a 3 x 3 array of grid cells centered on the monitor is used. USEPA recommends using an 8-hour ozone threshold concentration of 85 ppb and also recommends that RRFs be based on a minimum of 5 days, although a total of at least 10 days is preferred. USEPA allows a reduction of the threshold value to 70 ppb to meet the minimum 5- to 10-day requirement. These procedures were developed mainly for urban ozone nonattainment areas where there typically are many more days of elevated ozone concentrations than are observed in the rural Uinta Basin study area.

There are several issues with using the MATS tool in its standard configuration for the ozone analysis. The most serious is that the monitoring network is relatively dense in the Salt Lake City area but sparse throughout the rest of Utah, with no monitors in the Uinta Basin that have a sufficiently long data record to allow inclusion in the MATS tool (**Figure 5-3**). Therefore, use of the MATS tool in its standard configuration would result in the DVc in Uintah County, Utah, being based on interpolation of DVc from monitors hundreds of kilometers away in the Salt Lake City area, San Juan County, Utah (Canyonlands), and the Gothic, Colorado, and Centennial, Wyoming, CASTNet sites. This results in the interpolation of high Salt Lake City ozone values typical of an urban area across the Wasatch Range into the rural Uinta Basin region. Note that the Uinta Basin is not part of the Salt Lake City airshed. In addition, restricting sites used in MATS to those with a minimum of 5 days of DVc greater than 70 ppb means that MATS cannot project future ozone in the middle of the Uinta Basin and leaves this area blank in plotting future year design values in the unmonitored area analysis. To address this issue, the analysis includes monitors that record ozone data according to USEPA standard methods but have fewer than 5 years of data available.

For this analysis, a MATS assessment was performed in which all available data were used. While this may not be acceptable to NAAQS attainment designation, this approach leads to a more informative analysis of expected changes in ozone levels in an area that is fundamentally in compliance with the standard. The 5-year data requirement to construct DVc was relaxed so that sites with a minimum of 1 year of data were included as DVc in the analysis. DVc for sites with multiple years of record were based on the 3-year 8-hour ozone design value that spanned 2004 through 2008. In addition, in the enhanced MATS Unmonitored Area Analysis, grid cells were included in the RRF calculation if they had 1 or more days over the 70 ppb threshold. **Figure 5-3** displays the locations of the ozone monitors used in the enhanced MATS projection analysis using the expanded monitoring sites for the DVc. The most important difference in the Uinta Basin was the addition of DVc associated with the Vernal, Utah, ozone monitor and the monitor at Dinosaur National Monument. The Vernal monitor lies within the Uinta Basin and was active in 2007. The fourth highest daily maximum 8-hour ozone concentration was used for the DVc for this monitor. The DVc for the Dinosaur National Monument was based on 3 years of monitoring data (2006 though 2008) with the 3-year average fourth highest daily maximum 8-hour ozone concentrations.

### 5.2.3 Impact Assessment at Monitors

Monitor station 2006 design values (DVc) as well as 2018 future year design values (DVf) and RRFs for the 2018 Projected Baseline, 2017 Proposed Action, and 2026 Optimal Recovery Alternative for all stations in the domain for the 2005 and 2006 meteorological years are presented in **Tables 5-9** and **5-10**, respectively. USEPA guidance (USEPA 2007) suggests truncating ozone concentrations to the ppb level (truncating tenths of ppb) when performing attainment testing. However, for this analysis the results are presented to 0.1 ppb to better resolve the magnitude of potential project impacts. For all three future scenarios, all monitors in the modeling domain are predicted to be in attainment with the 75 ppb ozone standard.

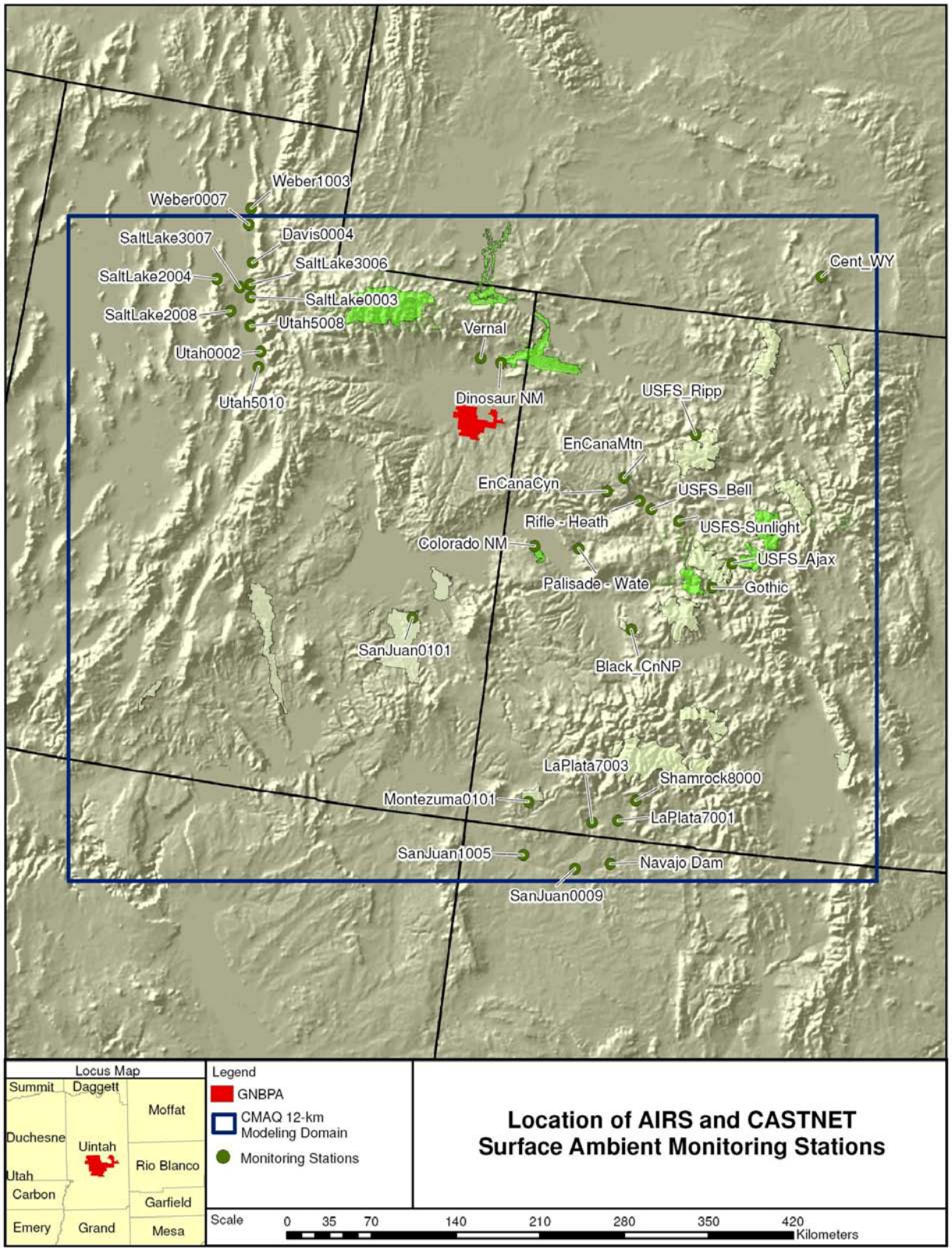



**Figure 5-3 Ozone Monitoring Stations**

**Table 5-9 Annual Monitoring Station 8-hour Ozone Design Values and Future Year Design Values for 2005 Meteorological Year**

| Monitor ID | State | Name | Baseline | 2018 Projected Baseline | | 2017 Proposed Action | | 2026 Optimal Recovery | |
|---|---|---|---|---|---|---|---|---|---|
| | | | DVc | DVf | RRF | DVf | RRF | DVf | RRF |
| 80450012 | CO | Rifle - Health | 66.0 | 60.4 | 0.9159 | 60.4 | 0.9159 | 60.5[1] | 0.9171 |
| 80677001 | CO | LaPlata7001 | 56.3 | 50.0 | 0.8895 | 50.0 | 0.8895 | 50.0 | 0.8895 |
| 80677003 | CO | LaPlata7003 | 65.3 | 56.8 | 0.8703 | 56.8 | 0.8703 | 56.8 | 0.8703 |
| 80679000 | CO | Shamrock | 71.3 | 66.4 | 0.9321 | 66.4 | 0.9321 | 66.4 | 0.9321 |
| 80770020 | CO | Palisade-Water | 70.0 | 64.3 | 0.9192 | 64.3 | 0.9192 | 64.4[1] | 0.9203 |
| 80771001 | CO | Colorado NM | 69.0 | 62.7 | 0.9094 | 62.7 | 0.9094 | 62.7 | 0.9096 |
| 80830101 | CO | Montezuma0101 | 72.3 | 64.1 | 0.8873 | 64.1 | 0.8873 | 64.1 | 0.8873 |
| 350450009 | NM | SanJuan0009 | 67.3 | 61.9 | 0.9205 | 61.9 | 0.9205 | 61.9 | 0.9206 |
| 350450018 | NM | Navajo Dam | 77.0 | 70.5 | 0.9161 | 70.5 | 0.9161 | 70.5 | 0.9161 |
| 350451005 | NM | SanJuan1005 | 71.0 | 66.1 | 0.9314 | 66.1 | 0.9314 | 66.1 | 0.9315 |
| 490110004 | UT | Davis0004 | 80.0 | 69.2 | 0.8657 | 69.2 | 0.8657 | 69.2 | 0.8657 |
| 490350003 | UT | SaltLake0003 | 80.0 | 72.6 | 0.9084 | 72.6 | 0.9084 | 72.6 | 0.9085 |
| 490352004 | UT | SaltLake2004 | 80.0 | 63.0 | 0.7886 | 63.0 | 0.7886 | 63.0 | 0.7886 |
| 490353006 | UT | SaltLake3006 | 77.0 | 69.2 | 0.8999 | 69.2 | 0.8999 | 69.2 | 0.8999 |
| 490353007 | UT | SaltLake3007 | 78.0 | 64.5 | 0.8271 | 64.5 | 0.8271 | 64.5 | 0.8271 |
| 490353008 | UT | SaltLake3008 | 78.0 | 66.5 | 0.8538 | 66.5 | 0.8538 | 66.5 | 0.8538 |
| 490370101 | UT | SanJuan0101 | 71.0 | 62.2 | 0.8764 | 62.2 | 0.8764 | 62.2 | 0.8768 |
| 490471002 | UT | Dinosaur NM | 65.0 | 58.6 | 0.9020 | 58.6 | 0.9020 | 58.7[1] | 0.9034 |
| 490490002 | UT | Utah0002 | 73.0 | 65.6 | 0.8988 | 65.6 | 0.8988 | 65.6 | 0.8989 |
| 490495008 | UT | Utah5008 | 75.0 | 67.5 | 0.9001 | 67.5 | 0.9001 | 67.5 | 0.9002 |
| 490495010 | UT | Utah5010 | 76.0 | 66.8 | 0.8793 | 66.8 | 0.8793 | 66.8 | 0.8793 |
| 490570007 | UT | Weber0007 | 78.0 | 66.8 | 0.8568 | 66.8 | 0.8568 | 66.8 | 0.8568 |
| 490571003 | UT | Weber1003 | 79.0 | 67.6 | 0.8568 | 67.6 | 0.8568 | 67.6 | 0.8568 |
| Black_CnNP | CO | Black_CnNP | 74.0 | 67.2 | 0.9088 | 67.2 | 0.9088 | 67.2 | 0.9090 |
| Cent_WY | WY | Cent_WY | 68.0 | 62.9 | 0.9264 | 62.9 | 0.9264 | 63.0[1] | 0.9265 |
| EnCanaCyn | CO | EnCanaCyn | 68.0 | 62.5 | 0.9203 | 62.5 | 0.9203 | 62.6[1] | 0.9219 |
| EnCanaMtn | CO | EnCanaMtn | 68.0 | 63.3 | 0.9310 | 63.3 | 0.9310 | 63.3 | 0.9318 |
| Gothic | CO | Gothic | 67.7 | 63.9 | 0.9448 | 63.9 | 0.9448 | 64.0[1] | 0.9465 |
| USFS-Sunlight | CO | USFS-Sunlight | 70.0 | 64.1 | 0.9162 | 64.1 | 0.9162 | 64.2[1] | 0.9172 |
| USFS_Ajax | CO | USFS_Ajax | 77.0 | 71.8 | 0.9335 | 71.8 | 0.9335 | 71.9[1] | 0.9345 |
| USFS_Bell | CO | USFS_Bell | 70.5 | 63.1 | 0.8952 | 63.1 | 0.8952 | 63.1 | 0.8964 |
| USFS_Ripp | CO | USFS_Ripp | 66.0 | 61.1 | 0.9258 | 61.1 | 0.9258 | 61.1 | 0.9260 |
| Vernal | UT | Vernal | 68.9 | 63.5 | 0.9222 | 63.5 | 0.9222 | 63.5 | 0.9225 |

[1] Ozone design value increases by 0.1 ppb compared to the 2018 Projected Baseline scenario.

**Table 5-10 Annual Monitoring Station 8-hour Ozone Design Values and Future Year Design Values for 2006 Meteorological Year**

| | | | Baseline | 2018 Projected Baseline | | 2017 Proposed Action | | 2026 Optimal Recovery | |
|---|---|---|---|---|---|---|---|---|---|
| Monitor ID | State | County | DVc | DVf | RRF | DVf | RRF | DVf | RRF |
| 80450012 | CO | Rifle - Health | 66.0 | 59.8 | 0.9062 | 59.8 | 0.9067 | 59.8 | 0.9074 |
| 80677001 | CO | LaPlata7001 | 56.3 | 51.8 | 0.9210 | 51.8 | 0.9211 | 51.8 | 0.9211 |
| 80677003 | CO | LaPlata7003 | 65.3 | 59.9 | 0.9176 | 59.9 | 0.9176 | 59.9 | 0.9177 |
| 80679000 | CO | Shamrock | 71.3 | 66.1 | 0.9282 | 66.1 | 0.9282 | 66.1 | 0.9283 |
| 80770020 | CO | Palisade-Water | 70.0 | 63.8 | 0.9123 | 63.8 | 0.9125 | 63.8 | 0.9128 |
| 80771001 | CO | Colorado NM | 69.0 | 62.6 | 0.9077 | 62.6 | 0.9079 | 62.6 | 0.9083 |
| 80830101 | CO | Montezuma0101 | 72.3 | 65.5 | 0.9068 | 65.5 | 0.9070 | 65.5 | 0.9071 |
| 350450009 | NM | SanJuan0009 | 67.3 | 62.7 | 0.9331 | 62.8[1] | 0.9332 | 62.8[1] | 0.9333 |
| 350450018 | NM | Navajo Dam | 77.0 | 70.9 | 0.9220 | 71.0[1] | 0.9221 | 71.0[1] | 0.9222 |
| 350451005 | NM | SanJuan1005 | 71.0 | 66.3 | 0.9339 | 66.3 | 0.9340 | 66.3 | 0.9341 |
| 490110004 | UT | Davis0004 | 80.0 | 73.2 | 0.9161 | 73.3[1] | 0.9163 | 73.3[1] | 0.9167 |
| 490350003 | UT | SaltLake0003 | 80.0 | 71.2 | 0.8908 | 71.2 | 0.8909 | 71.2 | 0.8911 |
| 490352004 | UT | SaltLake2004 | 80.0 | 67.6 | 0.8461 | 67.7[1] | 0.8463 | 67.7[1] | 0.8466 |
| 490353006 | UT | SaltLake3006 | 77.0 | 68.0 | 0.8841 | 68.0 | 0.8843 | 68.1 | 0.8845 |
| 490353007 | UT | SaltLake3007 | 78.0 | 66.5 | 0.8536 | 66.6 | 0.8539 | 66.6 | 0.8544 |
| 490353008 | UT | SaltLake3008 | 78.0 | 71.6 | 0.9187 | 71.6 | 0.9188 | 71.6 | 0.9190 |
| 490370101 | UT | SanJuan0101 | 71.0 | 64.0 | 0.9026 | 64.1[1] | 0.9033 | 64.1[1] | 0.9042 |
| 490471002 | UT | Dinosaur NM | 65.0 | 59.3 | 0.9132 | 59.7[1] | 0.9187 | 60.1[1] | 0.9261 |
| 490490002 | UT | Utah0002 | 73.0 | 65.1 | 0.8930 | 65.1 | 0.8930 | 65.1 | 0.8931 |
| 490495008 | UT | Utah5008 | 75.0 | 66.2 | 0.8837 | 66.2 | 0.8837 | 66.2 | 0.8837 |
| 490495010 | UT | Utah5010 | 76.0 | 67.1 | 0.8837 | 67.1 | 0.8838 | 67.1 | 0.8839 |
| 490570007 | UT | Weber0007 | 78.0 | 70.7 | 0.9067 | 70.7 | 0.9070 | 70.7 | 0.9073 |
| 490571003 | UT | Weber1003 | 79.0 | 71.6 | 0.9067 | 71.6 | 0.9070 | 71.6 | 0.9073 |
| Black_CnNP | CO | Black_CnNP | 74.0 | 68.3 | 0.9239 | 68.3 | 0.9240 | 68.3 | 0.9241 |
| Cent_WY | WY | Cent_WY | 68.0 | 64.3 | 0.9458 | 64.3 | 0.9466 | 64.4[1] | 0.9477 |
| EnCanaCyn | CO | EnCanaCyn | 68.0 | 62.0 | 0.9131 | 62.1[1] | 0.9136 | 62.1[1] | 0.9142 |
| EnCanaMtn | CO | EnCanaMtn | 68.0 | 61.8 | 0.9089 | 61.8 | 0.9094 | 61.8 | 0.9100 |
| Gothic | CO | Gothic | 67.7 | 63.1 | 0.9329 | 63.1 | 0.9330 | 63.1 | 0.9332 |
| USFS-Sunlight | CO | USFS-Sunlight | 70.0 | 64.7 | 0.9244 | 64.7 | 0.9247 | 64.7 | 0.9250 |
| USFS_Ajax | CO | USFS_Ajax | 77.0 | 71.8 | 0.9329 | 71.8 | 0.9330 | 71.8 | 0.9331 |
| USFS_Bell | CO | USFS_Bell | 70.5 | 64.1 | 0.9106 | 64.2[1] | 0.9108 | 64.2[1] | 0.9111 |
| USFS_Ripp | CO | USFS_Ripp | 66.0 | 62.8 | 0.9516 | 62.8 | 0.9523 | 62.9[1] | 0.9534 |
| Vernal | UT | Vernal | 68.9 | 63.8 | 0.9263 | 64.0[1] | 0.9296 | 64.3[1] | 0.9341 |

[1] Ozone design value increases by 0.1 ppb compared to the 2018 Projected Baseline scenario.

For the 2005 meteorological year (**Table 5-9**), the Proposed Action scenario does not increase ozone design values by over 0.1 ppb over the Projected Baseline scenario at any of the monitors; however, the Optimal Recovery scenario does increase ozone by 0.1ppb at 8 monitors. For the 2006 meteorological year (**Table 5-10**), the CMAQ model shows more impact from the project using the 2006 meteorology, where the Proposed Action scenario increases ozone by 0.1 ppb at 7 monitors, by 0.2 ppb at the Vernal monitor, and by 0.4 ppb at the Dinosaur NM monitor. The Optimal Recovery scenario increases ozone by 0.1 ppb at 9 monitors, 0.5 ppb at the Vernal monitor, and 0.8 ppb at the Dinosaur NM monitor.

### 5.2.4 Impact Assessment in Areas Removed from Monitors

To assess the project impacts in areas removed from monitor locations, USEPA guidance calls for an unmonitored area analysis. For this analysis, the MATS tool is used to prepare spatial fields of the projected future year ozone design values throughout the 12-km domain. USEPA does not determine attainment of the 8-hour standard based on the unmonitored area analysis; rather, the unmonitored analysis is used as more of a weight-of-evidence analysis and to guide potential future ozone monitor placement (USEPA 2007).

**Figure 5-4** presents the Baseline MATS estimated ozone design values using the 2005 and 2006 meteorology. For both meteorological years, the highest values are estimated to occur in the Salt Lake City area. For the 2005 meteorology in the GNBPA, the estimated design values were below 70 ppb. For the 2006 meteorology, the majority of the values were below 70 ppb with one grid cell in the range of 70 to 73 ppb. No grid cells in the vicinity of the GNBPA were estimated to have design values in excess of the 75 ppb ozone NAAQS.

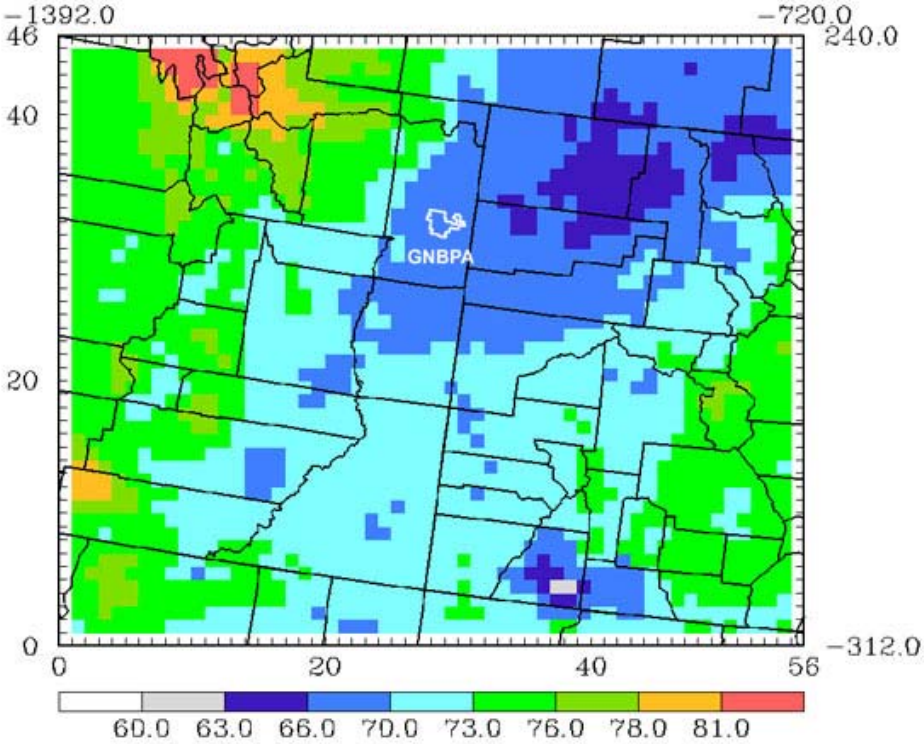
**Figure 5-5** presents the 2018 Projected Baseline design values. For both years of meteorology, the CMAQ model generally is estimating a decrease in the design value across the domain. **Figure 5-6** presents the future design values that include the 2017 Proposed Action emissions. The results are nearly indistinguishable from the 2018 Projected Baseline figures. Analogous 2026 Optimal Recovery results are presented in **Figure 5-7**. Again, the differences are difficult to distinguish from either the Projected Baseline or the Proposed Action. The model calculated no ozone concentrations in excess of the 75 ppb standard in the GNBPA for any of the scenarios.

To focus on the differences in the future design values, difference plots between the scenarios are shown. **Figure 5-8** presents the differences in the design values between the Projected Baseline and the Proposed Action. The Proposed Action scenario shows more extensive impact using the 2006 meteorology than for 2005. The maximum increase with the 2005 meteorology was 0.3 ppb occurring well southwest of the GNBPA, an ozone decrease of 0.3 ppb in the GNBPA, and only a limited area showed impacts of 0.2 ppb. With the 2006 meteorology, the maximum increase in the GNBPA was 2.4 ppb with the Proposed Action scenario showing a 0.2 ppb or greater impact over much of Uintah County and into Colorado.

**Figure 5-9** presents the future design value differences between the Optimal Recovery Alternative and the Projected Baseline. As with the Proposed Action, the 2006 meteorology showed a larger and more extensive impact from the Optimal Recovery Alternative. The maximum impact from the Optimal Recovery scenario using the 2005 meteorology was 0.6 ppb occurring southwest of the GNBPA, with an ozone decrease of 0.8 ppb in the GNBPA. The 2006 meteorology showed a maximum impact from the Optimal Recovery scenario of 4.9 ppb in the vicinity of the GNBPA, with a sizable portion of Unitah County having an impact greater than 0.4 ppb.

Differences between the Optimal Recovery Alternative and Proposed Action future design values are presented in **Figure 5-10** using the 2005 and 2006 meteorology. With the 2005 meteorology, the maximum difference in increase was 0.3 ppb and the maximum difference in decrease was 0.5 ppb. For the 2006 meteorology, the maximum difference in increase was 2.5 ppb and the maximum difference in decrease was 0.1 ppb.

**2005**




**2006**

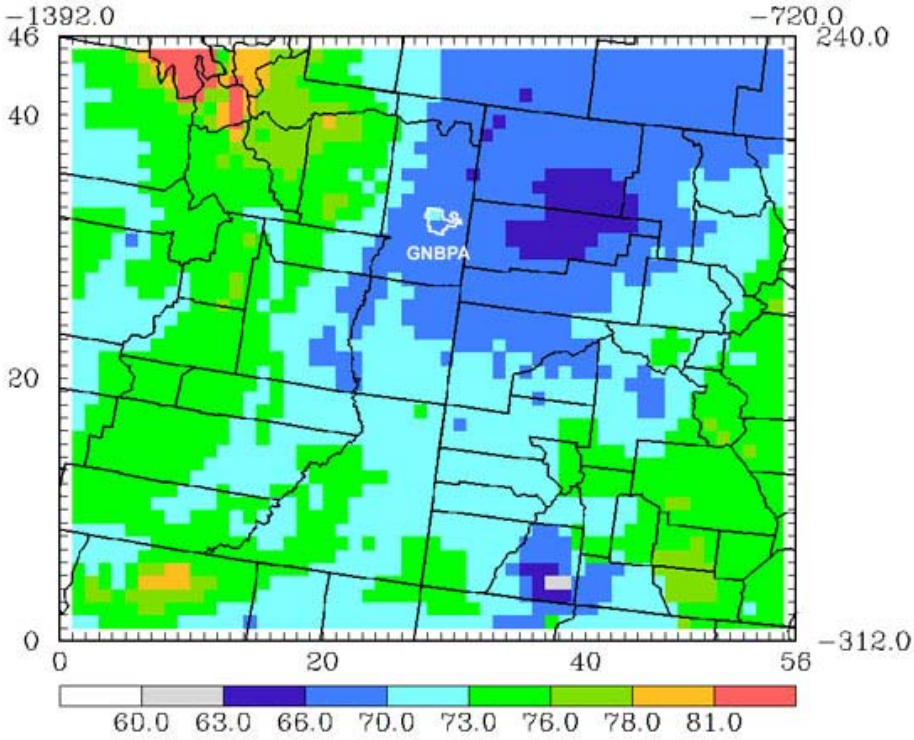
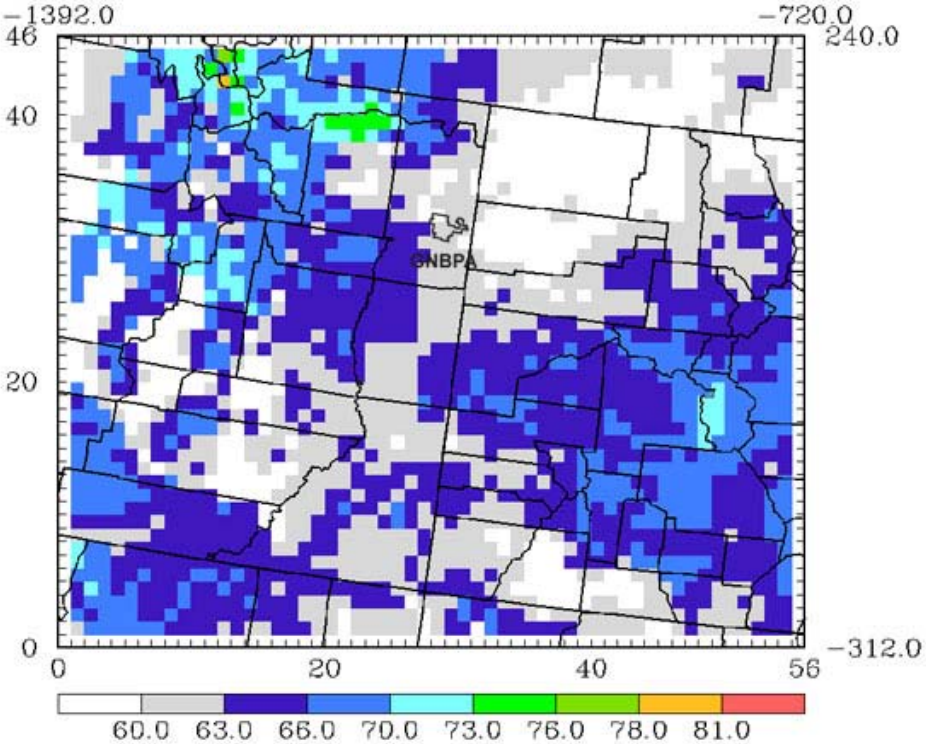



**Figure 5-4 Baseline 8-hour Ozone Design Values**

**2005**




**2006**

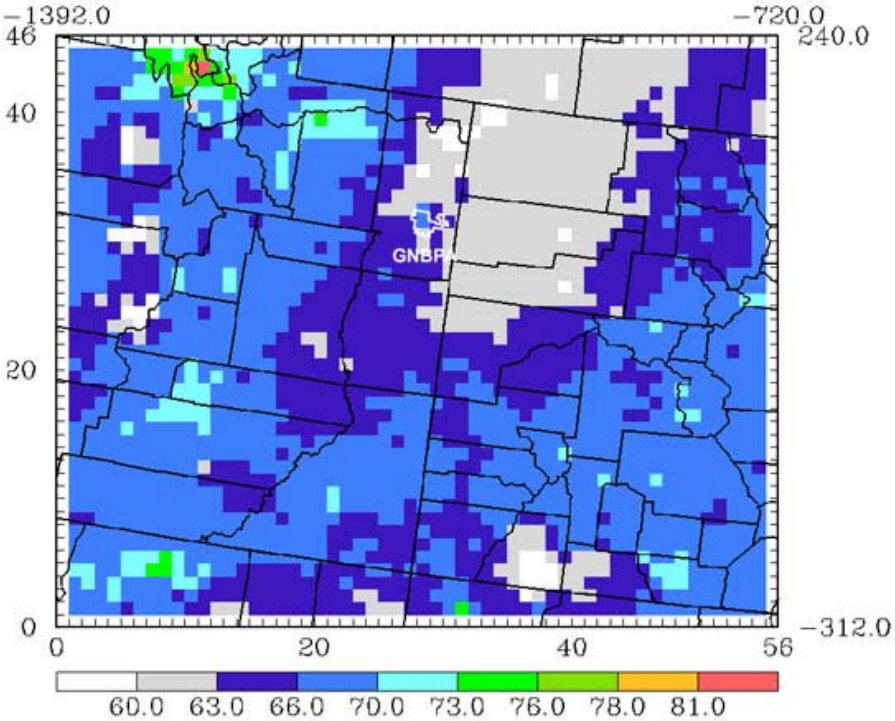
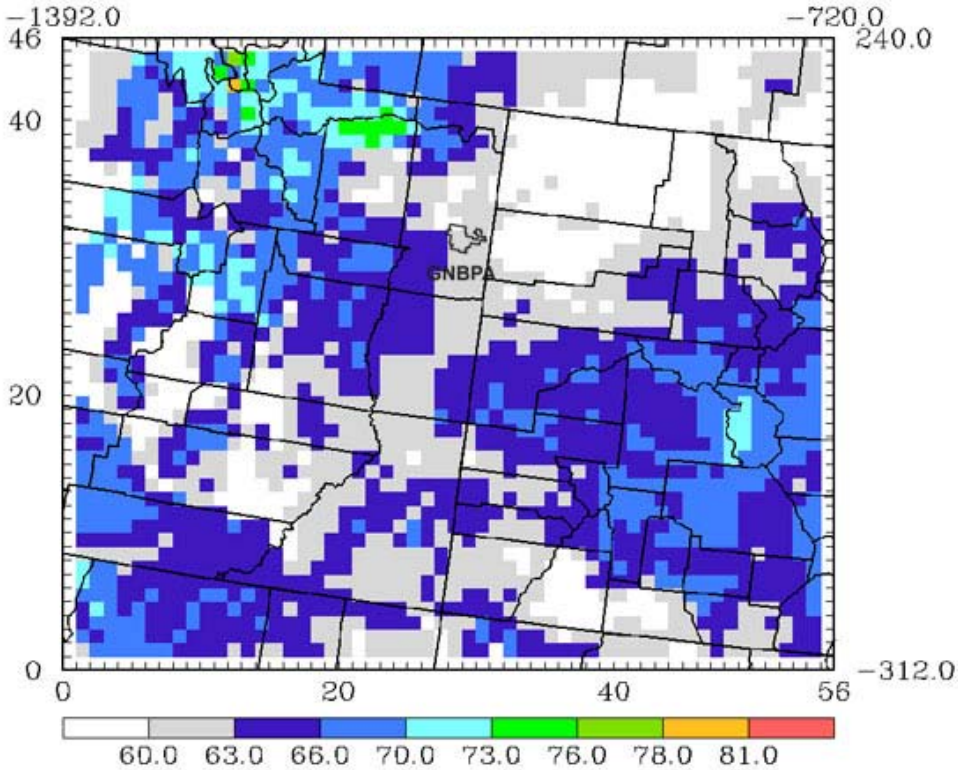



**Figure 5-5 Annual 8-hour Ozone Future Design Values for 2018 Projected Baseline**

**2005**




**2006**

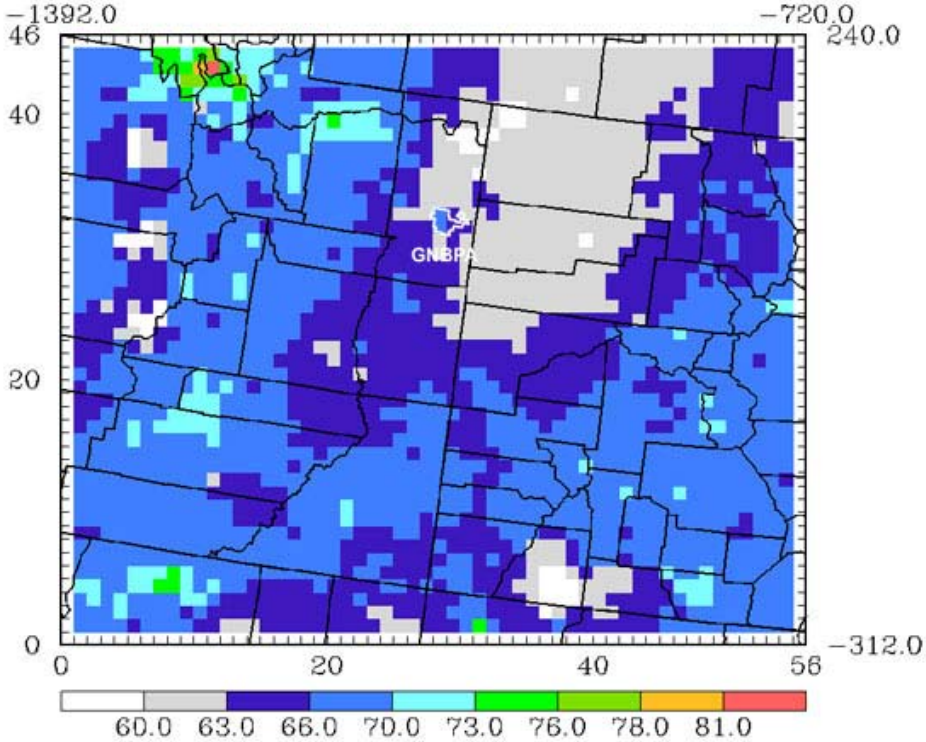
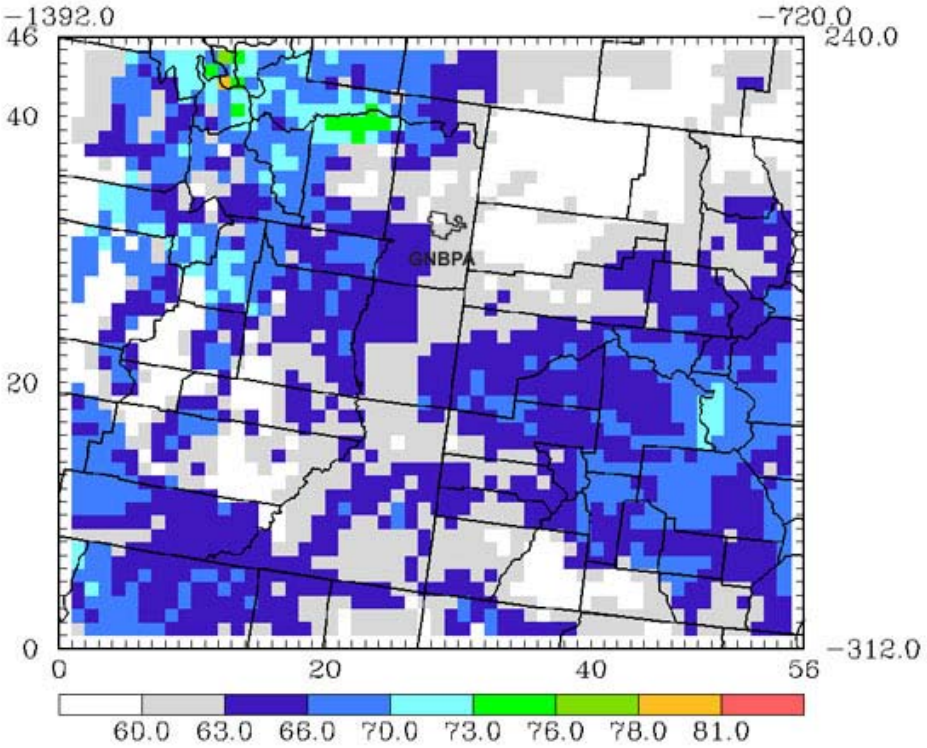



**Figure 5-6 Annual 8-hour Ozone Future Design Values for 2017 Proposed Action**

**2005**




**2006**

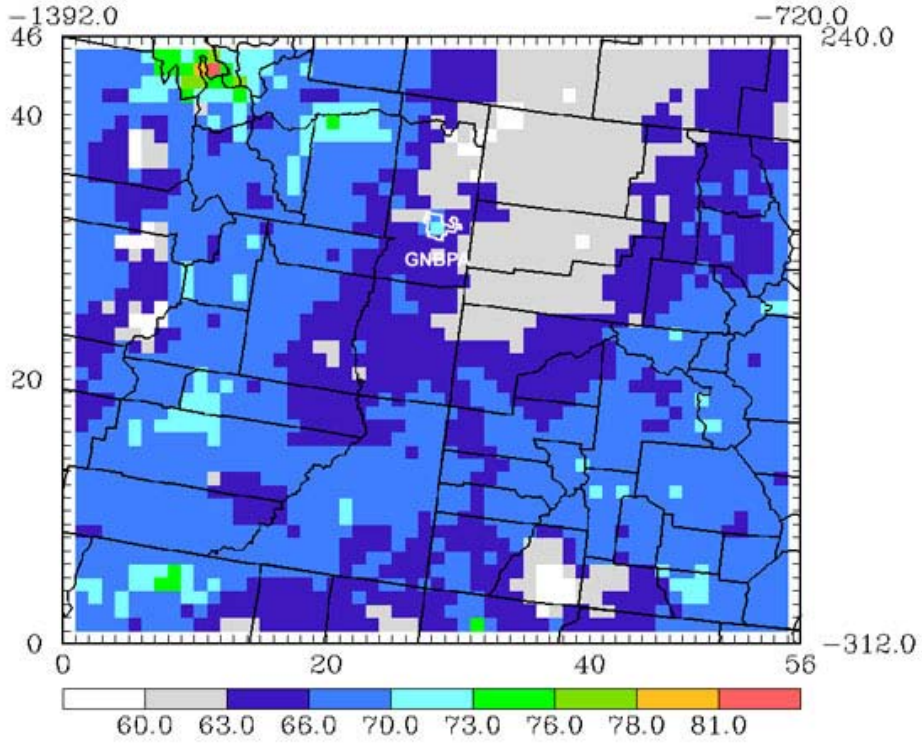
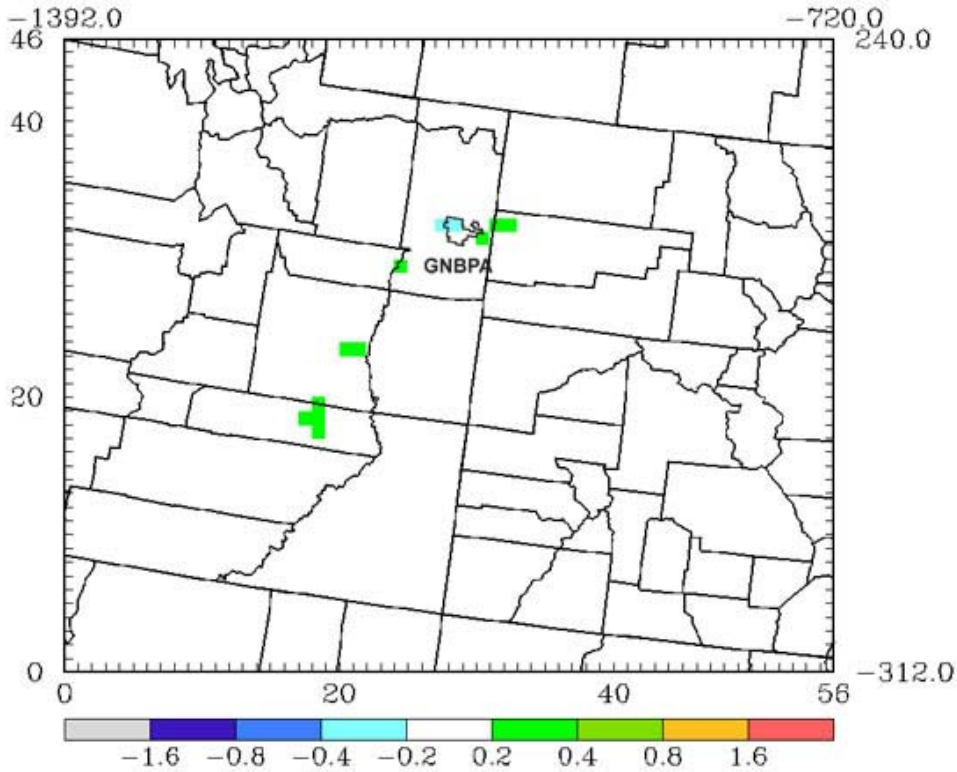



**Figure 5-7 Annual 8-hour Ozone Future Design Values for 2026 Optimal Recovery Alternative**

**2005**




**2006**

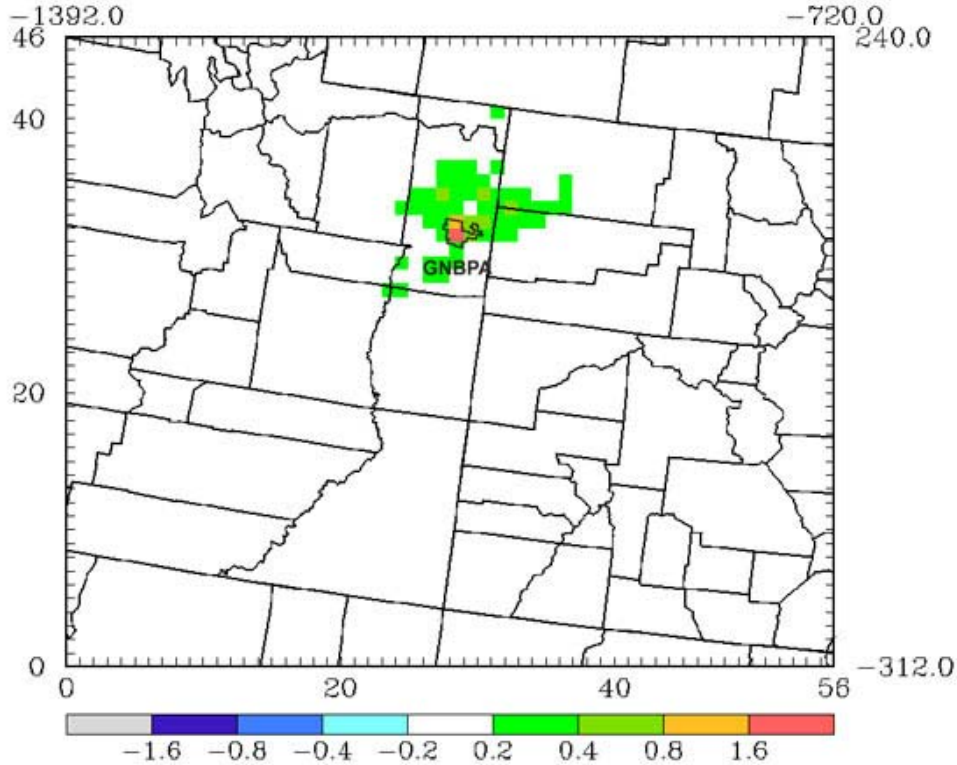
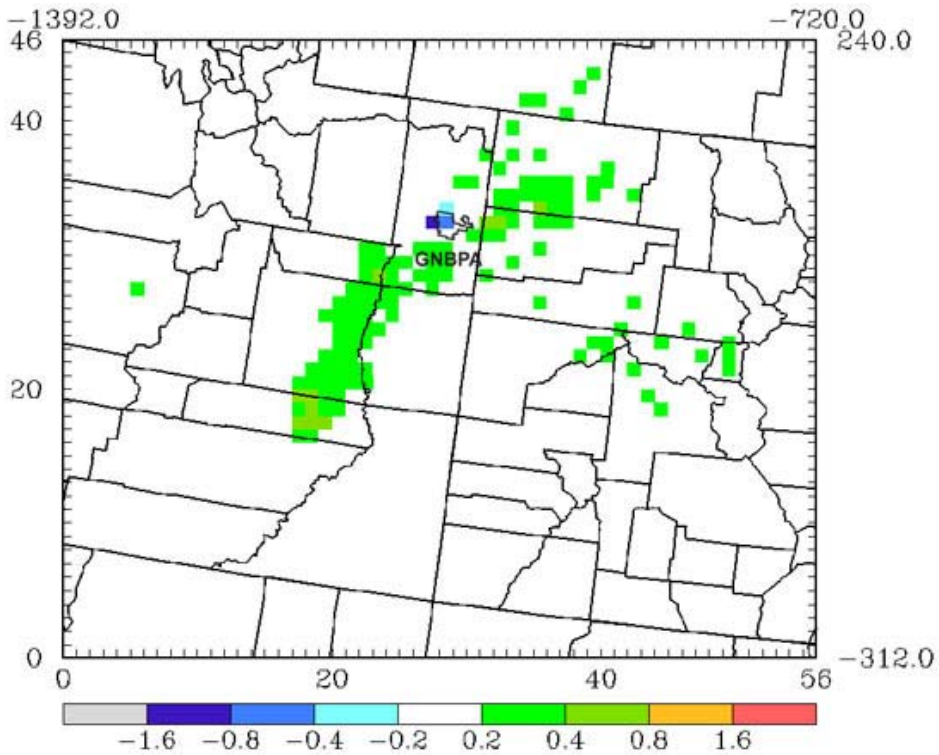



**Figure 5-8 Annual 8-hour Ozone Future Design Value Differences for Proposed Action Minus 2018 Projected Baseline**

**2005**




**2006**

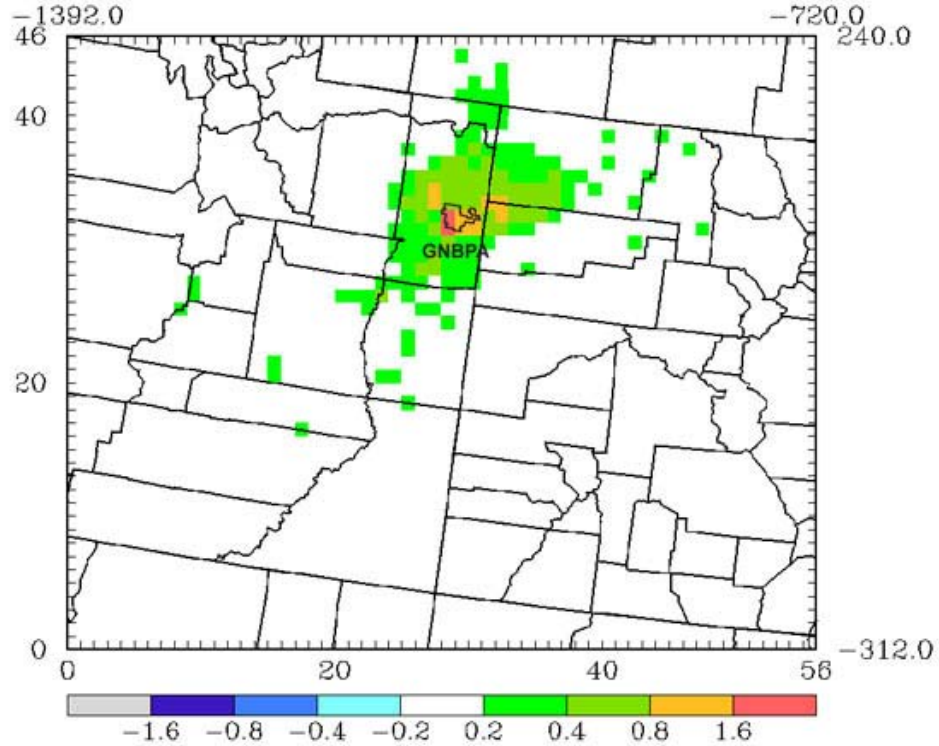
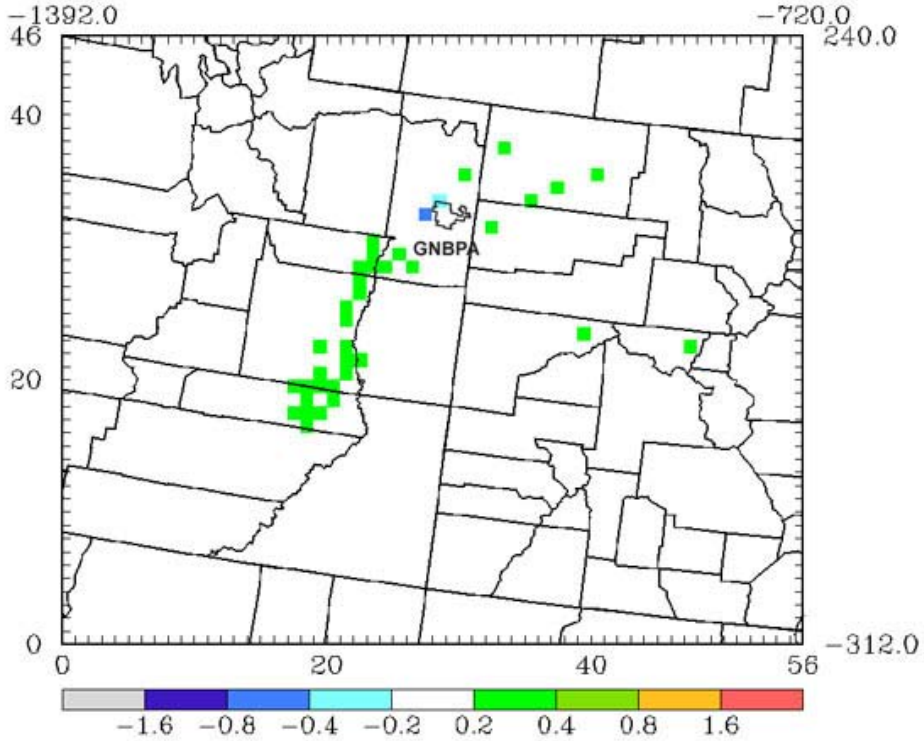



**Figure 5-9 Annual 8-hour Ozone Future Design Value Differences for Optimal Recovery Minus 2018 Projected Baseline**

**2005**




**2006**

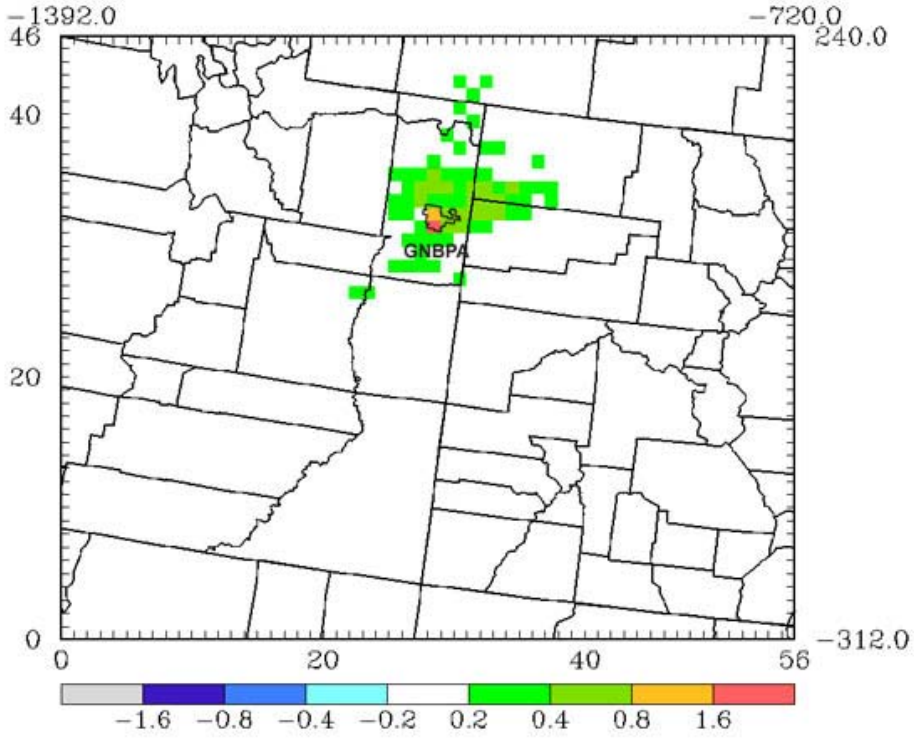



**Figure 5-10 Annual 8-hour Ozone Future Design Value Differences for Optimal Recovery Minus Proposed Action**

### 5.2.5 Ozone Projections Using Absolute Modeling Results

As was stated previously, the USEPA preferred approach for use of photochemical models to assess ozone attainment is to use air quality model results in a relative sense. However, another approach is to use the model in an absolute sense. Again, the lack of observations in the vicinity of the GNBPA make it impossible to assess whether the CMAQ model is able to replicate the ozone levels in the base year and hence reduces the credibility of the model to estimate future ozone concentrations.

The fourth highest annual daily maximum predicted 8-hour ozone concentrations for the 2018 Projected Baseline using the 2005 and 2006 meteorology are presented in **Figure 5-11**. Using the 2005 meteorology, the GNBPA was estimated to have ozone concentrations below 73 ppb and using the 2006 meteorology, the GNBPA was estimated to have ozone concentrations at 75 ppb or less. The model was not simulating a fourth high ozone concentration of above 75 ppb with either year of meteorology in the Uinta Basin counties.

Fourth high ozone concentrations for the 2017 Proposed Action scenario are presented in **Figure 5-12**. The spatial patterns are very similar to the Projected Baseline, with only a few grid cells near the GNBPA showing a difference. The 2026 Optimal Recovery Alternative fourth high ozone concentrations are presented in **Figure 5-13**. The only time the fourth highest ozone concentrations were above 75 ppb is under the Optimal Recovery Alternative at 3 grid square receptors using the 2006 meteorology. For all other cases, the maxima were 75 ppb or less.

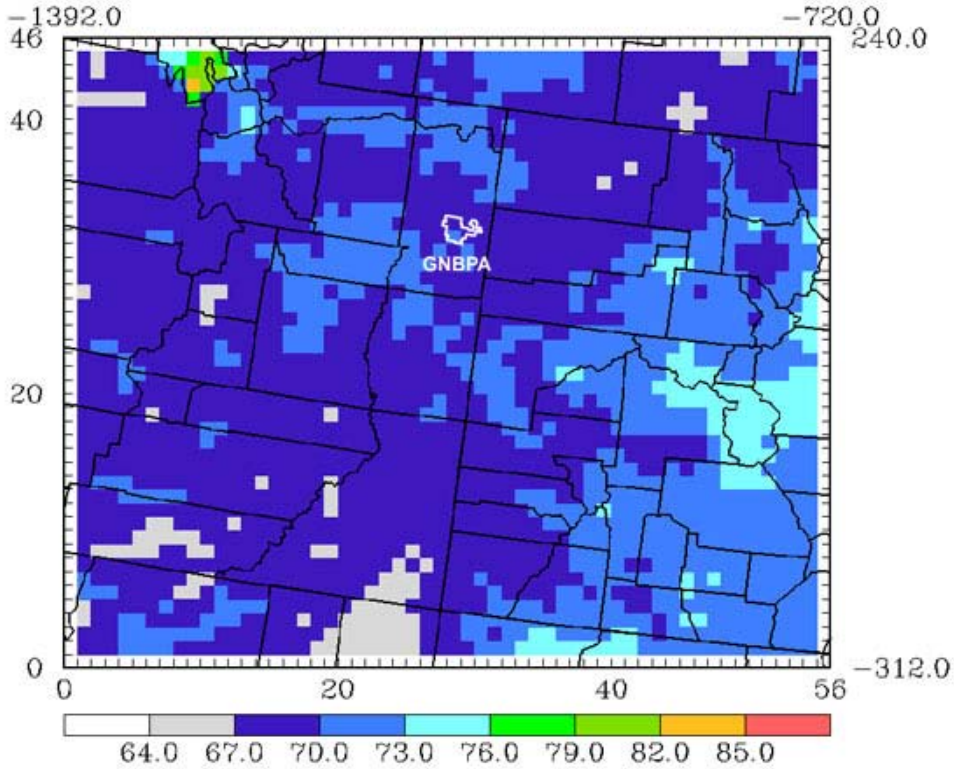
As was performed for the unmonitored area analysis, differences between the alternatives were prepared. **Figure 5-14** presents the differences in the modeled fourth highest ozone levels between the Proposed Action and the Projected Baseline using the 2005 and 2006 meteorological data. For the 2005 meteorology, the maximum ozone increase was 0.6 ppb, with the impact area generally being oriented southwest to northeast. For the 2006 meteorology, the maximum increase was 1.8 ppb. Analogous plots for the Projected Baseline and the Optimal Recovery Alternative are presented in **Figure 5-15**. For the 2005 meteorology, the maximum increase was 1.3 ppb and for the 2006 meteorology, the maximum increase was 3.7 ppb. Finally, differences between the Optimal Recovery Alternative and the Proposed Action are presented in **Figure 5-16**. The maximum differences between the two alternatives using 2005 meteorology was 1.2 ppb, and the maximum difference using 2006 meteorology was 2.6 ppb.

### 5.2.6 Ozone Impact Assessment Summary

The project impacts for the 2018 Projected Baseline, 2017 Proposed Action, and 2026 Optimal Recovery scenarios were examined using both the USEPA recommended relative approach and an absolute approach. Using the relative approach at the monitors, the criteria used by USEPA to show attainment of the NAAQS indicated that all monitors were simulated to be below the 75 ppb NAAQS for all scenarios. The maximum impact at a monitor was 0.4 ppb for the Proposed Action, and 0.8 ppb for the Optimal Recovery Alternative. However, for both cases the maximum impact was at the Dinosaur National Monument monitor, which does not have a sufficiently long data record for it to be used in a formal attainment designation. The maximum impact at an AIRS monitor that could be used for attainment designation was 0.1 ppb for both the Proposed Action and the Optimal Recovery Alternative.

Using the USEPA recommended relative non-monitored area analysis, no areas in the vicinity of the GNBPA were simulated to exceed the 75 ppb ozone standard using either the 2005 or 2006 meteorologies for any of the project alternatives. The maximum fourth highest impact was 2.4 ppb from the Proposed Action scenario and 4.9 ppb from the Optimal Recovery Alternative. For both scenarios, the impacts were occurring in areas simulated to remain below the 75 ppb ozone standard.

**2005**




**2006**

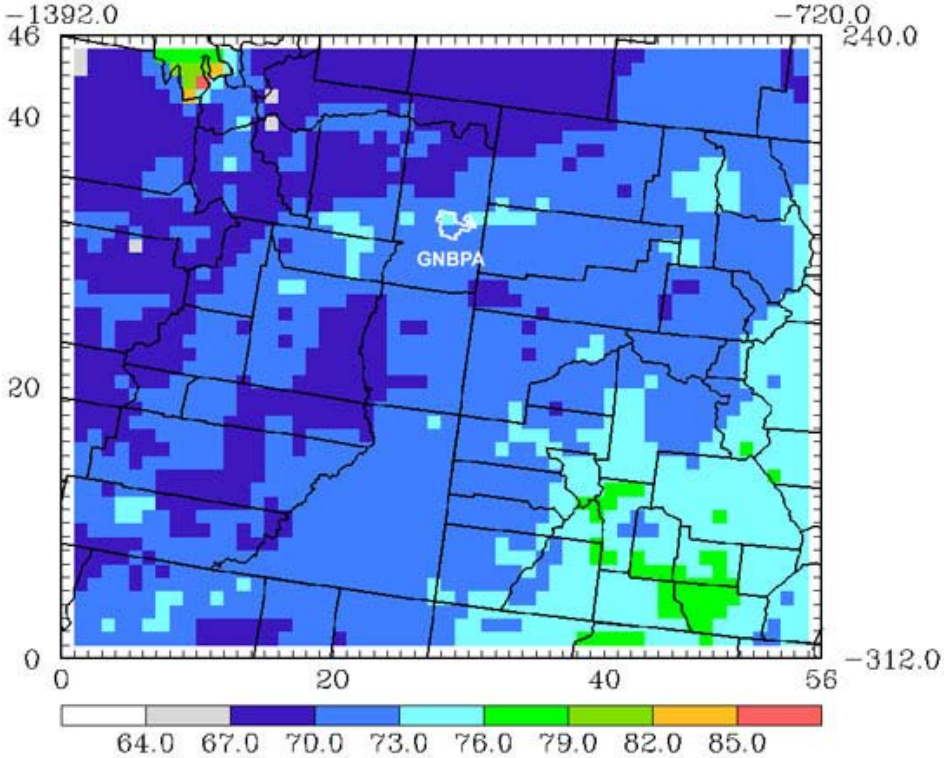
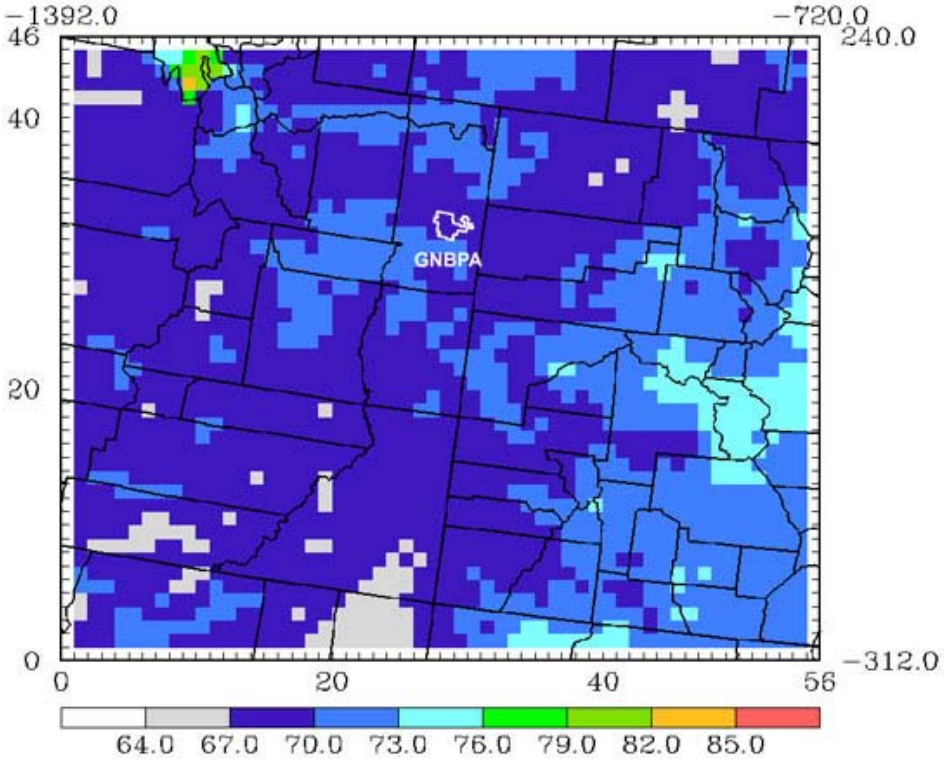



**Figure 5-11 Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for 2018 Projected Baseline**

**2005**




**2006**

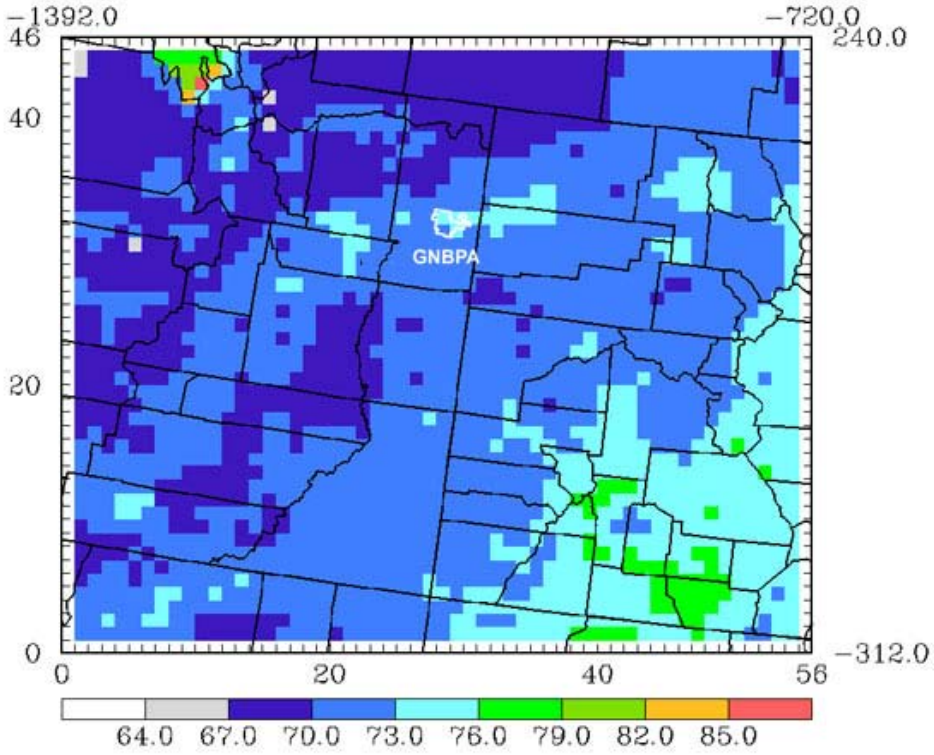
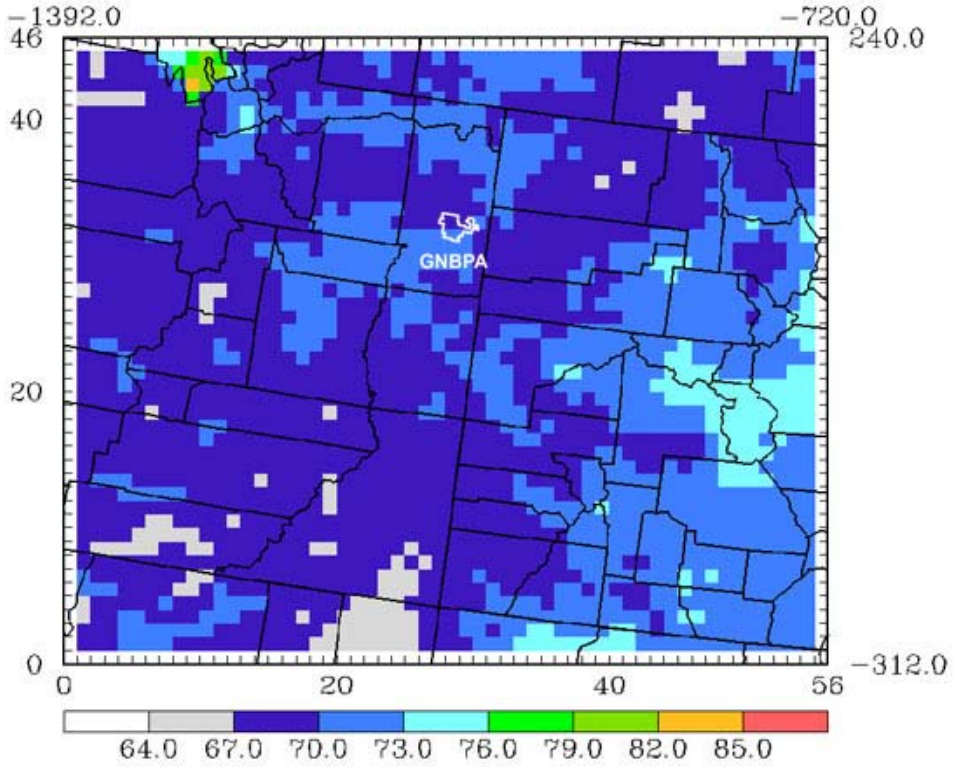



**Figure 5-12 Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for 2017 Proposed Action**

**2005**




**2006**

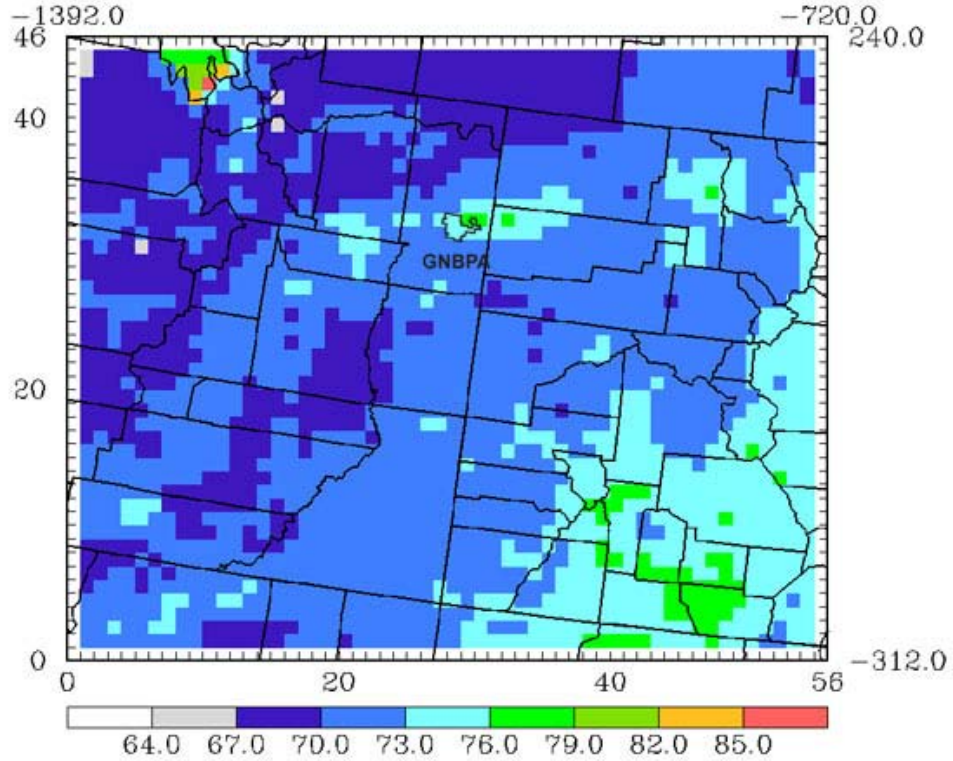
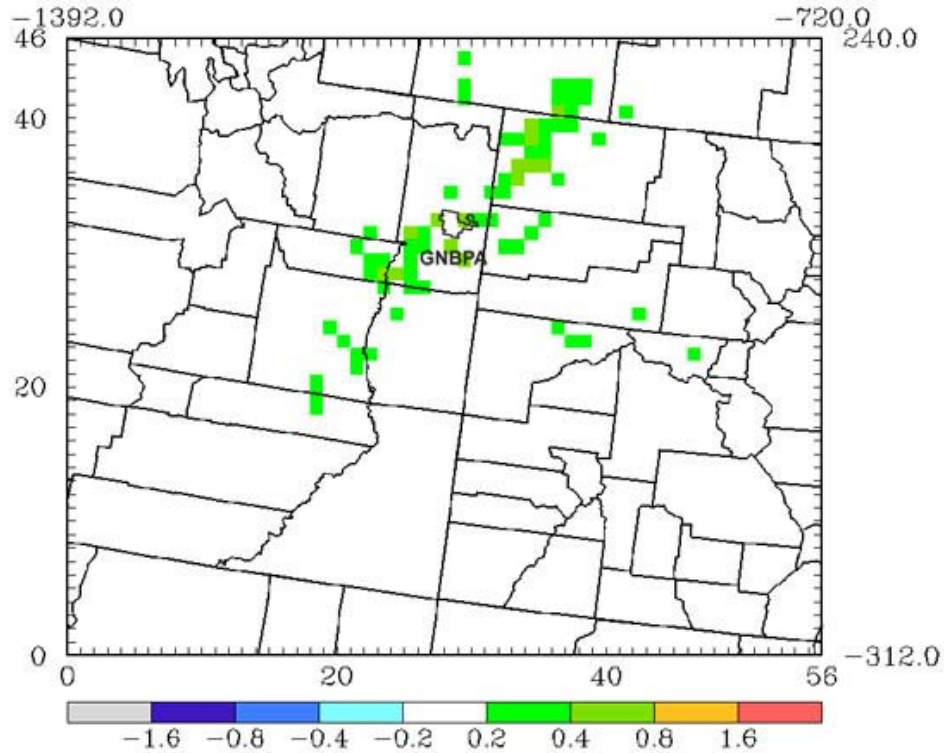



**Figure 5-13 Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for 2026 Optimal Recovery**

**2005**




**2006**

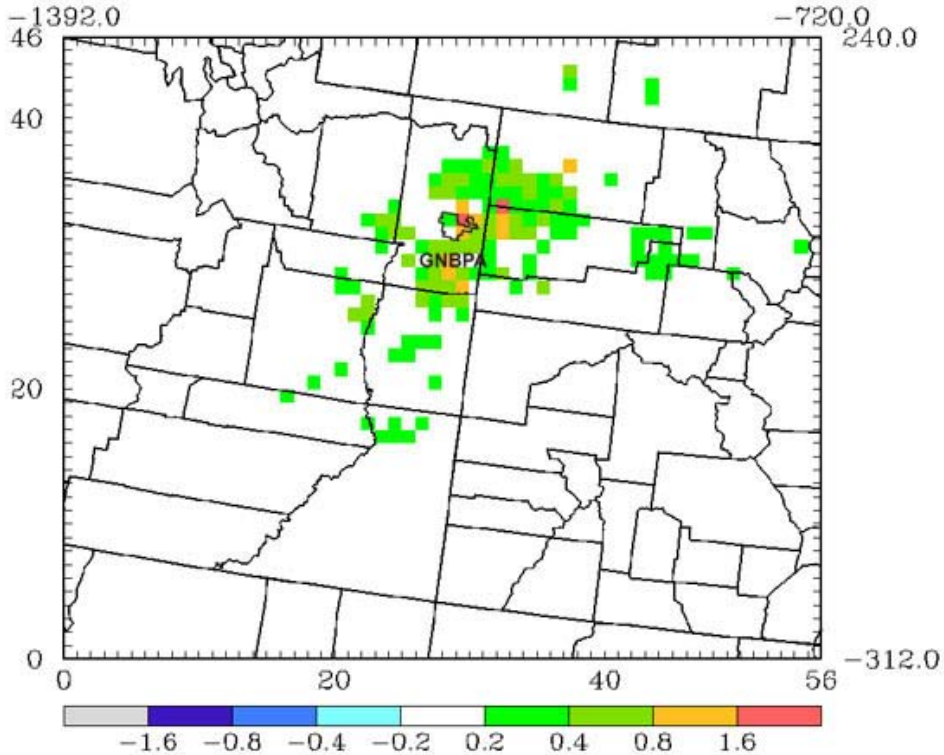
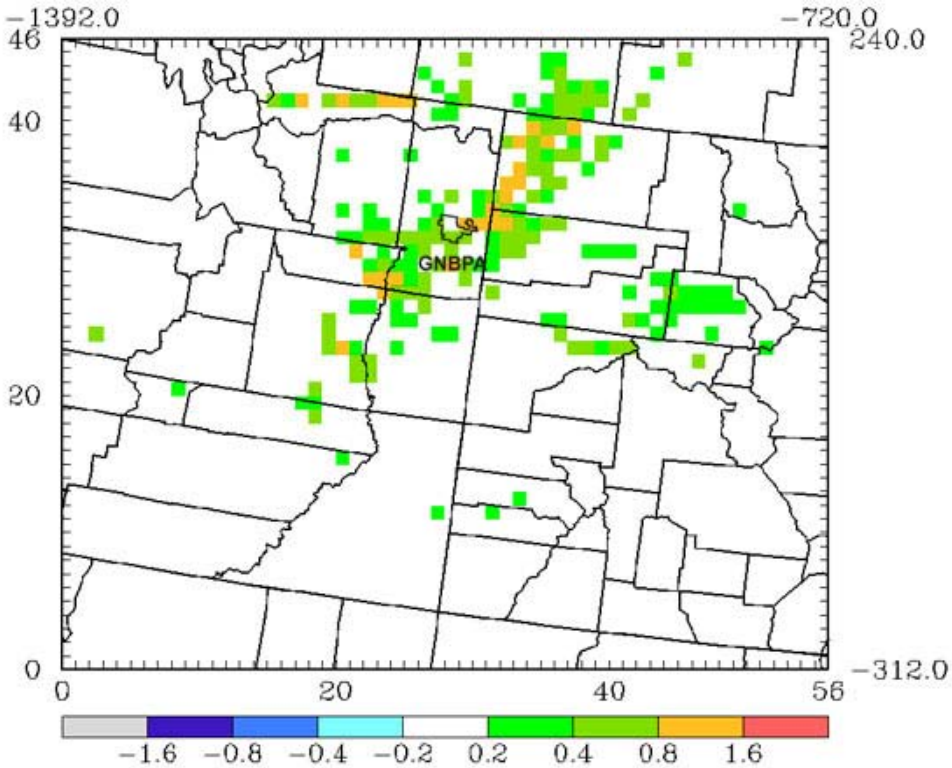



**Figure 5-14 Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Proposed Action Minus 2018 Projected Baseline**

**2005**




**2006**

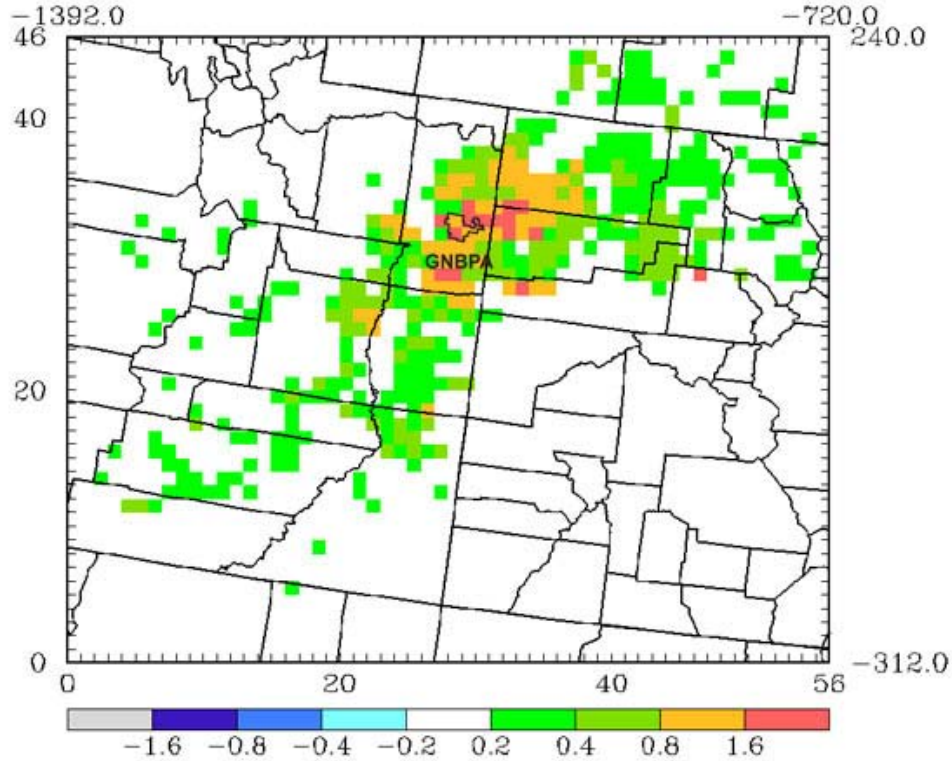
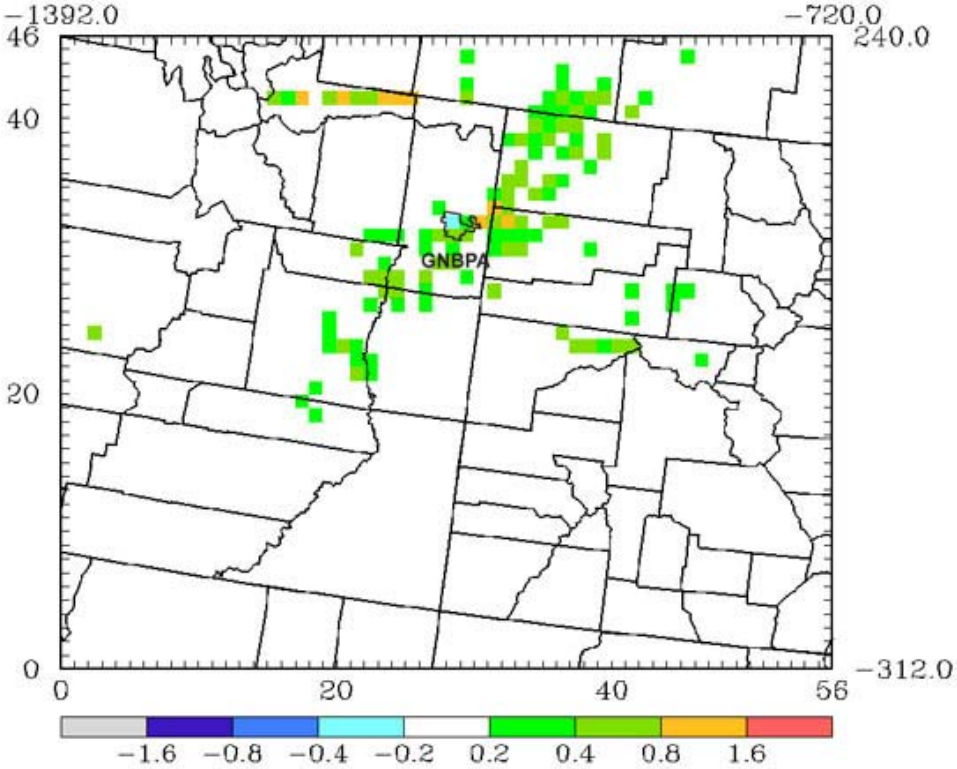



**Figure 5-15 Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Optimal Recovery Minus 2018 Projected Baseline**

**2005**




**2006**

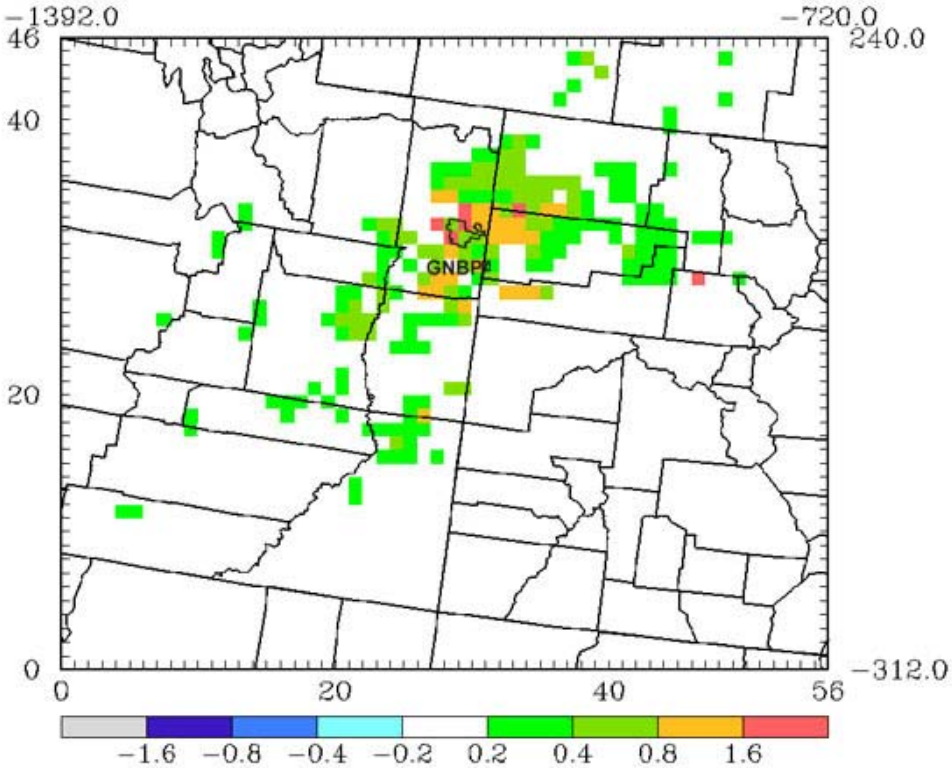



**Figure 5-16 Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Optimal Recovery Minus Proposed Action**

Using the much more uncertain absolute impact approach, the Projected Baseline and Proposed Action scenarios did not show any regions in the GNBPA to be in excess of the 75 ppb standard. For the Optimal Recovery Alternative using 2006 meteorology, 3 grid cells to the east of the GNBPA were simulated to exceed the 75 ppb ozone standard. On an absolute basis, the project emissions were simulated to increase ozone by a maximum of 1.8 ppb for the Proposed Action and 3.7 ppb for the Optimal Recovery Alternative.

## 5.3 AERMOD Impact Assessment for Near-Field Receptors

The near-field impacts from the proposed project were assessed using procedures described in Section 4.3 to quantify air quality impacts related to the density of well pad development and drill rig operations within a hypothetical designated square mile area (e.g., a section/township/range). Near-field impacts were addressed for $NO_2$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$ within the immediate vicinity of these development areas using the 5 years of meteorological data discussed in Section 4.3.3. The AERMOD modeling approach consisted of three phases: 1) single source impact analysis, 2) well pad production analysis, and 3) well drilling analysis.

The AERMOD modeled impacts were compared to the PSD Class II increments because they represent a convenient quantitative measure to evaluate the air quality impacts of the proposed project. In addition to reporting modeled concentrations alone, total impacts were assessed for compliance with the NAAQS and SAAQS by adding the modeled concentrations for the applicable averaging periods to their appropriate counterpart of background air quality data. These totals were compared to the applicable NAAQS for $NO_2$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$. As a conservative approach, the $NO_X$ adjustment option based on the ambient ratio method (40 CFR 51, Appendix W), which assumes a conversion rate of 75 percent, was not used for the $NO_X$ to $NO_2$ conversion rate.

**Tables 5-11** through **5-13** contain the AERMOD maximum modeled concentrations over the 5 meteorological modeled years for $NO_2$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$ for representative source types. The modeled impacts plus the background air quality concentrations were compared to the applicable NAAQS/SAAQS. Background air quality data were obtained as described in Chapter 2.0 for this analysis.

**Table 5-11** provides a summary of maximum modeled impacts of these criteria air pollutants for three separate point source types. **Table 5-12** provides similar summaries for well pad production operations at various well densities, as described in the table. **Table 5-13** provides a summary of annualized and short-term impacts for drilling 5 uniformly spaced wells with drill rigs operating in 1 square mile for a year, as discussed in Section 4.3.1.3. The results in **Tables 5-11** through **5-13** show that total concentrations for all source types for all pollutants are below the applicable NAAQS/SAAQS.

**Table 5-11 AERMOD Near-field Assessment Modeling Result Summary – Single Source Impact Analysis**

| Pollutant Average Time | Maximum Model Concentration by Source (μg/m$^3$) | | | Background Concentration (μg/m$^3$) | Total Concentration by Source (μg/m$^3$) | | | NAAQS (μg/m$^3$) | PSD Increments (μg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|
| | Compressor Station | Drill Rig | Production Well | | Compressor Station | Drill Rig | Production Well | | |
| **$NO_2$[1]** | | | | | | | | | |
| Annual | 2.53 | 0.38 | 1.58 | 13.17 | 15.70 | 13.54 | 14.75 | 100 | 25 |
| **CO** | | | | | | | | | |
| 1-hour | 12.60 | 270.12 | 21.66 | 6,325.00 | 6,337.60 | 6,595.12 | 6,346.66 | 40,000 | -- |
| 8-hour | 6.73 | 178.03 | 16.59 | 3,910.00 | 3,916.73 | 4,088.03 | 3,926.59 | 10,000 | -- |
| **$SO_2$** | | | | | | | | | |
| 3-hour | 0.63 | 0.54 | 0.85 | 18.34 | 18.97 | 18.88 | 19.19 | 1300 | 512 |
| 24-hour | 0.25 | 0.25 | 0.39 | 10.48 | 10.73 | 10.73 | 10.87 | 365 | 91 |
| Annual | 0.02 | 0.0007 | 0.05 | 2.62 | 2.64 | 2.62 | 2.67 | 80 | 20 |
| **$PM_{10}$** | | | | | | | | | |
| 24-hour | 2.87 | 1.11 | 1.93 | 18.00 | 20.87 | 19.11 | 19.93 | 150 | 30 |
| **$PM_{2.5}$** | | | | | | | | | |
| 24-hour | 2.87 | 1.11 | 1.93 | 27.00 | 29.87 | 28.11 | 28.93 | 35 | -- |
| Annual | 0.21 | 0.0036 | 0.34 | 7.00 | 7.21 | 7.00 | 7.34 | 15 | -- |

[1] Does not include a reduction from $NO_X$ to $NO_2$. All $NO_X$ is presumed to be $NO_2$.

**Table 5-12 AERMOD Near-field Modeling Results – Well Pad Production Analysis**

| Pollutant | Averaging Time | Maximum Modeled Concentration (µg/m$^3$) | Background Concentration (µg/m$^3$) | Total Impact (µg/m3) | NAAQS (µg/m$^3$) | PSD Increment (µg/m$^3$) | Distance (m) | Direction (deg) |
|---|---|---|---|---|---|---|---|---|
| **10-Acre Spacing Well Production** | | | | | | | | |
| $NO_2$[1] | Annual | 5.73 | 13.2 | 18.90 | 100 | 25 | 224 | 63 |
| CO | 1-hour | 68.64 | 6,325.0 | 6,393.64 | 40,000 | -- | 806 | 83 |
| | 8-hour | 33.82 | 3,910.0 | 3,943.82 | 10,000 | -- | 800 | 90 |
| $SO_2$ | 3-hour | 1.90 | 18.3 | 20.24 | 1,300 | 512 | 800 | 90 |
| | 24-hour | 0.91 | 10.5 | 11.39 | 365 | 91 | 800 | 90 |
| | Annual | 0.14 | 2.6 | 2.76 | 80 | 20 | 224 | 63 |
| $PM_{10}$ | 24-hour | 4.48 | 18.0 | 22.48 | 150 | 30 | 800 | 90 |
| $PM_{2.5}$ | 24-hour | 4.48 | 27.0 | 31.48 | 35 | -- | 800 | 90 |
| | Annual | 0.98 | 7.0 | 7.98 | 15 | -- | 224 | 63 |
| **20-Acre Spacing Well Production** | | | | | | | | |
| $NO_2$[1] | Annual | 3.59 | 13.2 | 16.76 | 100 | 25 | 158 | 18 |
| CO | 1-hour | 50.81 | 6,325.0 | 6,375.81 | 40,000 | -- | 962 | 118 |
| | 8-hour | 22.85 | 3,910.0 | 3,932.85 | 10,000 | -- | 850 | 90 |
| $SO_2$ | 3-hour | 1.35 | 18.3 | 19.69 | 1,300 | 512 | 850 | 90 |
| | 24-hour | 0.63 | 10.5 | 11.11 | 365 | 91 | 850 | 90 |
| | Annual | 0.08 | 2.6 | 2.70 | 80 | 20 | 711 | 51 |
| $PM_{10}$ | 24-hour | 3.09 | 18.0 | 21.09 | 150 | 30 | 850 | 90 |
| $PM_{2.5}$ | 24-hour | 3.09 | 27.0 | 30.09 | 35 | -- | 850 | 90 |
| | Annual | 0.54 | 7.0 | 7.54 | 15 | -- | 515 | 29 |
| **40-Acre Spacing Well Production** | | | | | | | | |
| $NO_2$[1] | Annual | 3.70 | 13.2 | 16.86 | 100 | 25 | 224 | 333 |
| CO | 1-hour | 39.97 | 6,325.0 | 6,364.97 | 40,000 | -- | 728 | 106 |
| | 8-hour | 19.63 | 3,910.0 | 3,929.63 | 10,000 | -- | 700 | 90 |
| $SO_2$ | 3-hour | 1.06 | 18.3 | 19.40 | 1,300 | 512 | 700 | 90 |
| | 24-hour | 0.52 | 10.5 | 11.00 | 365 | 91 | 700 | 90 |
| | Annual | 0.07 | 2.6 | 2.69 | 80 | 20 | 224 | 333 |
| $PM_{10}$ | 24-hour | 2.80 | 18.0 | 20.80 | 150 | 30 | 700 | 90 |
| $PM_{2.5}$ | 24-hour | 2.80 | 27.0 | 29.80 | 35 | -- | 700 | 90 |
| | Annual | 0.52 | 7.0 | 7.52 | 15 | -- | 224 | 333 |

[1] Does not include a reduction from $NO_X$ to $NO_2$. All $NO_X$ is presumed to be $NO_2$.

**Table 5-13 AERMOD Near-field Modeling Results – Well Drilling Analysis**

| Pollutant | Averaging Time | Maximum Modeled Concentration ($\mu g/m^3$) | Background Concentration ($\mu g/m^3$) | Total Impact (µg/m3) | NAAQS ($\mu g/m^3$) | PSD Increment ($\mu g/m^3$) | Distance (m) | Direction (deg) |
|---|---|---|---|---|---|---|---|---|
| $NO_2$[1] | Annual | 0.49 | 13.2 | 13.66 | 100 | 25 | 640 | 141 |
| CO | 1-hour | 262.99 | 6,325.0 | 6,587.99 | 40,000 | -- | 100 | 180 |
| | 8-hour | 160.53 | 3,910.0 | 4,070.53 | 10,000 | -- | 0 | 360 |
| $SO_2$ | 3-hour | 0.52 | 18.3 | 18.86 | 1,300 | 512 | 0 | 360 |
| | 24-hour | 0.20 | 10.5 | 10.68 | 365 | 91 | 100 | 270 |
| | Annual | 0.0010 | 2.6 | 2.62 | 80 | 20 | 640 | 141 |
| $PM_{10}$ | 24-hour | 0.91 | 18.0 | 18.91 | 150 | 30 | 100 | 270 |
| $PM_{2.5}$ | 24-hour | 0.91 | 27.0 | 27.91 | 35 | -- | 100 | 270 |
| | Annual | 0.0045 | 7.0 | 7.00 | 15 | -- | 640 | 141 |

[1] Does not include a reduction from $NO_X$ to $NO_2$. All $NO_X$ is presumed to be $NO_2$.

# 6.0 Greenhouse Gas Emissions

This chapter compares the potential GHG emissions from the project alternatives being analyzed under NEPA. The methodology described herein calculated the potential GHG emissions based on the activity levels described by KMG; then the projected potential annual GHG emissions increase for the Proposed Action and Optimal Recovery Alternative were compared with those of the No Action Alternative. The Resource Protection Alternative was not considered since its activity level was less than the Proposed Action and presumed to result in less GHG emissions. This analysis does not attempt to predict actual total emissions of GHG from each alternative, but only provides a comparison of relative GHG emissions increases from the Proposed Action and Optimal Recovery Alternative. As such, no estimate of current actual GHG emissions was required or included as part of this analysis.

## 6.1 General Quantification Methods

GHG were estimated using the Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry (API 2004) as implemented using the SANGEA™ software tool published by the API. The SANGEA™ tool is an Excel™ macro that uses the calculation methodologies described in the Compendium to calculate GHG emissions using a series of modules for different source types. These modules determine the emissions of $CO_2$, methane ($CH_4$), and nitrous oxide ($N_2O$) as well as the global warming potential (GWP) in $CO_2$ equivalents ($CO_2e$) based on the comparative GWP of each GHG species. For this analysis, the default GWP coefficients of 21 for $CH_4$ and 310 for $N_2O$ were used. These coefficients were multiplied by the calculated mass emission rate to determine the GWP. The SANGEA™ tool is available from API on request.

## 6.2 Well Count

Many of the calculations were dependent on the number of wells drilled per year and the total estimated number of wells in production in the maximum production year. Wells in production for each scenario assumed the total proposed wells for each scenario minus wells drilled per year as shown in **Table 6-1**.

**Table 6-1 Estimated Number of Wells Drilled and Operating in Maximum Production Year**

| Project Alternative | No Action | Proposed Action | Optimal Recovery |
|---|---|---|---|
| Maximum Production Year | 2012 | 2017 | 2026 |
| Total Wells Proposed (wells) | 1,102 | 3,675 | 13,446 |
| Wells Drilled Per Year (wells/year) | 192 | 336 | 672 |
| Wells Operating in Maximum Production Year (wells) | 910 | 3,339 | 12,774 |

## 6.3 Combustion Sources

Each project alternative included sources of combustion emissions including stationary sources such as compression engines and heaters, as well as mobile sources such as drill rig engines, rig boilers, mobile equipment, and vehicle fleet. GHG emissions were calculated in SANGEA™ for each pollutant based on total fuel consumption by activity. Therefore, potential fuel consumption for each alternative was calculated based on assumptions of VMT, operating hours, fuel consumption rates, load factors, and fuel characteristics. Where appropriate, these data were taken from information provided by KMG and criteria pollutant emission calculations as provided in Section 3.3 through 3.9. A description of each source and a summary of the throughput calculations are discussed in detail in the following sections.

### 6.3.1 Fuels

SANGEA™ has default characteristics for most standard fuels that are used for gasoline and diesel (distillate no. 2) fired sources. Natural gas fired sources would use local fuel gas that can vary significantly from the default settings for pipeline grade natural gas in SANGEA™. Local fuel gas would be provided from two sources, depending on the equipment to be operated. Uinta fuel gas is gas taken from the wells that has only been processed at the well to remove liquids and is used in equipment upstream of the compressors. GNB fuel gas is the gas that has been further treated at the compressor station and is used in midstream sources such as compressor stations and the processing plant. Local fuel specifications were based on analytical data provided by KMG as summarized in **Table 6-2**.

**Table 6-2 Local Fuel Gas Specifications**

| Parameter | | Unit | Uinta Fuel Gas (Upstream) | GNB Fuel Gas (Midstream) |
|---|---|---|---|---|
| Composition | Methane | Volume Fraction | 0.925 | 0.922 |
| | Ethane | Volume Fraction | 0.037 | 0.042 |
| | Propane | Volume Fraction | 0.014 | 0.014 |
| | Butane | Volume Fraction | 0.007 | 0.006 |
| | Pentane+ | Volume Fraction | 0.008 | 0.006 |
| | Hydrogen | Volume Fraction | 0.000 | 0.000 |
| | Hydrogen Sulfide | Volume Fraction | 0.000 | 0.000 |
| | $CO_2$ | Volume Fraction | 0.008 | 0.008 |
| | CO | Volume Fraction | 0.000 | 0.000 |
| | Inerts ($N_2$) | Volume Fraction | 0.001 | 0.002 |
| Density | | lb/scf | 0.0471 | 0.0470 |
| Low Heating Value | | Btu/scf | 985 | 982 |
| High Heating Value | | Btu/scf | 1,094 | 1,091 |
| $CO_2$ Emission Factor | | lb/$10^6$ Btu (HHV) | 118 | 118 |
| VOC Fraction | | Volume Fraction | 0.0287 | 0.0263 |
| VOC Molecular Weight | | lb/lbmol | 54.7 | 54.1 |

### 6.3.2 Stationary Combustion Sources

#### 6.3.2.1 Gas-fired Compression Engines

Gas-fired compression engines were assumed to consume GNB fuel gas based on the compression inventory provided (see **Appendix E**). The proposed compression power was converted to fuel basis using a brake specific fuel consumption (BSFC) of 7,000 Btu/hp-hr and assuming continuous operation. This conversion is summarized in **Equation 6-1**.

**Equation 6-1 Fuel Consumption for Gas-Fired Compression Engines**

$$Fuel\ Consumption\left(MMBtu/yr\right) = Planned\ Compression\ (hp)\ x\ \frac{8760\ hr}{yr}\ x\ \frac{7000\ Btu}{hp-hr}\ x\ \frac{MMBtu}{10^6\ Btu}$$

#### 6.3.2.2 Gas Processing Plant Heaters

Since one gas processing plant would be expanded under the action alternatives, the GHG emissions from this source were considered for all scenarios. This gas plant currently is approved for construction of three

trains regardless of alternative. Based on design data, gas processing will consume 62.4 MMBtu/hr of GNB fuel gas, with an annual fuel consumption of 546,624 MMBtu/yr assuming 8,760 hours of operation.

#### 6.3.2.3 Well Separator Heaters

Heaters would be used at each well in the phase separators that burn Uinta fuel gas from the well during cold months to maintain optimal separator temperatures. Consumption was based on seasonal operation (4,380 hours/year) at 0.5 MMBtu/hr per well or 2,190 MMBtu/yr per well. Maximum fuel consumption was the product of the number of operating wells as shown in **Table 6-3**.

**Table 6-3 Annual Consumption of Uinta Fuel Gas for Separator Heaters per Project Alternative**

| Project Alternative | Operating Wells | Fuel Consumption (MMBtu/yr) |
|---|---|---|
| No Action | 910 | 1,992,900 |
| Proposed Action | 3,339 | 7,312,410 |
| Optimal Recovery | 12,774 | 27,975,060 |

#### 6.3.2.4 Produced Water Injection Facilities

The Proposed Action and Optimal Recovery alternatives would include 650 gas-fired engines that drive pumps to dispose of produced water by deep well injection. For the maximum operating year, it was assumed that two wells would be constructed and the balance would be operating. These engines would be operated at upstream facilities and were assumed to be driven by Uinta fuel gas. Fuel consumption was calculated per **Equation 6-2**. A summary of total annual fuel consumption is provided in **Table 6-4**.

**Equation 6-2 Fuel Consumption for Gas-Fired Water Injection Engines**

$$Fuel\ Consumption = \frac{650\ hp}{facility}\ x\ \frac{7000\ Btu}{hp-hr}\ x\ \frac{MMBtu}{10^6\ Btu}\ x\ \frac{8760\ hr}{yr} = 39{,}858\ MMBtu\ /\ facility-year$$

**Table 6-4 Annual Consumption of Uinta Fuel Gas for Produced Water Injection per Project Alternative**

| Project Alternative | Operating Injection Facilities (wells) | Fuel Consumption (MMBtu/yr) |
|---|---|---|
| No Action | -- | -- |
| Proposed Action | 13 | 518,154 |
| Optimal Recovery | 23 | 916,734 |

### 6.3.3 Mobile Combustion Sources

The project alternatives would include mobile sources from drilling, construction, and production. Emissions from these sources were based on information provided by KMG and an estimate of VMT or mobile equipment operating hours used for criteria pollutant emissions.

#### 6.3.3.1 Drill Rigs

Drill rigs consume diesel fuel both in the engine and the rig boiler. Consumption in the engine was based on a BSFC of 7,000 Btu/hp-hr and a heating value of 137,000 Btu/gal. Each rig was assumed to have 4,000 hp of total power, with a load factor of 42 percent based on 65 percent utilization and a 65 percent average engine load (Pfleider 1972). Determination of diesel consumption based on this factor is shown in **Equation 6-3**. Each

rig would operate a 2.8 MMBtu/hr rig boiler to provide heat and steam during the winter months. Each boiler would operate a maximum of 4,380 hours per year. Diesel fuel consumption for rig boilers was determined as shown in **Equation 6-4**. **Table 6-5** summarizes the diesel fuel use for each project alternative.

**Equation 6-3 Diesel Fuel Consumption for Drill Rig Engines**

$$Fuel\ Consumption = \frac{4000\ hp}{drill\ rig}\ x\ \frac{7000\ Btu}{hp-hr}\ x\ \frac{15\ days}{wells}\ x\ \frac{24\ hr}{day}\ x\ \frac{gal}{137{,}000\ Btu}\ x\ 0.42\ load = 30{,}902\ gal/well$$

**Equation 6-4 Diesel Fuel Consumption for Rig Boiler**

$$Fuel\ Consumption = \frac{2.8\ MMBtu}{hr}\ x\ \frac{10^6\ Btu}{MMBtu}\ x\ \frac{gal}{137{,}000\ Btu}\ x\ \frac{4380\ hr}{yr} = 89{,}518\ gal/rig-yr$$

**Table 6-5 Annual Consumption of Diesel Fuel for Drill Rig Engines and Boilers**

| | Drill Rig Engines | | Rig Boilers | |
|---|---|---|---|---|
| **Project Alternative** | **Wells Drilled (wells/year)** | **Fuel Consumption (gallons/year)** | **Rig Count (rigs)** | **Fuel Consumption (gallons/year)** |
| No Action | 192 | 5,933,220 | 8 | 716,146 |
| Proposed Action | 336 | 10,383,136 | 14 | 1,253,255 |
| Optimal Recovery | 672 | 20,766,272 | 28 | 2,506,511 |

#### 6.3.3.2 Construction and Drilling Equipment

Heavy mobile equipment is used to construct well pads, water injection facilities, and linear facilities such as roads and pipelines. Additionally, mobile equipment is used during well drilling. Emissions of GHG result from the combustion of diesel fuel in these engines. Diesel fuel use in gallons was estimated from mobile equipment operation from an assumed engine operation in hp-hr/day using an estimate of vehicle size and operation duration for each activity. These assumptions are identical to those used for criteria pollutant assumptions in Chapter 3.0. Engine operation (in hp-hr/day) is the product of the number of each piece of required equipment, engine size per piece, and operating hours per day for each type of facility. Each facility total operation also includes an operating load factor of 42 percent (Pfleider 1972) to account for periods of non-continuous operation and less than peak load. **Tables 6-6**, **6-7**, and **6-8** summarize the load adjusted engine operation (in hp-hr/day) for the various types of construction activity considered under each alternative. As shown in Equation 6-5, annual diesel fuel use per unit constructed was estimated by converting engine operation (in hp-hr/day) to gallons using a BSFC of 7,000 Btu/hp-hr, a fuel heating value of 137,000 Btu/gal, and an estimate of construction duration. The diesel fuel consumption factor per activity is summarized in **Table 6-9**. Total annual diesel fuel consumption for each alternative is summarized in **Table 6 10**.

**Table 6-6 Load Adjusted Engine Operation for Well Pad Construction**

| Equipment | Duration (hours/day) | Engine Size (hp) | Number of Equipment Required | Operation (hp-hr/day) |
|---|---|---|---|---|
| Dozer | 12 | 300 | 2 | 7,200 |
| Grader | 12 | 300 | 1 | 3,600 |
| Water Truck | 12 | 210 | 1 | 2,520 |
| Dump Truck | 12 | 330 | 2 | 7,920 |
| | | | Total | 21,240 |
| | | | Load Factor | 0.42 |
| | | | **Load Adjusted[1]** | **8,921** |

[1] Per single well pad

**Table 6-7 Load Adjusted Engine Operation for Construction of Mancamps, Injection Facilities, and Linear Facilities**

| Equipment | Duration (hours/day) | Engine Size (hp) | Number of Equipment Required | Operation (hp-hr/day) |
|---|---|---|---|---|
| Loader | 8 | 200 | 1 | 1,600 |
| Dozer | 11 | 300 | 1 | 3,300 |
| Scraper | 11 | 600 | 2 | 13,200 |
| Grader | 12 | 300 | 1 | 3,600 |
| Backhoe | 8 | 100 | 1 | 800 |
| Roller | 10 | 200 | 1 | 2,000 |
| Water Truck | 12 | 210 | 1 | 2,520 |
| Dump Truck | 6 | 330 | 1 | 1,980 |
| | | | Total | 29,000 |
| | | | Load Factor | 0.42 |
| | | | **Load Adjusted[1]** | **12,180** |

[1] Per facility or mile of linear facility

**Table 6-8 Load Adjusted Engine Operation for Well Drilling**

| Equipment | Duration (hours/day) | Engine Size (hp) | Number of Equipment Required | Operation (hp-hr/day) |
|---|---|---|---|---|
| Backhoe | 4 | 100 | 1 | 400 |
| Cement/CSG Trucks | 12 | 200 | 6 | 14,400 |
| Water Truck | 12 | 210 | 3 | 7,560 |
| Dump Truck | 12 | 330 | 2 | 7,920 |
| | | | Total | 30,280 |
| | | | Load Factor | 0.42 |
| | | | **Load Adjusted[1]** | **12,718** |

[1] Per well drilled

**Equation 6-5 Diesel Fuel Consumption per Unit Constructed**

$$Fuel\ Consumption(gal/\ facility\ [mile]) = Operation(hp-hr/day)\ x\ Duration(days/\ facility\ [mile])\ x\ \frac{7000\ Btu}{hp-hr}\ x\ \frac{gal}{137{,}000\ Btu}$$

**Table 6-9 Diesel Fuel Consumption Factor for Mobile Equipment by Activity**

| Activity | Load Adjusted Operation (hp-hour/day) | Construction Duration (days) | Fuel Consumption Factor (gallons) |
|---|---|---|---|
| Single Well Pad (per pad) | 8,921 | 12.5 | 5,697.7 |
| Mancamps (per camp) | 12,180 | 25 | 15,558.4 |
| Injection Wells (per well) | 12,180 | 1 | 622.3 |
| Linear Facilities (per mile) | 12,180 | 3 | 1,867.0 |
| Well Drilling (per well) | 12,718 | 15 | 9,747.4 |

**Table 6-10 Annual Diesel Fuel Consumption for Mobile Equipment by Alternative and Activity**

| | Annual Activity By Alternative | | | | Annual Fuel Consumption By Alternative (gallons/year) | | |
|---|---|---|---|---|---|---|---|
| **Activity** | **No Action** | **Proposed Action** | **Optimal Recovery** | **Unit** | **No Action** | **Proposed Action** | **Optimal Recovery** |
| Single Well Pad | 192 | 336 | 672 | pads | 1,093,962 | 1,914,434 | 3,828,867 |
| Mancamps | 1 | 1 | 1 | camps | 15,558 | 15,558 | 15,558 |
| Injection Wells | -- | 2 | 2 | wells | -- | 1,245 | 1,245 |
| Linear Facilities | 50.75 | 199 | 232.1 | miles | 94,751 | 371,534 | 433,332 |
| **Construction Subtotal** | | | | | **1,204,271** | **2,301,526** | **4,279,002** |
| **Well Drilling** | **192** | **336** | **672** | **wells** | **1,871,495** | **3,275,117** | **6,550,234** |

### 6.3.3.3 Heavy Truck Traffic

GHG emissions from heavy truck traffic include the fuel consumed from hauling equipment and material to and from construction sites. Heavy truck traffic was estimated for each activity type (drilling, construction, and production) based on the estimate of VMT per well or unit of construction per the criteria pollutant emission calculations in Chapter 3.0. Diesel fuel use for each usage type was determined using the API Compendium fuel efficiency of 7 miles per gallon (mpg) for heavy diesel powered trucks (Table 4-10, API 2004) to develop a normalized fuel consumption factor in gallons per unit of construction. **Table 6-11** summarizes the diesel fuel consumption for each activity while **Table 6-12** summarizes annual fuel use for each alternative by activity.

**Table 6-11 Diesel Fuel Consumption Factor by Activity**

| Activity | Miles Traveled per Activity (VMT) | Fuel Consumption Factor (gallons) |
|---|---|---|
| Single Well Pad (per well) | 102.5 | 14.6 |
| Mancamps (per camp) | 2,640 | 377.1 |
| Injection Wells (per well) | 2,640 | 377.1 |
| Linear Facilities (per mile) | 2,640 | 377.1 |
| Drilling and Completion (per well) | 7,546 | 1,078 |
| Production (per well) | 1,022 | 146 |

**Table 6-12 Annual Diesel Fuel Consumption for Heavy Truck Traffic by Alternative and Activity**

| Activity | Annual Activity By Alternative | | | | Annual Fuel Consumption By Alternative (gallons/year) | | |
|---|---|---|---|---|---|---|---|
| | No Action | Proposed Action | Optimal Recovery | Unit | No Action | Proposed Action | Optimal Recovery |
| Single Well Pad | 192 | 336 | 672 | pads | 2,811 | 4,920 | 9,840 |
| Mancamps | 1 | 1 | 1 | camps | 377 | 377 | 377 |
| Injection Wells | -- | 2 | 2 | wells | -- | 754 | 754 |
| Linear Facilities | 50.75 | 199 | 232.1 | miles | 19,140 | 75,051 | 87,535 |
| **Construction Subtotal** | | | | | **22,329** | **81,103** | **95,506** |
| **Drilling and Completion** | **192** | **336** | **672** | **wells** | **206,976** | **362,208** | **724,416** |
| **Production** | **910** | **3,339** | **12,774** | **wells** | **132,860** | **487,494** | **1,865,004** |

### 6.3.3.4 Light Duty Vehicle Traffic

Light duty truck traffic for drilling and construction was based on the estimate of VMT per well or unit of construction from criteria pollutant calculations in Chapter 3.0. Data provided by KMG indicated that its light duty fleet traveled 4,323,405 miles in 2006 while servicing 1,083 wells that year for an average of 3,992.1 VMT/well. Gasoline consumption for each usage type was determined using the fuel efficiency of 14 mpg for gasoline powered trucks (Table 4-10, API 2004) to develop a normalized fuel consumption factor in gallons per unit of construction. **Table 6-13** summarizes the gasoline consumption for each activity while **Table 6-14** summarizes annual use for each alternative by activity.

**Table 6-13 Gasoline Consumption Factor by Activity**

| Activity | Miles Traveled per Activity (VMT) | Fuel Consumption Factor (gallons) |
|---|---|---|
| Single Well Pad (per well) | 410 | 29.3 |
| Mancamps (per camp) | 1,760 | 125.7 |
| Injection Wells (per well) | 1,760 | 125.7 |
| Linear Facilities (per mile) | 11 | 0.8 |
| Drilling and Completion (per well) | 10,890 | 777.9 |
| Production (per well) | 3,992.1 | 285.1 |

**Table 6-14 Annual Gasoline Consumption for Light Duty Vehicle Traffic by Alternative and Activity**

| Activity | Annual Activity By Alternative | | | | Annual Fuel Consumption By Alternative (gallons/year) | | |
|---|---|---|---|---|---|---|---|
| | No Action | Proposed Action | Optimal Recovery | Unit | No Action | Proposed Action | Optimal Recovery |
| Single Well Pad | 192 | 336 | 672 | pads | 5,623 | 9,840 | 19,680 |
| Mancamps | 1 | 1 | 1 | camps | 126 | 126 | 126 |
| Injection Wells | -- | 2 | 2 | wells | -- | 251 | 251 |
| Linear Facilities | 50.75 | 199 | 232.1 | miles | 40 | 156 | 182 |
| **Construction Subtotal** | | | | | **5,788** | **10,373** | **20,240** |
| **Drilling and Completion** | **192** | **336** | **672** | **wells** | **149,349** | **261,360** | **522,720** |
| **Production** | **910** | **3,339** | **12,774** | **Wells** | **259,484** | **952,107** | **4,383,109** |

## 6.4 Flaring

Data provided by KMG indicated flaring of 620,000 scf (620 Mscf) at the Bridge compressor station for a 3-month period during 2006. In 2006, the GNBPA produced 74,606 MMscf of gas. The volume of gas flared was assumed to be linearly proportional to the gas produced, with additional flares installed as necessary to accommodate requirements. **Equation 6-5** derives a flaring rate based on annual field production. **Table 6-15** summarizes the quantity of gas flared by project alternative during peak production.

**Equation 6-5 Estimation of Gas Flared**

$$Flaring = \frac{620\ Mscf\ \ flared}{3\ months}\ x\ \frac{year}{74{,}606\ MMscf\ produced}\ x\ \frac{12\ months}{year} = 0.033\ Mscf\ \ flared\ /\ MMscf\ \ produced$$

**Table 6-15 Gas Flaring by Alternative**

| Alternative | Peak Field Production (MMscf/year) | Gas Flared (Mscf/year) |
|---|---|---|
| No Action | 101,300 | 3,367 |
| Proposed Action | 318,900 | 10,601 |
| Optimal Recovery | 616.700 | 20,500 |

## 6.5 Flashing Emissions

Each project alternative would include the handling of condensate and produced water under pressures greater than atmospheric. When these material streams are allowed to return to atmospheric pressure, $CH_4$, held in liquid form by high pressure, returns to gas and is emitted to the atmosphere. The emissions from this process, known as flashing, were based on the physical properties of liquid. The SANGEA™ flashing module implements the Vasquez-Beggs equation for flashing emissions, which uses temperature, pressure, $CH_4$ content, specific gravity, and API gravity to estimate $CH_4$ emissions. In the absence of physical data on the liquid stream, emissions factors from the Compendium were used (API 2004).

### 6.5.1 Condensate Flashing

Since the physical data was available for condensate, the SANGEA™ flashing module was used to calculate $CH_4$ emissions from condensate flashing. A summary of condensate physical data as provided by KMG is provided in **Table 6-16**. Similar to VOC flashing emissions, new wells were assumed to produce 10 bbl/day of condensate, while old wells (1 year or older) produce an average of 3 bbl/day. This analysis assumed 1 year of drilling new wells and the balance of total wells to be old wells. **Table 6-17** provides a summary of maximum condensate throughput for each alternative.

**Table 6-16 Summary of Condensate Physical Characteristics**

| Parameter | Value |
|---|---|
| Specific Gravity of Flash Gas at 60°F | 1.22 |
| API Gravity of Oil at 60°F | 61.28 |
| Oil Temperature (°F) | 78 |
| Oil Pressure (psig) | 90 |
| Fraction of $CH_4$ in Flash Gas (Volume Fraction) | 0.496 |

Source: see **Appendix B**.

**Table 6-17 Maximum Condensate Production by Alternative**

| Alternative | Number of Operating Wells | | Condensate Production (bbl/year) |
|---|---|---|---|
| No Action | New | 192 | 700,800 |
| | Old | 910 | 996,450 |
| | Total | 1,102 | 1,697,250 |
| Proposed Action | New | 336 | 1,226,400 |
| | Old | 3,339 | 3,656,205 |
| | Total | 3,675 | 4,882,605 |
| Optimal Recovery | New | 672 | 2,452,800 |
| | Old | 12,774 | 13,987,530 |
| | Total | 13,446 | 16,440,330 |

### 6.5.2 Water Flashing

The Compendium provides emission factors for produced water tank flashing emissions for various separator pressures and produced water salt contents (Table 5-8, API 2004). This factor was used in lieu of the flashing module since the necessary physical properties of the produced water were unknown. The emission factor using an average salt content and a separator pressure of 250 psi is 0.0142 tonnes $CH_4$/1,000 bbl of produced water (kg/bbl), and this value was used as a conservative estimate. This factor will tend to overestimate methane emissions since it is based on higher separator pressure than measured in the separator. Base on data provided by KMG, total produced water was assumed to be 90 bbl/MMscf of gas produced. **Table 6-18** summarizes the estimates of produced water for water flashing emissions.

**Table 6-18 Produced Water by Alternative**

| Alternative | Peak Gas Production (MMscf/year) | Maximum Produced Water (bbl/year) |
|---|---|---|
| No Action | 101,300 | 9,117,000 |
| Proposed Action | 318,900 | 28,701,000 |
| Optimal Recovery | 616,700 | 55,503,000 |

## 6.6 Fugitive Emissions

Fugitive emissions include losses of $CH_4$ from production, processing, and transmission, which were based on either facility counts or production throughput. The fugitive emissions module in SANGEA™ uses emission factors from the API Compendium based on default $CH_4$ content of each process stream. For gas processing, the Chapita plant was designed to handle 750 MMscf/day using 3 trains for each action alternative, which is equivalent to a maximum throughput of 273,750 MMscf/year. However, this analysis assumes that the gas processing plant will only process the field maximum production as part of the No Action Alternative since this is less than the maximum throughput. The total field production for the remaining alternatives exceeds the maximum capacity of the gas plant, so the plant capacity was used. Additional $CH_4$ emissions from gathering lines and compression were based on amount of new lines and the number of new stations over existing conditions. **Table 6-19** summarizes the emission factors and inputs for all alternatives.

**Table 6-19 Emissions Factors and Operating Parameters for Estimating Fugitive $CH_4$ Emissions**

| Source | $CH_4$ Emission Factor | | Operating Parameter | Alternative | | |
|---|---|---|---|---|---|---|
| | | | | No Action | Proposed Action | Optimal Recovery |
| Onshore Gas Production | 0.026 | Mg/MMscf | MMscf/yr | 101,300 | 318,900 | 616,700 |
| Gathering Pipeline Leaks | 0.03 | Mg/mile | miles | 276 | 1,036 | 1,036 |
| Gas Processing Plants | 0.02 | Mg/MMscf | MMscf/yr | 101,300 | 273,750 | 273,750 |
| Compressor Stations | 5.12 | Mg/station | new station | 6 | 8 | 8 |

## 6.7 Indirect Emissions

Indirect GHG emissions include additional emissions that would occur upstream of the project as a result of the increased activity from the proposed alternatives. In this case, additional annual electricity use in all project alternatives and the gas plant would increase significantly due to the installation of electric compression engines. Compression at the gas plant is the same for all project alternatives. Total annual electricity consumption was based on additional electric compression using **Equation 6-6**. Emission factors for GHG from electricity production vary by region since the means of power production and fuel characteristics vary by region. GHG emissions for electricity consumption for this analysis were based on the factors provided in SANGEA™ for Utah-produced electrical power. The emissions factors are provided in **Table 6-20**, and a summary of estimated additional electricity consumption is provided in **Table 6-21**.

**Equation 6-6 Estimation of Annual Electricity Consumption for Added Electric Compression**

$$Electricy\ Consumption\ (GWh/yr) = Added\ Compression\ (hp)\ x\ \frac{0.7457\ kW}{hp}\ x\ \frac{GW}{10^6\ kW}\ x\ \frac{8{,}760\ hours}{year}$$

**Table 6-20 GHG Emissions Factors for Imported Utah-based Electric Consumption**

| Pollutant | Emission Factor (Mg/GWh) |
|---|---|
| $CO_2$ | 877.2 |
| $CH_4$ | 0.0061 |
| $N_2O$ | 0.014 |
| **Operating Parameters** | |
| Line Losses | 8% |
| Efficiency | 37.54% |

**Table 6-21 Summary of Estimated Electricity Consumption for Added Electric Compression**

| Alternative or Activity | Added Electric Compression (hp) | Estimated Annual Electricity Consumption (GWh/yr) |
|---|---|---|
| No Action | 67,550 | 441 |
| Proposed Action | 97,550 | 637 |
| Optimal Recovery | 196,300 | 1,282 |
| Gas Processing Plant | 91,550 | 598 |

## 6.8 Venting

### 6.8.1 Pneumatics

Based on pump inventory data provided by KMG, there are two pneumatic devices per operating well. No significant change in the pneumatics at midstream operations is anticipated. All pneumatics were considered to be "low-bleed" with a natural gas release rate of 3 scf/day, resulting in a calculated emission factor of 47.7 lb $CH_4$/device-year as shown in **Equation 6-7**. Emissions of $CO_2$ and $N_2O$ from gas-driven pneumatics are considered negligible. **Table 6-22** includes a summary of pneumatic counts by project alternative used for GHG estimation.

**Equation 6-7 Low Bleed Pneumatic $CH_4$ Emission Factor**

$$EF = \frac{3\ scf}{device - day}\ x\ \frac{0.047\ lb\ gas}{scf}\ x\ \frac{0.925\ lb\ CH_4}{lb\ gas}\ x\ \frac{365\ day}{year} = 47.7\ lb\ CH_4 / device - yr$$

**Table 6-22 Summary of Venting Parameters for GHG Emissions Calculations**

| Source | Operating Parameter | Alternative | | |
|---|---|---|---|---|
| | | No Action | Proposed Action | Optimal Recovery |
| Pneumatics | devices | 1,820 | 6,678 | 25,548 |
| Workovers | workovers | 107 | 389 | 1,507 |
| Completions | completions | 192 | 336 | 672 |

### 6.8.2 Workovers

GHG emissions in $CH_4$ from workovers were calculated based on the default Compendium factor of 4.6995 x 10-2 Mg $CH_4$/workover (API 2004). Based on data provided by KMG, there would be 1 workover per 8.5 operating wells. The number of workovers by project alternative considered for GHG estimation is provided in **Table 6-22**.

### 6.8.3 Completions

Additional GHG are emitted during fracturing and completion of a well. Review of KMG completion procedures indicated that 1.5 MMscf of gas is released per day of completion, with 95 percent captured or controlled. Using a gas analysis of $CH_4$ and $CO_2$ (see **Appendix B**), an estimate of GHG per completion of 8.2 tons $CH_4$/completion and 0.07 tons $CO_2$/completion is derived as shown in **Equations 6-8** and **6-9**. The number of completions is equal to the number of wells drilled as shown in **Table 6-22**.

**Equation 6-8 $CH_4$ Emissions from Well Completions**

$$EF = \frac{1.5\ MMscf}{day}\ x\ \frac{10^6\ scf}{MMscf}\ x\ \frac{0.047\ lb\ gas}{scf}\ x\ \frac{0.925\ lb\ CH_4}{lb\ gas}\ x\ \frac{ton}{2000\ lb}\ x\ \frac{5\ days}{completion}\ (1 - 0.95)\ Control = 8.2\ ton\ CH_4 / completion$$

**Equation 6-9 $CO_2$ Emissions from Well Completions**

$$EF = \frac{1.5\ MMscf}{day}\ x\ \frac{10^6\ scf}{MMscf}\ x\ \frac{0.047\ lb\ gas}{scf}\ x\ \frac{0.008\ lb\ CO_{24}}{lb\ gas}\ x\ \frac{ton}{2000\ lb}\ x\ \frac{5\ days}{completion}\ (1 - 0.95)\ Control = 0.07\ ton\ CO_2 / completion$$

## 6.9 Summary of GHG Emissions

The data as described in previous sections was entered into the SANGEA™ tool. The total annual GHG emissions (in $CO_2e$) for each alternative are summarized in **Table 6-23**. Detailed emission rates by source and pollutant type for each alternative are provided in **Tables 6-24**, **6-25**, and **6-26**. Inputs are summarized in **Table 6-27**. The input and output worksheets are provided in **Appendix F**.

**Table 6-23 Maximum Projected Annual GHG Emissions Increase by Alternative**

| | No Action | Proposed Action | Optimal Recovery |
|---|---|---|---|
| **Total Emissions** (tonne $CO_2e$) | 1,761,016 | 2,754,167 | 5,484,666 |

**Table 6-24 Detailed Summary of Annual GHG Emissions by Source for the No Action Alternative**

| Source | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | $CO_2e$ |
|---|---|---|---|---|---|---|
| Stationary Combustion | 462,999 | 9 | 8.5 | 186 | 2,623 | 465,808 |
| Mobile Combustion | 106,744 | 15 | 10.5 | 322 | 3,261 | 110,357 |
| Flare | 239 | 0 | 0.005 | 5 | 1 | 246 |
| Flashing | 0 | 1,463 | 0 | 30,730 | 0 | 30,730 |
| Fugitive | 0 | 6,056 | 0 | 127,182 | 0 | 127,182 |
| Indirect Emission | 990,719 | 7 | 15.6 | 144 | 4,891 | 995,754 |
| Venting | 12 | 1,473 | 0 | 30,926 | 0 | 30,938 |
| **Total (tonne $CO_2e$)** | **1,560,774** | **9,024** | **34.8** | **189,496** | **10,777** | **1,761,016** |

**Table 6-25 Detailed Summary of GHG Emissions by Source for the Proposed Action**

| Source | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | $CO_2e$ |
|---|---|---|---|---|---|---|
| Stationary Combustion | 855,690 | 16 | 15.6 | 344 | 4,847 | 860,880 |
| Mobile Combustion | 197,377 | 28 | 19.1 | 581 | 5,915 | 203,873 |
| Flare | 753 | 1 | 0.01 | 17 | 5 | 775 |
| Flashing | 0 | 4,245 | 0 | 89,142 | 0 | 89,142 |
| Fugitive | 0 | 17,142 | 0 | 359,973 | 0 | 359,973 |
| Indirect Emission | 1,177,611 | 8 | 18.8 | 171 | 5,814 | 1,183,596 |
| Venting | 21 | 2,662 | 0 | 55,907 | 0 | 55,928 |
| **Total (tonne $CO_2e$)** | **2,231,452** | **24,102** | **53.5** | **506,135** | **16,580** | **2,754,167** |

**Table 6-26 Detailed Summary of GHG Emissions by Source for the Optimal Recovery Alternative**

| Source | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | $CO_2e$ |
|---|---|---|---|---|---|---|
| Stationary Combustion | 2,306,292 | 44 | 42.1 | 926 | 13,063 | 2,320,281 |
| Mobile Combustion | 419,221 | 58 | 40.1 | 1,212 | 12,446 | 432,879 |
| Flare | 1,456 | 2 | 0.03 | 33 | 9 | 1,498 |
| Flashing | 0 | 13,709 | 0 | 287,883 | 0 | 287,883 |
| Fugitive | 0 | 24,870 | 0 | 522,260 | 0 | 522,260 |
| Indirect Emission | 1,792,639 | 12 | 28.5 | 261 | 8,850 | 1,801,750 |
| Venting | 43 | 5,622 | 0 | 118,072 | 0 | 188,115 |
| **Total (tonne $CO_2e$)** | **4,519,651** | **44,317** | **110.9** | **930,647** | **34,368** | **5,484,666** |

## Table 6-27 Summary of Input Parameters for GHG Calculations

| | | | | | | |
|---|---|---|---|---|---|---|
| **Stationary Combustion Sources** | | | | | | |
| **Location** | **Source Description** | **Source Id** | **Units** | **No Action** | **Proposed Action** | **Optimal Recovery** |
| **Fuel** | **Uinta Fuel Gas** | | | | | |
| E&P | Separator Heater | SHTR | $10^6$ Btu (HHV) | 1,992,900 | 7,312,410 | 27,909,360 |
| E&P | Water Injection Compression Engines | WICMP | $10^6$ Btu (HHV) | N/A | 518,154 | 916,734 |
| **Fuel** | **GNB Fuel Gas** | | | | | |
| Midstream | Chapita Plant Heaters | CHPT HTR | $10^6$ Btu (HHV) | 546,624 | 546,624 | 546,624 |
| Midstream | Compression (Gas Fired) | CMP | $10^6$ Btu (HHV) | 6,096,741 | 7,581,911 | 13,627,261 |
| Midstream | Flaring | FLARE | $10^3$ scf | 3,367 | 10,601 | 20,500 |
| **Mobile Combustion Sources** | | | | | | |
| **Location** | **Source Description** | **Source Id** | **Units** | **No Action** | **Proposed Action** | **Optimal Recovery** |
| **Fuel** | **Gasoline** | | | | | |
| E&P | Light Truck Traffic (Drilling and Completion) | LTDC | $10^3$ gal | 149 | 261 | 523 |
| E&P | Light Truck Traffic (Construction) | LTCON | $10^3$ gal | 6 | 10 | 20 |
| Midstream | Light Truck Traffic (Production) | LTPRD | $10^3$ gal | 312 | 1,146 | 4,383 |
| **Fuel** | **Diesel / Distillate (No. 2)** | | | | | |
| E&P | Drill Rig Engines | DRENG | $10^3$ gal | 5,933 | 10,383 | 20,776 |
| E&P | Heavy Truck Traffic (Drilling and Completion) | HTDC | $10^3$ gal | 207 | 362 | 724 |
| E&P | Mobile Equipment (Drilling and Completion) | DRMOB | $10^3$ gal | 1,871 | 3,275 | 6,550 |
| E&P | Heavy Truck Traffic (Construction) | HTCON | $10^3$ gal | 22 | 81 | 99 |
| E&P | Mobile Equipment (Construction) | CNMOB | $10^3$ gal | 1,204 | 2,302 | 4,279 |
| E&P | Rig Boilers | DRBOIL | $10^3$ gal | 716 | 1,253 | 2,507 |
| Midstream | Heavy Truck Traffic (Production) | HTPRD | $10^3$ gal | 133 | 487 | 1,865 |
| **Flashing Sources** | | | | | | |
| **Location** | **Input Parameters** | **Source Id** | **Units** | **No Action** | **Proposed Action** | **Optimal Recovery** |
| Midstream | Oil Flow | OIL FLASH | bbl | 1,697,250 | 4,882,605 | 16,440,330 |
| | Oil Temperature | | F | 78 | 78 | 78 |
| | Oil Pressure | | psi | 90 | 90 | 90 |
| | Fraction of $CH_4$ in Flash Gas | | Volume Fraction | 0.496 | 0.496 | 0.496 |
| E&P | CH4 emission based on Activity Data | WTR FLASH | bbl | 9,117,000 | 28,701,000 | 55,503,000 |
| **Fugitive Sources** | | | | | | |
| **Location** | **Source Description** | **Source Id** | **Units** | **No Action** | **Proposed Action** | **Optimal Recovery** |
| E&P | Onshore Gas Production | PRD FUG | $10^6$ scf | 101,300 | 318,900 | 616,700 |
| E&P | Gathering Pipeline Leaks | FUG GTH | Mile | 276 | 1,036 | 1,036 |
| Midstream | Compressor Stations | FUG CMP | Station | 6 | 8 | 8 |
| Midstream | Gas Processing Plants | FUG CHPT | $10^6$ scf | 101,300 | 273,750 | 273,750 |
| **Indirect Sources** | | | | | | |
| **Location** | **Source Description** | **Source Id** | **Units** | **No Action** | **Proposed Action** | **Optimal Recovery** |
| Midstream | Electric Compression – Field | ELEC CMP | GWh | 441 | 637 | 1,282 |
| Midstream | Electric Compression – Chapita | ELEC CHPT | GWh | 598 | 598 | 598 |
| **Venting Sources** | | | | | | |
| **Location** | **Source Description** | **Source Id** | **Units** | **No Action** | **Proposed Action** | **Optimal Recovery** |
| E&P | Gas Driven Pneumatics | EP PNEU | Devices | 1,820 | 6,678 | 25,548 |
| E&P | Workovers | WORKOVER | Workovers | 107 | 389 | 1,507 |
| E&P | $CO_2$ emission based on Activity Data | Completion - $CO_2$ | Completions | 192 | 336 | 672 |
| E&P | $CH_4$ emission based on Activity Data | Completion - $CH_4$ | Completions | 192 | 336 | 672 |

# 7.0 Air Quality Summary

This technical support document provides details regarding local and regional air quality conditions and expected impacts resulting from the reasonably foreseeable future development within the GNBPA. The analyses assess the impacts of the Proposed Action and the Optimal Recovery Alternative compared to emissions from the Projected Baseline. The Resource Protection Alternative was not modeled because emissions related to the development of this alternative are well-characterized by the impacts from the Proposed Action. As noted in Chapter 2.0, the regional air quality currently is classified as in attainment or unclassifiable. This means that there are no direct measurements of background air quality in the area of development.

## 7.1 Impact on Class I and II Areas – Air Quality

The guideline CALPUFF modeling system was used to determine impacts on Class I areas and selected Class II areas in the region. For the Proposed Action scenario, the greatest impact on ambient air quality from project sources on Class I areas was at Arches National Park, where the maximum impact for all criteria air pollutants occurs. The highest $PM_{10}$ 24-hour impact was 0.10 µg/m$^3$ at this site. All other impacts for all criteria pollutants at all Class I areas for the Proposed Action scenario were below 0.01 µg/m$^3$.

The greatest impacts under the Proposed Action scenario at the identified sensitive Class II areas were at the Flaming Gorge National Recreation Area (3.23 µg/m$^3$ for 24-hour $PM_{10}$ levels and 0.58 µg/m$^3$ for annual $PM_{10}$). All other impacts from all other criteria pollutants at Class II areas were less than 0.5 µg/m$^3$.

For the Optimal Recovery Alternative, the maximum 24-hour $PM_{10}$ impact at Class I areas was 0.24 µg/m$^3$ at Arches National Park. The highest annual average $PM_{10}$ impact of 0.02 µg/m$^3$ also occurred at this area. All other impacts from all other criteria pollutants at Class I areas were less than 0.13 µg/m$^3$.

For the Optimal Recovery Alternative at sensitive Class II areas, the maximum impacts were at the Flaming Gorge National Recreation Area for all criteria air pollutants. The maximum annual average $NO_2$ impact was 0.94 µg/m$^3$. The $PM_{10}$ impact on a 24-hour average was 7.36 µg/m$^3$, and the annual $PM_{10}$ impact was 1.38 µg/m$^3$. Impacts from all other criteria pollutants at all other Class II areas were less than 1.0 µg/m$^3$.

When added to the background concentrations, all cumulative impacts from all sources for each of the alternatives, including the modeled non-project sources, were below the established NAAQS for all criteria pollutants.

## 7.2 Impact at Class I and II Areas – Visibility

The CALPUFF model system was used to evaluate impacts on visibility at the Class I areas and at the listed sensitive Class II areas. The results of the simulations under the Proposed Action scenario showed that there are no days with a contribution to visibility impacts greater than 5 percent in extinction (0.5 dv) at listed Class I areas for either the Method 2 or Method 6 analysis. The conclusion is that the Proposed Action would not contribute to an impact on visibility at these sites. The modeling results at the listed sensitive Class II areas showed the highest impacts at Flaming Gorge National Recreation Area and Dinosaur National Monument. Results from Method 6 showed that up to 102 days would be impacted with greater than 10 percent increase in extinction at Flaming Gorge. The same analysis showed the eighth highest increase in extinction for the Proposed Action is 32.6 percent. At Dinosaur National Monument, the model predicted 32 days per year with an impact above 10 percent and an eighth highest increase in light extinction of 16.6 percent. Except at Flaming Gorge National Recreation Area and Dinosaur National Monument, modeled results for all other Class II areas under Method 6 showed all of the eighth highest impacts were less than a 10 percent increase in extinction (1.0 dv).

For the Optimal Recovery Alternative, all project-related impacts were below 10 percent light extinction at all Class I areas. At Class II areas under the Optimal Recovery Alternative, the eighth highest impacts using Method 6 were above 10 percent at Flaming Gorge National Recreation Area and Dinosaur National Monument. The eighth highest increase in light extinction for project-related sources was 62.4 percent at Flaming Gorge National Recreation Area, with 156 days predicted to be greater than 10 percent. At Dinosaur National Monument, the eighth highest increase in light extinction was 32.7 percent, with 71 days predicted to be greater than 10 percent.

## 7.3 Impacts at Class I and II areas – Acid Deposition

The CALPUFF model system also provided acid deposition results for sulfate and nitrate ion deposition at Class I and sensitive Class II areas, which were then used to analyze impacts to the ANC of selected sensitive lakes in the modeling domain. Impacts from project-related sources under both the Proposed Action and the Optimal Recovery Alternative were well below the USFS-established comparative deposition values (5 and 3 kg/ ha-yr for sulfur and nitrogen deposition, respectively). Cumulative deposition from all modeled sources also was below the established comparative deposition values for both alternatives at all Class I and Class II areas except Mesa Verde National Park.

The model showed that project-related impacts at all identified sensitive lakes were below the USFS screening threshold for ANC established for further analysis. Therefore, no additional analysis was conducted on these impacts.

## 7.4 Impacts on Ambient Ozone Levels

Impacts on ozone were evaluated using the CMAQ model system. The modeling system meets the USEPA-established criteria for acceptable model accuracy and error statistics at the existing monitoring stations in the modeling domain, but not in the region. There are no recent or statistically valid representative monitoring data that can be used to compare to baseline modeled impacts actual levels in the GNBPA. This lack of concurrent data prevents validation and calibration of the model results; however, the model does provide a means to compare the relative change in ambient ozone concentration between the project alternatives and baseline air quality.

The model results showed ozone levels below the current ozone standard of 75 ppb for the fourth highest annual level in the Uinta Basin for the Projected Baseline and for the project alternatives. The maximum fourth highest impact was 2.4 ppb from the Proposed Action scenario and 4.9 ppb from the Optimal Recovery Alternative. For both scenarios, the impacts were occurring in areas simulated to remain below the 75 ppb ozone standard.

## 7.5 Localized Impacts on Air Quality

The AERMOD modeling system was used to evaluate localized impacts on criteria air pollutants at receptors within the GNBPA. The analysis was based on a series of source configurations, including well sites, drilling, operation, and compression, and provided projected air quality impacts on the near field. A 5-year period of meteorological data from the Vernal Airport was utilized. Although background concentrations were difficult to assess in this region due to the lack of recent monitoring, all projected impacts for criteria pollutants were below the NAAQS.

Using those background data, the localized impacts of single sources plus background were all less than the NAAQS. The impacts of the multi-well scenario and the well drilling operations, as discussed above, also were lower than the NAAQS.

## 7.6 Greenhouse Gas Emissions

The predicted annual increase in GHG emissions ($CO_2$, $N_2O$, and $CH_4$) were tabulated for both the Proposed Action and the Optimal Recovery Alternative. Both direct project-related and indirect (from electric power

generation) emissions were included. During the maximum production year for each alternative, a total 2.75 million metric tons of $CO_2$ equivalent gases would be emitted by the Proposed Action, and 5.48 million metric tons of $CO_2$ equivalent gases would be emitted by the Optimal Recovery Alternative.

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# Appendix A

# Projected Baseline Emissions Calculations Supporting Data

**Table A-1 Summary of 2018 Projected Baseline Emissions by County**

| $NO_x$ | | | | |
|---|---|---|---|---|
| | Historical | Projected Baseline | | Baseline/ |
| | WRAP | Uncontrolled | Controlled | Historical |
| County | 2006 | 2018 | | Ratio |
| Uintah | 6,096 | 10,841 | 5,888 | 0.97 |
| Carbon | 995 | 3,823 | 1,322 | 1.33 |
| Duchesne | 3,053 | 4,797 | 2,512 | 0.82 |
| Grand | 337 | 337 | 213 | 0.63 |
| Emery | 273 | 273 | 204 | 0.75 |
| Total | 10,754 | 20,071 | 10,138 | 0.94 |

| CO | | | | |
|---|---|---|---|---|
| | Historical | Projected Baseline | | Baseline/ |
| | WRAP | Uncontrolled | Controlled | Historical |
| County | 2006 | 2018 | | Ratio |
| Uintah | 4,133 | 8,589 | 5,136 | 1.24 |
| Carbon | 814 | 3,855 | 1,550 | 1.90 |
| Duchesne | 2,448 | 4,768 | 2,723 | 1.11 |
| Grand | 207 | 207 | 154 | 0.74 |
| Emery | 199 | 199 | 170 | 0.85 |
| Total | 7,800 | 17,618 | 9,732 | 1.25 |

| $SO_2$ | | | | |
|---|---|---|---|---|
| | Historical | Projected Baseline | | Baseline/ |
| | WRAP | Uncontrolled | Controlled | Historical |
| County | 2006 | 2018 | | Ratio |
| Uintah | 247 | 275 | 20 | 0.08 |
| Carbon | 22 | 7 | 2 | 0.08 |
| Duchesne | 96 | 58 | 6 | 0.07 |
| Grand | 16 | 16 | 1 | 0.05 |
| Emery | 9 | 9 | 1 | 0.06 |
| Total | 391 | 365 | 30 | 0.08 |

| $PM_{10}$ | | | | |
|---|---|---|---|---|
| | Historical | Projected Baseline | | Baseline/ |
| | WRAP | Uncontrolled | Controlled | Historical |
| County | 2006 | 2018 | | Ratio |
| Uintah | 344 | 523 | 284 | 0.83 |
| Carbon | 40 | 86 | 81 | 2.02 |
| Duchesne | 173 | 235 | 186 | 1.08 |
| Grand | 22 | 22 | 7 | 0.34 |
| Emery | 14 | 14 | 6 | 0.44 |
| Total | 592 | 879 | 565 | 0.95 |

| VOC | | | | |
|---|---|---|---|---|
| | Historical | Projected Baseline | | Baseline/ |
| | WRAP | Uncontrolled | Controlled | Historical |
| County | 2006 | 2018 | | Ratio |
| Uintah | 45,646 | 130,537 | 126,425 | 2.77 |
| Carbon | 2,747 | 14,027 | 13,553 | 4.93 |
| Duchesne | 19,019 | 41,663 | 41,495 | 2.18 |
| Grand | 2,360 | 2,360 | 2,345 | 0.99 |
| Emery | 453 | 453 | 444 | 0.98 |
| Total | 70,226 | 189,040 | 184,262 | 2.62 |

**Table A-2 Summary of Emissions Scaling Factors Based on Selected Operational Activity Projections**

| Well Count (cumulative) | | | | | |
|---|---|---|---|---|---|
| | Historical | UBAQS | GNB EIS Projections | | Emissions |
| County | 2006 | 2012 | | 2018 | Scaling Ratio |
| Uintah | 4,035 | 6,718 | 7,692 | 12,207 | 3.03 |
| Carbon | 730 | 258 | 1,244 | 1,615 | 2.21 |
| Duchesne | 1,474 | 2,421 | 2,082 | 2,981 | 2.02 |
| Grand | 368 | 408 | N/A | 368 | 1.00 |
| Emery | 56 | 91 | N/A | 56 | 1.00 |

| Spud Count (spuds/year) | | | | | |
|---|---|---|---|---|---|
| | Historical | UBAQS | GNB EIS Projections | | Emissions |
| County | 2006 | 2012 | | 2018 | Scaling Ratio |
| Uintah | 685 | 934 | 1,049 | 677 | 0.99 |
| Carbon | 58 | 118 | 120 | 0 | 0.00 |
| Duchesne | 277 | 389 | 158 | 156 | 0.56 |
| Grand | 27 | 70 | N/A | 27 | 1.00 |
| Emery | 23 | 22 | N/A | 23 | 1.00 |

| Gas Production (MMscf) | | | | | |
|---|---|---|---|---|---|
| | Historical | UBAQS | GNB EIS Projections | | Emissions |
| County | 2006 | 2012 | | 2018 | Scaling Ratio |
| Uintah | 203,391 | 323,265 | 445,153 | 595,651 | 2.93 |
| Carbon | 20,497 | 52,904 | 148,923 | 121,803 | 5.94 |
| Duchesne | 22,526 | 43,037 | 27,536 | 40,025 | 1.78 |
| Grand | 6,855 | 6,534 | N/A | 6,855 | 1.00 |
| Emery | 951 | 3,978 | N/A | 951 | 1.00 |

| Condensate Production ($10^3$ bbl) | | | | | |
|---|---|---|---|---|---|
| | Historical | UBAQS | GNB EIS Projections | | Emissions |
| County | 2006 | 2012 | | 2018 | Scaling Ratio |
| Uintah | 1,554 | 5,723 | 4,987 | 5,842 | 3.76 |
| Carbon | 43 | 77 | 180 | 148 | 3.43 |
| Duchesne | 163 | 394 | 320 | 455 | 2.79 |
| Grand | 9 | 11 | N/A | 9 | 1.00 |
| Emery | 4 | 2 | N/A | 4 | 1.00 |

| Oil Production (bbl) | | | | | |
|---|---|---|---|---|---|
| | Historical | UBAQS | GNB EIS Projections | | Emissions |
| County | 2006 | 2012 | | 2018 | Scaling Ratio |
| Uintah | 3,399 | 3,291 | 4,061 | 4,828 | 1.42 |
| Carbon | 0.3 | 0.3 | N/A | 0.3 | 1.00 |
| Duchesne | 6,402 | 10,673 | 10,992 | 15,093 | 2.36 |
| Grand | 116 | 119 | N/A | 116 | 1.00 |
| Emery | 4 | 2 | N/A | 4 | 1.00 |

**Table A-3 Calculation of 2018 Projected Baseline Emissions By Source Category and County**

**Uintah County**

| SCC | Description | 2006 WRAP Phase III Emissions by Source | | | | | Scaling Parameter | ESF | Scaled 2018 Baseline (w/o reductions) | | | | | Rule Control Effectiveness | | | | | Rule Retroactive | Consent Decree VOC Control | Reduced 2018 Baseline | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| | | (tpy) | | | | | | | (tpy) | | | | | (% reduction) | | | | | | (% reduction) | (tpy) | | | | |
| 2310000100 | Heaters | 595.53 | 506.08 | 3.91 | 46.92 | 34.02 | Well Count | 3.03 | 1,801.66 | 1,531.05 | 11.84 | 141.94 | 102.92 | 0% | 0% | 0% | 0% | 0% | N | 0% | 1,801.66 | 1,531.05 | 11.84 | 141.94 | 102.92 |
| 2310000220 | Drill rigs | 3,062.16 | 1,156.05 | 231.70 | 226.73 | 266.00 | Spud Count | 0.99 | 3,026.40 | 1,142.55 | 229.00 | 224.08 | 262.89 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 1,140.38 | 349.49 | 6.87 | 16.81 | 36.81 |
| 2310000230 | Workover rigs | 134.64 | 54.14 | 11.15 | 11.14 | 12.45 | Well Count | 3.03 | 407.34 | 163.78 | 33.75 | 33.69 | 37.68 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 153.49 | 50.10 | 1.01 | 2.53 | 5.27 |
| 2310000300 | Pneumatic devices | - | - | - | - | 9,920.59 | Well Count | 3.03 | - | - | - | - | 30,012.56 | 0% | 0% | 0% | 0% | 0% | Y | 8.2% | - | - | - | 0.00 | 27,551.53 |
| 2310000330 | Artificial Lift | 760.99 | 878.43 | 0.40 | 32.84 | 234.82 | Oil Production | 1.42 | 1,080.80 | 1,247.59 | 0.57 | 46.64 | 333.50 | 90% | 80% | 0% | 0% | 0% | N | 0% | 792.97 | 952.27 | 0.57 | 46.64 | 333.50 |
| 2310000700 | Unpermitted Fugitives | - | - | - | - | 1,271.30 | Well Count | 3.03 | - | - | - | - | 3,846.05 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 3,846.05 |
| 2310000800 | Truck Loading of Condensate | - | - | - | - | 111.49 | Condensate Production | 3.76 | - | - | - | - | 419.07 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 419.07 |
| 2310000801 | Truck Loading of Oil | - | - | - | - | 335.77 | Oil Production | 1.42 | - | - | - | - | 476.88 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 476.88 |
| 2310000820 | Gas Plant Truck Loading | - | - | - | - | 2.92 | Condensate Production | 3.76 | - | - | - | - | 10.97 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 10.97 |
| 2310001610 | Venting - initial completions | - | - | - | - | 207.80 | Spud Count | 0.99 | - | - | - | - | 205.37 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 205.37 |
| 2310001611 | Initial completion Flaring | 0.36 | 1.96 | - | - | - | Spud Count | 0.99 | 0.36 | 1.94 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.36 | 1.94 | - | 0.00 | - |
| 2310001620 | Venting - recompletions | - | - | - | - | 32.10 | Spud Count | 0.99 | - | - | - | - | 31.73 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 31.73 |
| 2310001630 | Venting - blowdowns | - | - | - | - | 230.44 | Gas Production | 2.93 | - | - | - | - | 674.85 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 674.85 |
| 2310001640 | Venting - Compressor Startup | - | - | - | - | 651.21 | Gas Production | 2.93 | - | - | - | - | 1,907.14 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 1,907.14 |
| 2310001650 | Venting - Compressor Shutdown | - | - | - | - | 617.24 | Gas Production | 2.93 | - | - | - | - | 1,807.65 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 1,807.65 |
| 2310002230 | Condensate tank | - | - | - | - | 5,439.26 | Condensate Production | 3.76 | - | - | - | - | 20,445.75 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 20,445.75 |
| 2310002231 | Condensate tank flaring | 0.25 | 1.38 | - | - | - | Condensate Production | 3.76 | 0.96 | 5.20 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.96 | 5.20 | - | 0.00 | - |
| 2310002240 | Oil Tank | - | - | - | - | 5,001.29 | Oil Production | 1.42 | - | - | - | - | 7,103.06 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 7,103.06 |
| 2310003100 | Miscellaneous engines | 95.76 | 34.68 | 0.05 | 0.45 | 23.12 | Well Count | 3.03 | 289.69 | 104.91 | 0.15 | 1.37 | 69.95 | 90% | 80% | 0% | 0% | 0% | N | 0% | 115.15 | 48.72 | 0.15 | 1.37 | 69.95 |
| 2310003200 | Pneumatic pumps | - | - | - | - | 5,614.18 | Well Count | 3.03 | - | - | - | - | 16,984.45 | 0% | 0% | 0% | 0% | 0% | Y | 8.2% | - | - | - | 0.00 | 15,591.73 |
| 2310020600 | Compressor engines | 1,354.87 | 1,423.11 | - | 18.75 | 313.21 | Gas Production | 2.93 | 3,967.86 | 4,167.71 | - | 54.91 | 917.26 | 90% | 80% | 0% | 0% | 0% | N | 0% | 1,616.16 | 1,972.03 | - | 54.91 | 917.26 |
| 2310021410 | Dehydrator | 90.91 | 76.36 | - | 6.91 | 15,327.27 | Gas Production | 2.93 | 266.23 | 223.64 | - | 20.23 | 44,887.41 | 0% | 0% | 0% | 0% | 0% | N | 0% | 266.23 | 223.64 | - | 20.23 | 44,887.41 |
| 2310021411 | Dehydrator Flaring | 0.07 | 0.38 | - | - | - | Gas Production | 2.93 | 0.21 | 1.13 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.21 | 1.13 | - | 0.00 | - |
| | | 6,095.55 | 4,132.58 | 247.22 | 343.73 | 45,646.48 | | | 10,841.49 | 8,589.49 | 275.30 | 522.87 | 130,537.14 | | | | | | | | 5,887.57 | 5,135.55 | 20.44 | 284.43 | 126,424.89 |

**Carbon County**

| SCC | Description | 2006 WRAP Phase III Emissions by Source | | | | | Scaling Parameter | ESF | Scaled 2018 Baseline (w/o reductions) | | | | | Rule Control Effectiveness | | | | | Rule Retroactive | Consent Decree VOC Control | Reduced 2018 Baseline | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| | | (tpy) | | | | | | | (tpy) | | | | | (% reduction) | | | | | | (% reduction) | (tpy) | | | | |
| 2310000100 | Heaters | 107.74 | 91.56 | 0.71 | 8.49 | 6.16 | Well Count | 2.21 | 238.36 | 202.56 | 1.57 | 18.78 | 13.62 | 0% | 0% | 0% | 0% | 0% | N | 0% | 238.36 | 202.56 | 1.57 | 18.78 | 13.62 |
| 2310000220 | Drill rigs | 254.81 | 96.20 | 19.28 | 18.87 | 22.13 | Spud Count | 0.00 | - | - | - | - | - | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | - | - | - | 0.00 | - |
| 2310000230 | Workover rigs | 28.84 | 11.60 | 2.39 | 2.39 | 2.67 | Well Count | 2.21 | 63.81 | 25.66 | 5.29 | 5.28 | 5.90 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 24.04 | 7.85 | 0.16 | 0.40 | 0.83 |
| 2310000300 | Pneumatic devices | - | - | - | - | 297.05 | Well Count | 2.21 | - | - | - | - | 657.18 | 0% | 0% | 0% | 0% | 0% | Y | 50.0% | - | - | - | 0.00 | 328.59 |
| 2310000330 | Artificial Lift | 0.06 | 0.07 | 0.00 | 0.00 | 0.02 | Oil Production | 1.00 | 0.06 | 0.07 | 0.00 | 0.00 | 0.02 | 90% | 80% | 0% | 0% | 0% | N | 0% | 0.06 | 0.07 | 0.00 | 0.00 | 0.02 |
| 2310000700 | Unpermitted Fugitives | - | - | - | - | 36.67 | Well Count | 2.21 | - | - | - | - | 81.13 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 81.13 |
| 2310000800 | Truck Loading of Condensate | - | - | - | - | 3.09 | Condensate Production | 3.43 | - | - | - | - | 10.61 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 10.61 |
| 2310000801 | Truck Loading of Oil | - | - | - | - | 0.03 | Oil Production | 1.00 | - | - | - | - | 0.03 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.03 |
| 2310000820 | Gas Plant Truck Loading | - | - | - | - | 0.08 | Condensate Production | 3.43 | - | - | - | - | 0.28 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.28 |
| 2310001610 | Venting - initial completions | - | - | - | - | 1.67 | Spud Count | 0.00 | - | - | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | - |
| 2310001611 | Initial completion Flaring | 0.03 | 0.16 | - | - | - | Spud Count | 0.00 | - | - | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | - |
| 2310001620 | Venting - recompletions | - | - | - | - | 0.26 | Spud Count | 0.00 | - | - | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | - |
| 2310001630 | Venting - blowdowns | - | - | - | - | 26.48 | Gas Production | 5.94 | - | - | - | - | 157.38 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 157.38 |
| 2310001640 | Venting - Compressor Startup | - | - | - | - | 74.84 | Gas Production | 5.94 | - | - | - | - | 444.75 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 444.75 |
| 2310001650 | Venting - Compressor Shutdown | - | - | - | - | 70.94 | Gas Production | 5.94 | - | - | - | - | 421.55 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 421.55 |
| 2310002230 | Condensate tank | - | - | - | - | 150.77 | Condensate Production | 3.43 | - | - | - | - | 517.68 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 517.68 |
| 2310002231 | Condensate tank flaring | 0.00 | 0.01 | - | - | - | Condensate Production | 3.43 | 0.01 | 0.04 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.01 | 0.04 | - | 0.00 | - |
| 2310002240 | Oil Tank | - | - | - | - | 0.42 | Oil Production | 1.00 | - | - | - | - | 0.42 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.42 |
| 2310003100 | Miscellaneous engines | 17.32 | 6.27 | 0.01 | 0.08 | 4.18 | Well Count | 2.21 | 38.33 | 13.88 | 0.02 | 0.18 | 9.25 | 90% | 80% | 0% | 0% | 0% | N | 0% | 19.42 | 7.79 | 0.02 | 0.18 | 9.25 |
| 2310003200 | Pneumatic pumps | - | - | - | - | 126.80 | Well Count | 2.21 | - | - | - | - | 280.53 | 0% | 0% | 0% | 0% | 0% | Y | 50.0% | - | - | - | 0.00 | 140.27 |
| 2310020600 | Compressor engines | 549.17 | 576.83 | - | 7.60 | 126.95 | Gas Production | 5.94 | 3,263.50 | 3,427.89 | - | 45.17 | 754.43 | 90% | 80% | 0% | 0% | 0% | N | 0% | 820.60 | 1,147.04 | - | 45.17 | 754.43 |
| 2310021410 | Dehydrator | 36.85 | 30.95 | - | 2.80 | 1,795.88 | Gas Production | 5.94 | 218.97 | 183.94 | - | 16.64 | 10,672.23 | 0% | 0% | 0% | 0% | 0% | N | 0% | 218.97 | 183.94 | - | 16.64 | 10,672.23 |
| 2310021411 | Dehydrator Flaring | 0.03 | 0.16 | - | - | - | Gas Production | 5.94 | 0.17 | 0.93 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.17 | 0.93 | - | 0.00 | - |
| | | 994.86 | 813.82 | 22.39 | 40.23 | 2,747.10 | | | 3,823.22 | 3,854.96 | 6.87 | 86.05 | 14,026.99 | | | | | | | | 1,321.65 | 1,550.22 | 1.74 | 81.17 | 13,553.06 |

**Table A-3 Calculation of 2018 Projected Baseline Emissions By Source Category and County**

**Duchesne County**

| SCC | Description | 2006 WRAP Phase III Emissions by Source | | | | | Scaling Parameter | ESF | Scaled 2018 Baseline (w/o reductions) | | | | | Rule Control Effectiveness | | | | | Rule Retroactive | Consent Decree VOC Control | Reduced 2018 Baseline | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| | | (tpy) | | | | | | | (tpy) | | | | | (% reduction) | | | | | | (% reduction) | (tpy) | | | | |
| 2310000100 | Heaters | 217.55 | 184.87 | 1.43 | 17.14 | 12.43 | Well Count | 2.02 | 439.97 | 373.89 | 2.89 | 34.66 | 25.13 | 0% | 0% | 0% | 0% | 0% | N | 0% | 439.97 | 373.89 | 2.89 | 34.66 | 25.13 |
| 2310000220 | Drill rigs | 1,238.28 | 467.48 | 93.70 | 91.68 | 107.57 | Spud Count | 0.56 | 697.37 | 263.28 | 52.77 | 51.63 | 60.58 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 262.78 | 80.53 | 1.58 | 3.87 | 8.48 |
| 2310000230 | Workover rigs | 5.36 | 2.16 | 0.44 | 0.44 | 0.50 | Well Count | 2.02 | 10.84 | 4.36 | 0.90 | 0.90 | 1.00 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 4.09 | 1.33 | 0.03 | 0.07 | 0.14 |
| 2310000300 | Pneumatic devices | - | - | - | - | 3,629.17 | Well Count | 2.02 | - | - | - | - | 7,339.60 | 0% | 0% | 0% | 0% | 0% | Y | 1.0% | - | - | - | 0.00 | 7,266.20 |
| 2310000330 | Artificial Lift | 1,396.51 | 1,612.03 | 0.74 | 60.26 | 430.91 | Oil Production | 2.36 | 3,292.48 | 3,800.60 | 1.74 | 142.08 | 1,015.94 | 90% | 80% | 0% | 0% | 0% | N | 0% | 1,586.11 | 2,049.75 | 1.74 | 142.08 | 1,015.94 |
| 2310000700 | Unpermitted Fugitives | - | - | - | - | 465.08 | Well Count | 2.02 | - | - | - | - | 940.56 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 940.56 |
| 2310000800 | Truck Loading of Condensate | - | - | - | - | 11.72 | Condensate Production | 2.79 | - | - | - | - | 32.64 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 32.64 |
| 2310000801 | Truck Loading of Oil | - | - | - | - | 616.18 | Oil Production | 2.36 | - | - | - | - | 1,452.75 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 1,452.75 |
| 2310000820 | Gas Plant Truck Loading | - | - | - | - | 0.31 | Condensate Production | 2.79 | - | - | - | - | 0.85 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.85 |
| 2310001610 | Venting - initial completions | - | - | - | - | 30.72 | Spud Count | 0.56 | - | - | - | - | 17.30 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 17.30 |
| 2310001611 | Initial completion Flaring | 0.15 | 0.79 | - | - | - | Spud Count | 0.56 | 0.08 | 0.45 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.08 | 0.45 | - | 0.00 | - |
| 2310001620 | Venting - recompletions | - | - | - | - | 4.75 | Spud Count | 0.56 | - | - | - | - | 2.67 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 2.67 |
| 2310001630 | Venting - blowdowns | - | - | - | - | 25.52 | Gas Production | 1.78 | - | - | - | - | 45.34 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 45.34 |
| 2310001640 | Venting - Compressor Startup | - | - | - | - | 72.12 | Gas Production | 1.78 | - | - | - | - | 128.14 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 128.14 |
| 2310001650 | Venting - Compressor Shutdown | - | - | - | - | 68.35 | Gas Production | 1.78 | - | - | - | - | 121.46 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 121.46 |
| 2310002230 | Condensate tank | - | - | - | - | 571.77 | Condensate Production | 2.79 | - | - | - | - | 1,592.50 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 1,592.50 |
| 2310002231 | Condensate tank flaring | 0.33 | 1.79 | - | - | - | Condensate Production | 2.79 | 0.92 | 4.98 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.92 | 4.98 | - | 0.00 | - |
| 2310002240 | Oil Tank | - | - | - | - | 9,177.96 | Oil Production | 2.36 | - | - | - | - | 21,638.40 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 21,638.40 |
| 2310003100 | Miscellaneous engines | 34.98 | 12.67 | 0.02 | 0.17 | 8.45 | Well Count | 2.02 | 70.74 | 25.62 | 0.04 | 0.33 | 17.08 | 90% | 80% | 0% | 0% | 0% | N | 0% | 38.56 | 15.26 | 0.04 | 0.33 | 17.08 |
| 2310003200 | Pneumatic pumps | - | - | - | - | 2,053.93 | Well Count | 2.02 | - | - | - | - | 4,153.85 | 0% | 0% | 0% | 0% | 0% | Y | 1.0% | - | - | - | 0.00 | 4,112.31 |
| 2310020600 | Compressor engines | 149.82 | 157.37 | - | 2.07 | 34.64 | Gas Production | 1.78 | 266.22 | 279.63 | - | 3.68 | 61.54 | 90% | 80% | 0% | 0% | 0% | N | 0% | 161.46 | 181.82 | - | 3.68 | 61.54 |
| 2310021410 | Dehydrator | 10.05 | 8.44 | - | 0.76 | 1,697.36 | Gas Production | 1.78 | 17.86 | 15.00 | - | 1.36 | 3,015.98 | 0% | 0% | 0% | 0% | 0% | N | 0% | 17.86 | 15.00 | - | 1.36 | 3,015.98 |
| 2310021411 | Dehydrator Flaring | 0.01 | 0.04 | - | - | - | Gas Production | 1.78 | 0.01 | 0.08 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.01 | 0.08 | - | 0.00 | - |
| | | 3,053.04 | 2,447.65 | 96.33 | 172.53 | 19,019.42 | | | 4,796.50 | 4,767.88 | 58.33 | 234.65 | 41,663.33 | | | | | | | | 2,511.84 | 2,723.09 | 6.28 | 186.06 | 41,495.44 |

**Grand County**

| SCC | Description | 2006 WRAP Phase III Emissions by Source | | | | | Scaling Parameter | ESF | Scaled 2018 Baseline (w/o reductions) | | | | | Rule Control Effectiveness | | | | | Rule Retroactive | Consent Decree VOC Control | Reduced 2018 Baseline | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| | | (tpy) | | | | | | | (tpy) | | | | | (% reduction) | | | | | | (% reduction) | (tpy) | | | | |
| 2310000100 | Heaters | 54.31 | 46.16 | 0.36 | 4.28 | 3.10 | Well Count | 1.00 | 54.31 | 46.16 | 0.36 | 4.28 | 3.10 | 0% | 0% | 0% | 0% | 0% | N | 0% | 54.31 | 46.16 | 0.36 | 4.28 | 3.10 |
| 2310000220 | Drill rigs | 120.70 | 45.57 | 9.13 | 8.94 | 10.48 | Spud Count | 1.00 | 120.70 | 45.57 | 9.13 | 8.94 | 10.48 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 45.48 | 13.94 | 0.27 | 0.67 | 1.47 |
| 2310000230 | Workover rigs | 78.95 | 31.75 | 6.54 | 6.53 | 7.30 | Well Count | 1.00 | 78.95 | 31.75 | 6.54 | 6.53 | 7.30 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 29.75 | 9.71 | 0.20 | 0.49 | 1.02 |
| 2310000300 | Pneumatic devices | - | - | - | - | 906.06 | Well Count | 1.00 | - | - | - | - | 906.06 | 0% | 0% | 0% | 0% | 0% | Y | 0% | - | - | - | 0.00 | 906.06 |
| 2310000330 | Artificial Lift | 26.08 | 30.10 | 0.01 | 1.13 | 8.05 | Oil Production | 1.00 | 26.08 | 30.10 | 0.01 | 1.13 | 8.05 | 90% | 80% | 0% | 0% | 0% | N | 0% | 26.08 | 30.10 | 0.01 | 1.13 | 8.05 |
| 2310000700 | Unpermitted Fugitives | - | - | - | - | 116.11 | Well Count | 1.00 | - | - | - | - | 116.11 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 116.11 |
| 2310000800 | Truck Loading of Condensate | - | - | - | - | 0.66 | Condensate Production | 1.00 | - | - | - | - | 0.66 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.66 |
| 2310000801 | Truck Loading of Oil | - | - | - | - | 11.51 | Oil Production | 1.00 | - | - | - | - | 11.51 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 11.51 |
| 2310000820 | Gas Plant Truck Loading | - | - | - | - | 0.02 | Condensate Production | 1.00 | - | - | - | - | 0.02 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.02 |
| 2310001610 | Venting - initial completions | - | - | - | - | 0.75 | Spud Count | 1.00 | - | - | - | - | 0.75 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.75 |
| 2310001611 | Initial completion Flaring | 0.01 | 0.08 | - | - | - | Spud Count | 1.00 | 0.01 | 0.08 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.01 | 0.08 | - | 0.00 | - |
| 2310001620 | Venting - recompletions | - | - | - | - | 0.12 | Spud Count | 1.00 | - | - | - | - | 0.12 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.12 |
| 2310001630 | Venting - blowdowns | - | - | - | - | 7.77 | Gas Production | 1.00 | - | - | - | - | 7.77 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 7.77 |
| 2310001640 | Venting - Compressor Startup | - | - | - | - | 21.95 | Gas Production | 1.00 | - | - | - | - | 21.95 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 21.95 |
| 2310001650 | Venting - Compressor Shutdown | - | - | - | - | 20.80 | Gas Production | 1.00 | - | - | - | - | 20.80 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 20.80 |
| 2310002230 | Condensate tank | - | - | - | - | 32.01 | Condensate Production | 1.00 | - | - | - | - | 32.01 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 32.01 |
| 2310002231 | Condensate tank flaring | 0.01 | 0.04 | - | - | - | Condensate Production | 1.00 | 0.01 | 0.04 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.01 | 0.04 | - | 0.00 | - |
| 2310002240 | Oil Tank | - | - | - | - | 171.37 | Oil Production | 1.00 | - | - | - | - | 171.37 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 171.37 |
| 2310003100 | Miscellaneous engines | 8.73 | 3.16 | 0.00 | 0.04 | 2.11 | Well Count | 1.00 | 8.73 | 3.16 | 0.00 | 0.04 | 2.11 | 90% | 80% | 0% | 0% | 0% | N | 0% | 8.73 | 3.16 | 0.00 | 0.04 | 2.11 |
| 2310003200 | Pneumatic pumps | - | - | - | - | 512.79 | Well Count | 1.00 | - | - | - | - | 512.79 | 0% | 0% | 0% | 0% | 0% | Y | 0% | - | - | - | 0.00 | 512.79 |
| 2310020600 | Compressor engines | 45.59 | 47.89 | - | 0.63 | 10.54 | Gas Production | 1.00 | 45.59 | 47.89 | - | 0.63 | 10.54 | 90% | 80% | 0% | 0% | 0% | N | 0% | 45.59 | 47.89 | - | 0.63 | 10.54 |
| 2310021410 | Dehydrator | 3.06 | 2.57 | - | 0.23 | 516.52 | Gas Production | 1.00 | 3.06 | 2.57 | - | 0.23 | 516.52 | 0% | 0% | 0% | 0% | 0% | N | 0% | 3.06 | 2.57 | - | 0.23 | 516.52 |
| 2310021411 | Dehydrator Flaring | 0.00 | 0.01 | - | - | - | Gas Production | 1.00 | 0.00 | 0.01 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.00 | 0.01 | - | 0.00 | - |
| | | 337.45 | 207.31 | 16.05 | 21.78 | 2,359.99 | | | 337.45 | 207.31 | 16.05 | 21.78 | 2,359.99 | | | | | | | | 213.03 | 153.65 | 0.85 | 7.47 | 2,344.69 |

**Table A-3 Calculation of 2018 Projected Baseline Emissions By Source Category and County**

**Emery county**

| SCC | Description | 2006 WRAP Phase III Emissions by Source | | | | | Scaling Parameter | ESF | Scaled 2018 Baseline (w/o reductions) | | | | | Rule Control Effectiveness | | | | | Rule Retroactive | Consent Decree VOC Control | Reduced 2018 Baseline | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC | | | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| | | (tpy) | | | | | | | (tpy) | | | | | (% reduction) | | | | | | (% reduction) | (tpy) | | | | |
| 2310000100 | Heaters | 40.44 | 34.37 | 0.27 | 3.19 | 2.31 | Well Count | 1.00 | 40.44 | 34.37 | 0.27 | 3.19 | 2.31 | 0% | 0% | 0% | 0% | 0% | N | 0% | 40.44 | 34.37 | 0.27 | 3.19 | 2.31 |
| 2310000220 | Drill rigs | 102.82 | 38.82 | 7.78 | 7.61 | 8.93 | Spud Count | 1.00 | 102.82 | 38.82 | 7.78 | 7.61 | 8.93 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 38.74 | 11.87 | 0.23 | 0.57 | 1.25 |
| 2310000230 | Workover rigs | 7.20 | 2.90 | 0.60 | 0.60 | 0.67 | Well Count | 1.00 | 7.20 | 2.90 | 0.60 | 0.60 | 0.67 | 62.3% | 69.4% | 97.0% | 92.5% | 86.0% | Y | 0% | 2.71 | 0.89 | 0.02 | 0.04 | 0.09 |
| 2310000300 | Pneumatic devices | - | - | - | - | 162.78 | Well Count | 1.00 | - | - | - | - | 162.78 | 0% | 0% | 0% | 0% | 0% | Y | 0% | - | - | - | 0.00 | 162.78 |
| 2310000330 | Artificial Lift | 0.86 | 0.99 | 0.00 | 0.04 | 0.26 | Oil Production | 1.00 | 0.86 | 0.99 | 0.00 | 0.04 | 0.26 | 90% | 80% | 0% | 0% | 0% | N | 0% | 0.86 | 0.99 | 0.00 | 0.04 | 0.26 |
| 2310000700 | Unpermitted Fugitives | - | - | - | - | 20.39 | Well Count | 1.00 | - | - | - | - | 20.39 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 20.39 |
| 2310000800 | Truck Loading of Condensate | - | - | - | - | 0.02 | Condensate Production | 1.00 | - | - | - | - | 0.02 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.02 |
| 2310000801 | Truck Loading of Oil | - | - | - | - | 0.38 | Oil Production | 1.00 | - | - | - | - | 0.38 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.38 |
| 2310000820 | Gas Plant Truck Loading | - | - | - | - | 0.00 | Condensate Production | 1.00 | - | - | - | - | 0.00 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.00 |
| 2310001610 | Venting - initial completions | - | - | - | - | 0.27 | Spud Count | 1.00 | - | - | - | - | 0.27 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.27 |
| 2310001611 | Initial completion Flaring | 0.01 | 0.07 | - | - | - | Spud Count | 1.00 | 0.01 | 0.07 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.01 | 0.07 | - | 0.00 | - |
| 2310001620 | Venting - recompletions | - | - | - | - | 0.04 | Spud Count | 1.00 | - | - | - | - | 0.04 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.04 |
| 2310001630 | Venting - blowdowns | - | - | - | - | 1.88 | Gas Production | 1.00 | - | - | - | - | 1.88 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 1.88 |
| 2310001640 | Venting - Compressor Startup | - | - | - | - | 5.31 | Gas Production | 1.00 | - | - | - | - | 5.31 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 5.31 |
| 2310001650 | Venting - Compressor Shutdown | - | - | - | - | 5.03 | Gas Production | 1.00 | - | - | - | - | 5.03 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 5.03 |
| 2310002230 | Condensate tank | - | - | - | - | 0.76 | Condensate Production | 1.00 | - | - | - | - | 0.76 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 0.76 |
| 2310002231 | Condensate tank flaring | 0.00 | 0.00 | - | - | - | Condensate Production | 1.00 | 0.00 | 0.00 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.00 | 0.00 | - | 0.00 | - |
| 2310002240 | Oil Tank | - | - | - | - | 5.62 | Oil Production | 1.00 | - | - | - | - | 5.62 | 0% | 0% | 0% | 0% | 0% | N | 0% | - | - | - | 0.00 | 5.62 |
| 2310003100 | Miscellaneous engines | 6.50 | 2.35 | 0.00 | 0.03 | 1.57 | Well Count | 1.00 | 6.50 | 2.35 | 0.00 | 0.03 | 1.57 | 90% | 80% | 0% | 0% | 0% | N | 0% | 6.50 | 2.35 | 0.00 | 0.03 | 1.57 |
| 2310003200 | Pneumatic pumps | - | - | - | - | 78.03 | Well Count | 1.00 | - | - | - | - | 78.03 | 0% | 0% | 0% | 0% | 0% | Y | 0% | - | - | - | 0.00 | 78.03 |
| 2310020600 | Compressor engines | 107.74 | 113.17 | - | 1.49 | 24.91 | Gas Production | 1.00 | 107.74 | 113.17 | - | 1.49 | 24.91 | 90% | 80% | 0% | 0% | 0% | N | 0% | 107.74 | 113.17 | - | 1.49 | 24.91 |
| 2310021410 | Dehydrator | 7.23 | 6.07 | - | 0.55 | 133.45 | Gas Production | 1.00 | 7.23 | 6.07 | - | 0.55 | 133.45 | 0% | 0% | 0% | 0% | 0% | N | 0% | 7.23 | 6.07 | - | 0.55 | 133.45 |
| 2310021411 | Dehydrator Flaring | 0.01 | 0.03 | - | - | - | Gas Production | 1.00 | 0.01 | 0.03 | - | - | - | 0% | 0% | 0% | 0% | 0% | N | 0% | 0.01 | 0.03 | - | 0.00 | - |
| | | 272.81 | 198.76 | 8.65 | 13.50 | 452.61 | | | 272.81 | 198.76 | 8.65 | 13.50 | 452.61 | | | | | | | | 204.24 | 169.81 | 0.52 | 5.91 | 444.36 |

# Appendix B

# Project-specific Emissions Calculations Supporting Data

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

## EXTENDED NATURAL GAS LIQUID ANALYSIS (*DHA)

| | | | |
|---|---|---|---|
| PROJECT NO. : | **200705124** | ANALYSIS NO. : | **01** |
| COMPANY NAME : | **ANADARKO** | ANALYSIS DATE: | MAY 24, 2007 |
| ACCOUNT NO. : | | SAMPLE DATE : | MAY 14, 2007 |
| PRODUCER : | | CYLINDER NO. : | Q12374 |
| LEASE NO. : | | SAMPLED BY : | J. S. JOHNSON |
| NAME/DESCRIP : | NATURAL BUTTES<br>NBU 920 - 25F | | |

| | | | |
|---|---|---|---|
| ***FIELD DATA*** | | SAMPLE TEMP. : | 78 |
| SAMPLE PRES. : | 140 | AMBIENT TEMP.: | |
| VAPOR PRES. : | | GRAVITY : | |
| COMMENTS : | GAS VOLUME: 1,061 MCF<br>MANUAL; CYL. PRESS: 140 | | |

| COMPONENT | MOLE % | MASS % | VOL % |
|---|---|---|---|
| NITROGEN (AIR) | 0.000 | 0.000 | 0.000 |
| CO2 | 0.219 | 0.091 | 0.081 |
| METHANE | 4.224 | 0.647 | 1.561 |
| ETHANE | 2.156 | 0.614 | 1.257 |
| PROPANE | 2.127 | 0.888 | 1.280 |
| I-BUTANE | 1.037 | 0.571 | 0.738 |
| N-BUTANE | 1.849 | 1.018 | 1.274 |
| 2,2 DIMETHYLPROPANE | 0.000 | 0.000 | 0.000 |
| I-PENTANE | 1.791 | 1.224 | 1.430 |
| N-PENTANE | 1.895 | 1.295 | 1.499 |
| HEXANES PLUS | 84.702 | 93.652 | 90.880 |
| TOTALS | 100.000 | 100.000 | 100.000 |

| **BTEX COMPONENTS** | **MOLE%** | **MASS%** |
|---|---|---|
| BENZENE | 0.942 | 0.697 |
| TOLUENE | 5.668 | 4.946 |
| ETHYLBENZENE | 0.431 | 0.433 |
| XYLENE | 6.198 | 6.231 |
| TOTAL BTEX | 13.239 | 12.307 |

(CALC: GPA STD 2145-94 & TP-17 @14.696 & 60 F)

| | | |
|---|---|---|
| Specific Gravity (H2O=1) = | **0.7327** | 60/60 |
| API Gravity = | **61.62** | 60/60 |
| Molecular Weight = | **105.58** | |
| Absolute Density = | **6.09** | LBS/GAL |
| Heating Value Liq. Idl Gas= | **123403** | BTU/GAL |
| Vapor/Liquid = | **21.89** | CUFT/GAL |
| Vapor Pressure = | **235.91** | PSIA & 100 F |

**(DETAILED HYDROCARBON ANALYSIS/NJ 1993) ; ASTM D6730*
*THIS DATA HAS BEEN ACQUIRED THROUGH APPLICATION OF CURRENT STATE-OF-THE-ART ANALYTICAL TECHNIQUES. THE USE OF THIS INFORMATION IS THE RESPONSIBLITY OF THE USER. EMPACT ANALYTICAL SYSTEMS, ASSUMES NO RESPONSIBLITY FOR ACCURACY OF THE REPORTED INFORMATION NOR ANY CONSEQUENCES OF IT'S APPLICATION.*

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

**EXTENDED NATURAL GAS LIQUID ANALYSIS (*DHA)**

| | | | |
|---|---|---|---|
| PROJECT NO. : | **200705124** | ANALYSIS NO. : | **01** |
| COMPANY NAME : | **ANADARKO** | ANALYSIS DATE: | MAY 24, 2007 |
| ACCOUNT NO. : | | SAMPLE DATE : | MAY 14, 2007 |
| PRODUCER : | | CYLINDER NO. : | Q12374 |
| LEASE NO. : | | SAMPLED BY : | J. S. JOHNSON |
| NAME/DESCRIP : | NATURAL BUTTES<br>NBU 920 - 25F | | |
| ***FIELD DATA*** | | SAMPLE TEMP. : | 78 |
| SAMPLE PRES. : | 140 | AMBIENT TEMP.: | |
| VAPOR PRES. : | | GRAVITY : | |
| COMMENTS : | GAS VOLUME: 1,061 MCF<br>MANUAL; CYL. PRESS: 140 | | |

TOTALS BY CARBON NUMBER

| CARBON NUMBER | MOLE% | MASS % | VOL % |
|---|---|---|---|
| Nitrogen (air) | 0.000 | 0.000 | 0.000 |
| Carbon Dioxide | 0.219 | 0.091 | 0.081 |
| Methanol | 0.000 | 0.000 | 0.000 |
| C1 | 4.224 | 0.647 | 1.561 |
| C2 | 2.156 | 0.614 | 1.257 |
| C3 | 2.127 | 0.888 | 1.280 |
| C4 | 2.886 | 1.589 | 2.012 |
| C5 | 4.122 | 2.809 | 3.211 |
| C6 | 10.147 | 8.138 | 8.302 |
| C7 | 22.854 | 21.074 | 20.240 |
| C8 | 21.942 | 23.123 | 21.913 |
| C9 | 12.345 | 14.780 | 14.465 |
| C10 | 7.924 | 11.117 | 11.057 |
| C11 | 4.019 | 6.483 | 6.290 |
| C12 | 2.222 | 3.584 | 3.476 |
| C13 | 1.535 | 2.681 | 2.577 |
| C14 | 0.845 | 1.474 | 1.418 |
| C15 | 0.306 | 0.636 | 0.600 |
| C16 | 0.114 | 0.244 | 0.231 |
| C17 | 0.011 | 0.024 | 0.023 |
| C18 | 0.002 | 0.004 | 0.006 |
| C19 | 0.000 | 0.000 | 0.000 |
| C20+ | 0.000 | 0.000 | 0.000 |
| Total | 100.000 | 100.000 | 100.000 |

| | | |
|---|---|---|
| Average Molecular Weight of Hexanes plus | = | **116.98** |
| Average Specific Gravity of Hexanes plus | = | **0.756** |
| Average Molecular Weight of Decanes plus | = | **160.26** |
| Average Specific Gravity of Decanes plus | = | **0.741** |

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

## E & P Tank / GlyCalc Information

| | | | |
|---|---|---|---|
| PROJECT NO. : | **200705124** | ANALYSIS NO. : | **01** |
| COMPANY NAME : | **ANADARKO** | ANALYSIS DATE: | MAY 24, 2007 |
| ACCOUNT NO. : | | SAMPLE DATE : | MAY 14, 2007 |
| PRODUCER : | | CYLINDER NO. : | Q12374 |
| LEASE NO. : | | SAMPLED BY : | J. S. JOHNSON |
| NAME/DESCRIP : | NATURAL BUTTES<br>NBU 920 - 25F | | |
| ***FIELD DATA*** | | SAMPLE TEMP. : | 78 |
| SAMPLE PRES. : | 140 | AMBIENT TEMP.: | |
| VAPOR PRES. : | | GRAVITY : | |
| COMMENTS : | GAS VOLUME: 1,061 MCF | | |

| COMPONENT | Mole % | | Wt % | | LV % | |
|---|---|---|---|---|---|---|
| CO2 | 0.219 | | 0.091 | | 0.081 | |
| HYDROGEN SULFIDE | 0.000 | | 0.000 | | 0.000 | |
| METHANOL | 0.000 | | 0.000 | | 0.000 | |
| NITROGEN (AIR) | 0.000 | | 0.000 | | 0.000 | |
| METHANE | 4.224 | | 0.647 | | 1.561 | |
| ETHANE | 2.156 | | 0.614 | | 1.257 | |
| PROPANE | 2.127 | | 0.888 | | 1.280 | |
| I-BUTANE | 1.037 | | 0.571 | | 0.738 | |
| N-BUTANE | 1.849 | | 1.018 | | 1.274 | |
| I-PENTANE | 1.791 | | 1.224 | | 1.430 | |
| N-PENTANE | 1.895 | | 1.295 | | 1.499 | |
| CYCLOPENTANE (N-C5) | 0.436 | | 0.290 | | 0.282 | |
| N-HEXANE | 2.805 | | 2.289 | | 2.519 | |
| CYCLOHEXANE (OTHER C6) | 2.548 | | 2.031 | | 1.891 | |
| OTHER HEXANES | 3.852 | | 3.121 | | 3.315 | |
| OTHER HEPTANES | 9.898 | | 9.351 | | 9.702 | |
| METHYLCYCLOHEXANE (OTHER C6) | 7.288 | | 6.777 | | 6.393 | |
| 2,2,4 TRIMETHYLPENTANE | 0.000 | | 0.000 | | 0.000 | |
| BENZENE | 0.942 | | 0.697 | | 0.577 | |
| TOLUENE | 5.668 | | 4.946 | | 4.145 | |
| ETHYLBENZENE | 0.431 | | 0.433 | | 0.363 | |
| XYLENES | 6.198 | | 6.231 | | 5.200 | |
| OTHER OCTANES | 15.313 | | 16.459 | | 16.350 | |
| OCTANES PLUS | ---- | 44.636 | ---- | 57.486 | ---- | 56.493 |
| NONANES | 12.345 | | 14.780 | | 14.465 | |
| DECANES PLUS | 16.978 | | 26.247 | | 25.678 | |
| SUBTOTAL | 100.000 | | 100.000 | | 100.000 | |
| OXYGEN | 0.000 | | 0.000 | | 0.000 | |
| TOTAL | 100.000 | | 100.000 | | 100.000 | |

API Gravity = **61.62** 60/60
Vapor Pressure = **235.91** PSIA & 100 F
Average Molecular Weight of Decanes plus = **160.26**
Average Specific Gravity of Decanes plus = **0.741**

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

**EXTENDED NATURAL GAS LIQUID ANALYSIS (*DHA)**

PROJECT NO. : **200705124** ANALYSIS NO. : **01**
COMPANY NAME : **ANADARKO** ANALYSIS DATE: **MAY 24, 2007**

| COMPONENT | PIANO # | MOLE % | MASS % | VOL % |
|---|---|---|---|---|
| NITROGEN (AIR) | | 0.000 | 0.000 | 0.000 |
| CO2 | | 0.219 | 0.091 | 0.081 |
| METHANE | P1 | 4.224 | 0.647 | 1.562 |
| ETHANE | P2 | 2.156 | 0.614 | 1.256 |
| PROPANE | P3 | 2.127 | 0.888 | 1.280 |
| I-BUTANE | I4 | 1.037 | 0.571 | 0.738 |
| N-BUTANE | P4 | 1.849 | 1.018 | 1.274 |
| 2,2 DIMETHYLPROPANE | I5 | 0.000 | 0.000 | 0.000 |
| I-PENTANE | I5 | 1.791 | 1.224 | 1.430 |
| N-PENTANE | P5 | 1.895 | 1.295 | 1.499 |
| 2,2 DIMETHYLBUTANE | I6 | 0.157 | 0.128 | 0.144 |
| METHANOL | X1 | 0.000 | 0.000 | 0.000 |
| CYCLOPENTANE | N5 | 0.436 | 0.290 | 0.282 |
| 2 METHYLPENTANE | I6 | 1.534 | 1.252 | 1.389 |
| 3 METHYLPENTANE | I6 | 0.980 | 0.800 | 0.871 |
| N-HEXANE | P6 | 2.805 | 2.289 | 2.519 |
| 2,2-DIMETHYLPENTANE | I7 | 0.075 | 0.071 | 0.075 |
| METHYLCYCLOPENTANE | N6 | 1.181 | 0.941 | 0.911 |
| 2,4 DIMETHYLPENTANE | I7 | 0.377 | 0.358 | 0.386 |
| 2,2,3 TRIMETHYLBUTANE | I7 | 0.102 | 0.097 | 0.104 |
| BENZENE | A6 | 0.942 | 0.697 | 0.577 |
| 3,3 DIMETHYLPENTANE | I7 | 0.139 | 0.132 | 0.138 |
| CYCLOHEXANE | N6 | 2.548 | 2.031 | 1.891 |
| 2 METHYLHEXANE | I7 | 0.705 | 0.669 | 0.715 |
| 2,3 DIMETHYLPENTANE | I7 | 0.692 | 0.656 | 0.686 |
| 1,1 DIMETHYLCYCLOPENTANE | N7 | 0.474 | 0.441 | 0.421 |
| 3 METHYLHEXANE | I7 | 1.320 | 1.253 | 1.320 |
| 1,C 3 DIMETHYLCYCLOPENTANE | N7 | 0.398 | 0.370 | 0.363 |
| 1,T 3 DIMETHYLCYCLOPENTANE | N7 | 0.286 | 0.266 | 0.259 |
| 3 ETHYLPENTANE | I7 | 0.131 | 0.124 | 0.127 |
| 1,T 2 DIMETHYLCYCLOPENTANE | N7 | 0.877 | 0.816 | 0.790 |
| N-HEPTANE | P7 | 4.063 | 3.856 | 4.093 |
| 1,C 2 DIMETHYLCYCLOPENTANE | N7 | 0.008 | 0.008 | 0.006 |
| METHYLCYCLOHEXANE | N7 | 7.288 | 6.777 | 6.393 |
| 2,2-DIMETHYLHEXANE | I8 | 1.314 | 1.421 | 1.441 |
| ETHYLCYCLOPENTANE | N7 | 0.251 | 0.234 | 0.219 |
| 2,2,3-TRIMETHYLPENTANE | I8 | 0.226 | 0.245 | 0.248 |
| 2,4-DIMETHYLHEXANE | I8 | 0.358 | 0.387 | 0.404 |
| 1C,2T,4-TRIMETHYLCYCLOPENTANE | N8 | 0.131 | 0.139 | 0.133 |

PROJECT NO. : **200705124** ANALYSIS NO. : **01**
COMPANY NAME : **ANADARKO** ANALYSIS DATE: **MAY 24, 2007**

| COMPONENT | PIANO # | MOLE % | MASS % | VOL % |
|---|---|---|---|---|
| 3,3-DIMETHYLHEXANE | I8 | 0.170 | 0.184 | 0.184 |
| 2,3,4-TRIMETHYLPENTANE | I8 | 0.036 | 0.039 | 0.040 |
| 2,3,3-TRIMETHYLPENTANE | I8 | 0.004 | 0.005 | 0.006 |
| TOLUENE | A7 | 5.668 | 4.946 | 4.145 |
| 2,3-DIMETHYLHEXANE | I8 | 0.297 | 0.321 | 0.329 |
| 2-METHYL-3-ETHYLPENTANE | I8 | 0.127 | 0.137 | 0.127 |
| 1,1,2-TRIMETHCYCLOPENTANE | N8 | 0.072 | 0.078 | 0.081 |
| 2-METHYLHEPTANE | I8 | 0.747 | 0.808 | 0.842 |
| 4-METHYLHEPTANE | I8 | 0.642 | 0.695 | 0.715 |
| 3-METHYL-3-ETHYLPENTANE | I8 | 0.095 | 0.103 | 0.098 |
| 3,4-DIMETHYLHEXANE | I8 | 0.070 | 0.075 | 0.075 |
| 1C,2C,4-TRIMETHYLCYCLOPENTANE | N8 | 0.258 | 0.274 | 0.254 |
| 3-METHYLHEPTANE | I8 | 0.710 | 0.768 | 0.790 |
| 1C,2T,3-TRIMETHYLCYCLOPENTANE | N8 | 1.266 | 1.346 | 1.239 |
| 3-ETHYLHEXANE | I8 | 0.200 | 0.216 | 0.219 |
| 1T,4-DIMETHYLCYCLOHEXANE | N8 | 1.922 | 2.042 | 1.943 |
| 1,1-DIMETHYLCYCLOHEXANE | N8 | 0.470 | 0.499 | 0.461 |
| 3C-ETHYLMETHYLCYCLOPENTANE | N8 | 0.053 | 0.056 | 0.052 |
| 3T-ETHYLMETHYLCYCLOPENTANE | N8 | 0.120 | 0.128 | 0.115 |
| 2T-ETHYLMETHYLCYCLOPENTANE | N8 | 0.068 | 0.072 | 0.063 |
| 1,1-METHYLETHYLCYCLOPENTANE | N8 | 0.115 | 0.122 | 0.110 |
| 2,2,4-TRIMETHYLHEXANE | I9 | 0.063 | 0.077 | 0.075 |
| 1T,2-DIMETHYLCYCLOHEXANE | N8 | 0.794 | 0.844 | 0.778 |
| N-OCTANE | P8 | 3.439 | 3.720 | 3.845 |
| 2,4,4-TRIMETHYLHEXANE | I9 | 0.235 | 0.286 | 0.288 |
| 1C,2-DIMETHYLCYCLOHEXANE | N8 | 0.093 | 0.099 | 0.092 |
| 2,2-DIMETHYLHEPTANE | I9 | 0.068 | 0.082 | 0.081 |
| 2,3,5-TRIMETHYLHEXANE | I9 | 0.121 | 0.147 | 0.150 |
| 1,1,4-TRIMETHYLCYCLOHEXANE | N9 | 0.839 | 1.004 | 0.945 |
| 2,2,3-TRIMETHYLHEXANE | I9 | 0.447 | 0.543 | 0.553 |
| ETHYLCYCLOHEXANE | N9 | 0.261 | 0.312 | 0.294 |
| N-PROPYLCYCLOPENTANE | N8 | 0.248 | 0.264 | 0.248 |
| 1C,3C,5-TRIMETHYLCYCLOHEXANE | N9 | 0.140 | 0.168 | 0.156 |
| 3,5-DIMETHYLHEPTANE | I9 | 0.061 | 0.075 | 0.075 |
| 2,6-DIMETHYLHEPTANE | I9 | 0.038 | 0.046 | 0.046 |
| 2,5-DIMETHYLHEPTANE | I9 | 0.073 | 0.088 | 0.092 |
| 3,3-DIMETHYLHEPTANE | I9 | 0.106 | 0.128 | 0.127 |
| ETHYLBENZENE | A8 | 0.431 | 0.433 | 0.363 |
| 1C,2T,4T-TRIMETHYLCYCLOHEXANE | N9 | 0.053 | 0.063 | 0.058 |
| 1,3-DIMETHYLBENZENE (M-XYLENE) | A8 | 3.655 | 3.674 | 3.067 |
| 1,4-DIMETHYLBENZENE (P-XYLENE) | A8 | 1.423 | 1.431 | 1.193 |
| 3,4-DIMETHYLHEPTANE | I9 | 1.389 | 1.686 | 1.678 |
| 4-METHYLOCTANE | I9 | 0.234 | 0.285 | 0.288 |
| 2-METHYLOCTANE | I9 | 0.833 | 1.012 | 1.032 |
| 1C,2T,3-TRIMETHYLCYCLOHEXANE | N9 | 0.196 | 0.239 | 0.242 |
| 3-ETHYLHEPTANE | I9 | 0.112 | 0.136 | 0.138 |

PROJECT NO. : **200705124** ANALYSIS NO. : **01**

COMPANY NAME : **ANADARKO** ANALYSIS DATE: **MAY 24, 2007**

| COMPONENT | PIANO # | MOLE % | MASS % | VOL % |
|---|---|---|---|---|
| 3-METHYLOCTANE | I9 | 0.537 | 0.653 | 0.657 |
| 1C,2T,4C-TRIMETHYLCYCLOHEXANE | N9 | 0.184 | 0.220 | 0.202 |
| 1,1,2-TRIMETHYLCYCLOHEXANE | N9 | 0.011 | 0.012 | 0.012 |
| 1,2-DIMETHYLBENZENE (O-XYLENE) | A8 | 1.120 | 1.126 | 0.940 |
| I-BUTYCYCLOPENTANE | N9 | 0.285 | 0.341 | 0.306 |
| UNKNOWN OCTANE'S | U8 | 1.268 | 1.372 | 1.418 |
| N-NONANE | P9 | 2.777 | 3.373 | 3.413 |
| I-PROPYLBENZENE | A9 | 0.292 | 0.294 | 0.242 |
| I-PROPYLCYCLOHEXANE | N9 | 0.358 | 0.360 | 0.300 |
| 2,4-DIMETHYLOCTANE | I10 | 0.324 | 0.437 | 0.427 |
| 2,6-DIMETHYLOCTANE | I10 | 0.427 | 0.575 | 0.582 |
| N-BUTYCYCLOPENTANE | N9 | 0.570 | 0.682 | 0.617 |
| 3,3-DIMETHYLOCTANE | I10 | 0.316 | 0.426 | 0.421 |
| N-PROPYLBENZENE | A9 | 0.479 | 0.546 | 0.455 |
| 3,6-DIMETHYLOCTANE | I10 | 0.051 | 0.069 | 0.069 |
| 3-METHYL-5-ETHYLHEPTANE | I10 | 0.069 | 0.084 | 0.081 |
| UNKNOWN NONANE'S | U9 | 1.583 | 1.922 | 1.943 |
| N-DECANE | P10 | 2.315 | 3.273 | 3.257 |
| UNKNOWN DECANE'S | U10 | 4.422 | 6.253 | 6.220 |
| N-UNDECANE | P11 | 4.019 | 6.483 | 6.290 |
| DODECANES | C12'S | 2.222 | 3.584 | 3.476 |
| TRIDECANES | C13'S | 1.535 | 2.681 | 2.577 |
| TETRADECANES | C14'S | 0.845 | 1.474 | 1.418 |
| PENTADECANES | C15'S | 0.306 | 0.636 | 0.600 |
| HEXADECANES | C16'S | 0.114 | 0.244 | 0.231 |
| HEPTADECANES | C17'S | 0.011 | 0.024 | 0.023 |
| OCTADECANES | C18'S | 0.002 | 0.004 | 0.006 |
| TOTALS | | 100.000 | 100.000 | 100.000 |

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

## EXTENDED NATURAL GAS LIQUID ANALYSIS (*DHA)

| | | | |
|---|---|---|---|
| PROJECT NO. : | **200705124** | ANALYSIS NO. : | **02** |
| COMPANY NAME : | **ANADARKO** | ANALYSIS DATE: | MAY 24, 2007 |
| ACCOUNT NO. : | | SAMPLE DATE : | MAY 14, 2007 |
| PRODUCER : | | CYLINDER NO. : | Q11074 |
| LEASE NO. : | | SAMPLED BY : | J. S. JOHNSON |
| NAME/DESCRIP : | NATURAL BUTTES<br>NBU 920 - 25O | | |

| | | | |
|---|---|---|---|
| ***FIELD DATA*** | | SAMPLE TEMP. : | 79 |
| SAMPLE PRES. : | 100 | AMBIENT TEMP.: | |
| VAPOR PRES. : | | GRAVITY : | |
| COMMENTS : | MANUAL; CYL. PRESS: 100 | | |

| COMPONENT | MOLE % | MASS % | VOL % |
|---|---|---|---|
| NITROGEN (AIR) | 0.000 | 0.000 | 0.000 |
| CO2 | 0.618 | 0.254 | 0.229 |
| METHANE | 3.864 | 0.569 | 1.423 |
| ETHANE | 1.778 | 0.499 | 1.029 |
| PROPANE | 1.794 | 0.738 | 1.069 |
| I-BUTANE | 0.845 | 0.458 | 0.600 |
| N-BUTANE | 1.561 | 0.847 | 1.063 |
| 2,2 DIMETHYLPROPANE | 0.000 | 0.000 | 0.000 |
| I-PENTANE | 1.544 | 1.040 | 1.223 |
| N-PENTANE | 1.647 | 1.109 | 1.292 |
| HEXANES PLUS | 86.349 | 94.486 | 92.072 |
| TOTALS | 100.000 | 100.000 | 100.000 |

| **BTEX COMPONENTS** | **MOLE%** | **MASS%** |
|---|---|---|
| BENZENE | 0.871 | 0.635 |
| TOLUENE | 5.646 | 4.854 |
| ETHYLBENZENE | 0.466 | 0.462 |
| XYLENE | 6.947 | 6.882 |
| TOTAL BTEX | 13.930 | 12.833 |

(CALC: GPA STD 2145-94 & TP-17 @14.696 & 60 F)

| | | |
|---|---|---|
| Specific Gravity (H2O=1) = | **0.7353** | 60/60 |
| API Gravity = | **60.94** | 60/60 |
| Molecular Weight = | **107.18** | |
| Absolute Density = | **6.13** | LBS/GAL |
| Heating Value Liq. Idl Gas= | **123624** | BTU/GAL |
| Vapor/Liquid = | **21.67** | CUFT/GAL |
| Vapor Pressure = | **213.58** | PSIA & 100 F |

**(DETAILED HYDROCARBON ANALYSIS/NJ 1993) ; ASTM D6730*
*THIS DATA HAS BEEN ACQUIRED THROUGH APPLICATION OF CURRENT STATE-OF-THE-ART ANALYTICAL TECHNIQUES. THE USE OF THIS INFORMATION IS THE RESPONSIBLITY OF THE USER. EMPACT ANALYTICAL SYSTEMS, ASSUMES NO RESPONSIBLITY FOR ACCURACY OF THE REPORTED INFORMATION NOR ANY CONSEQUENCES OF IT'S APPLICATION.*

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

**EXTENDED NATURAL GAS LIQUID ANALYSIS (*DHA)**

| | | | |
|---|---|---|---|
| PROJECT NO. : | **200705124** | ANALYSIS NO. : | **02** |
| COMPANY NAME : | **ANADARKO** | ANALYSIS DATE: | MAY 24, 2007 |
| ACCOUNT NO. : | | SAMPLE DATE : | MAY 14, 2007 |
| PRODUCER : | | CYLINDER NO. : | Q11074 |
| LEASE NO. : | | SAMPLED BY : | J. S. JOHNSON |
| NAME/DESCRIP : | NATURAL BUTTES<br>NBU 920 - 25O | | |
| ***FIELD DATA*** | | SAMPLE TEMP. : | 79 |
| SAMPLE PRES. : | 100 | AMBIENT TEMP.: | |
| VAPOR PRES. : | | GRAVITY : | |
| COMMENTS : | MANUAL; CYL. PRESS: 100 | | |

TOTALS BY CARBON NUMBER

| CARBON NUMBER | MOLE% | MASS % | VOL % |
|---|---|---|---|
| Nitrogen (air) | 0.000 | 0.000 | 0.000 |
| Carbon Dioxide | 0.618 | 0.254 | 0.229 |
| Methanol | 0.000 | 0.000 | 0.000 |
| C1 | 3.864 | 0.569 | 1.423 |
| C2 | 1.778 | 0.499 | 1.029 |
| C3 | 1.794 | 0.738 | 1.069 |
| C4 | 2.406 | 1.305 | 1.663 |
| C5 | 3.611 | 2.424 | 2.784 |
| C6 | 9.504 | 7.509 | 7.688 |
| C7 | 22.715 | 20.631 | 19.935 |
| C8 | 23.337 | 24.205 | 23.028 |
| C9 | 12.817 | 15.083 | 14.796 |
| C10 | 8.031 | 11.102 | 11.109 |
| C11 | 4.344 | 6.904 | 6.740 |
| C12 | 2.384 | 3.788 | 3.699 |
| C13 | 1.531 | 2.634 | 2.550 |
| C14 | 0.784 | 1.350 | 1.304 |
| C15 | 0.329 | 0.672 | 0.640 |
| C16 | 0.114 | 0.241 | 0.229 |
| C17 | 0.024 | 0.054 | 0.051 |
| C18 | 0.008 | 0.018 | 0.017 |
| C19 | 0.002 | 0.006 | 0.006 |
| C20+ | 0.005 | 0.014 | 0.011 |
| Total | 100.000 | 100.000 | 100.000 |

| | | |
|---|---|---|
| Average Molecular Weight of Hexanes plus | = | **117.50** |
| Average Specific Gravity of Hexanes plus | = | **0.755** |
| Average Molecular Weight of Decanes plus | = | **159.08** |
| Average Specific Gravity of Decanes plus | = | **0.742** |

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

## E & P Tank / GlyCalc Information

| | | | |
|---|---|---|---|
| PROJECT NO. : | **200705124** | ANALYSIS NO. : | **02** |
| COMPANY NAME : | **ANADARKO** | ANALYSIS DATE: | MAY 24, 2007 |
| ACCOUNT NO. : | | SAMPLE DATE : | MAY 14, 2007 |
| PRODUCER : | | CYLINDER NO. : | Q11074 |
| LEASE NO. : | | SAMPLED BY : | J. S. JOHNSON |
| NAME/DESCRIP : | NATURAL BUTTES<br>NBU 920 - 25O | | |
| ***FIELD DATA*** | | SAMPLE TEMP. : | 79 |
| SAMPLE PRES. : | 100 | AMBIENT TEMP.: | |
| VAPOR PRES. : | | GRAVITY : | |
| COMMENTS : | MANUAL; CYL. PRESS: 100 | | |

| COMPONENT | Mole % | | Wt % | | LV % | |
|---|---|---|---|---|---|---|
| CO2 | 0.618 | | 0.254 | | 0.229 | |
| METHANOL | 0.000 | | 0.000 | | 0.000 | |
| NITROGEN (AIR) | 0.000 | | 0.000 | | 0.000 | |
| METHANE | 3.864 | | 0.569 | | 1.423 | |
| ETHANE | 1.778 | | 0.499 | | 1.029 | |
| PROPANE | 1.794 | | 0.738 | | 1.069 | |
| I-BUTANE | 0.845 | | 0.458 | | 0.600 | |
| N-BUTANE | 1.561 | | 0.847 | | 1.063 | |
| I-PENTANE | 1.544 | | 1.040 | | 1.223 | |
| N-PENTANE | 1.647 | | 1.109 | | 1.292 | |
| CYCLOPENTANE (N-C5) | 0.420 | | 0.275 | | 0.269 | |
| N-HEXANE | 2.588 | | 2.081 | | 2.304 | |
| CYCLOHEXANE (OTHER C6) | 2.441 | | 1.917 | | 1.795 | |
| OTHER HEXANES | 3.604 | | 2.876 | | 3.063 | |
| OTHER HEPTANES | 9.616 | | 8.949 | | 9.358 | |
| METHYLCYCLOHEXANE (OTHER C6) | 7.453 | | 6.828 | | 6.483 | |
| 2,2,4 TRIMETHYLPENTANE | 0.000 | | 0.000 | | 0.000 | |
| BENZENE | 0.871 | | 0.635 | | 0.526 | |
| TOLUENE | 5.646 | | 4.854 | | 4.094 | |
| ETHYLBENZENE | 0.466 | | 0.462 | | 0.389 | |
| XYLENES | 6.947 | | 6.882 | | 5.780 | |
| OTHER OCTANES | 15.924 | | 16.861 | | 16.859 | |
| OCTANES PLUS | ---- | 46.297 | ---- | 58.727 | ---- | 58.011 |
| NONANES | 12.817 | | 15.083 | | 14.796 | |
| DECANES PLUS | 17.556 | | 26.783 | | 26.356 | |
| SUBTOTAL | 100.000 | | 100.000 | | 100.000 | |
| OXYGEN | 0.000 | | 0.000 | | 0.000 | |
| TOTAL | 100.000 | | 100.000 | | 100.000 | |

| | | |
|---|---|---|
| API Gravity = | **60.94** | 60/60 |
| Vapor Pressure = | **213.58** | PSIA & 100 F |
| Average Molecular Weight of Decanes plus = | **159.08** | |
| Average Specific Gravity of Decanes plus = | **0.742** | |

# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET
BRIGHTON, CO 80601
(303) 637-0150

**EXTENDED NATURAL GAS LIQUID ANALYSIS (*DHA)**

PROJECT NO. : **200705124** ANALYSIS NO. : **02**
COMPANY NAME : **ANADARKO** ANALYSIS DATE: **MAY 24, 2007**

| COMPONENT | PIANO # | MOLE % | MASS % | VOL % |
|---|---|---|---|---|
| NITROGEN (AIR) | | 0.000 | 0.000 | 0.000 |
| CO2 | | 0.618 | 0.254 | 0.229 |
| METHANE | P1 | 3.864 | 0.569 | 1.423 |
| ETHANE | P2 | 1.778 | 0.499 | 1.029 |
| PROPANE | P3 | 1.794 | 0.738 | 1.069 |
| I-BUTANE | I4 | 0.845 | 0.458 | 0.600 |
| N-BUTANE | P4 | 1.561 | 0.847 | 1.063 |
| 2,2 DIMETHYLPROPANE | I5 | 0.000 | 0.000 | 0.000 |
| I-PENTANE | I5 | 1.544 | 1.040 | 1.223 |
| N-PENTANE | P5 | 1.647 | 1.109 | 1.292 |
| 2,2 DIMETHYLBUTANE | I6 | 0.148 | 0.119 | 0.131 |
| METHANOL | X1 | 0.000 | 0.000 | 0.000 |
| CYCLOPENTANE | N5 | 0.420 | 0.275 | 0.269 |
| 2,3 DIMETHYLBUTANE | I6 | 0.000 | 0.000 | 0.000 |
| 2 METHYLPENTANE | I6 | 1.366 | 1.099 | 1.229 |
| 3 METHYLPENTANE | I6 | 0.886 | 0.713 | 0.783 |
| N-HEXANE | P6 | 2.588 | 2.081 | 2.304 |
| 2,2-DIMETHYLPENTANE | I7 | 0.077 | 0.072 | 0.080 |
| METHYLCYCLOPENTANE | N6 | 1.204 | 0.945 | 0.920 |
| 2,4 DIMETHYLPENTANE | I7 | 0.307 | 0.287 | 0.314 |
| 2,2,3 TRIMETHYLBUTANE | I7 | 0.091 | 0.085 | 0.091 |
| BENZENE | A6 | 0.871 | 0.635 | 0.526 |
| 3,3 DIMETHYLPENTANE | I7 | 0.118 | 0.110 | 0.114 |
| CYCLOHEXANE | N6 | 2.441 | 1.917 | 1.795 |
| 2 METHYLHEXANE | I7 | 0.801 | 0.749 | 0.806 |
| 2,3 DIMETHYLPENTANE | I7 | 0.567 | 0.530 | 0.555 |
| 1,1 DIMETHYLCYCLOPENTANE | N7 | 0.424 | 0.389 | 0.377 |
| 3 METHYLHEXANE | I7 | 1.286 | 1.202 | 1.281 |
| 1,C 3 DIMETHYLCYCLOPENTANE | N7 | 0.392 | 0.359 | 0.354 |
| 1,T 3 DIMETHYLCYCLOPENTANE | N7 | 0.311 | 0.285 | 0.280 |
| 3 ETHYLPENTANE | I7 | 0.103 | 0.096 | 0.103 |
| 1,T 2 DIMETHYLCYCLOPENTANE | N7 | 0.841 | 0.771 | 0.749 |
| N-HEPTANE | P7 | 4.037 | 3.775 | 4.031 |
| 1,C 2 DIMETHYLCYCLOPENTANE | N7 | 0.009 | 0.008 | 0.006 |
| METHYLCYCLOHEXANE | N7 | 7.453 | 6.828 | 6.483 |
| 2,2-DIMETHYLHEXANE | I8 | 1.182 | 1.260 | 1.286 |
| ETHYLCYCLOPENTANE | N7 | 0.252 | 0.231 | 0.217 |
| 2,5-DIMETHYLHEXANE | I8 | 0.218 | 0.232 | 0.246 |
| 2,4-DIMETHYLHEXANE | I8 | 0.332 | 0.354 | 0.366 |

PROJECT NO. : **200705124** ANALYSIS NO. : **02**
COMPANY NAME : **ANADARKO** ANALYSIS DATE: **MAY 24, 2007**

| COMPONENT | PIANO # | MOLE % | MASS % | VOL % |
|---|---|---|---|---|
| 1C,2T,4-TRIMETHYLCYCLOPENTANE | N8 | 0.137 | 0.144 | 0.137 |
| 3,3-DIMETHYLHEXANE | I8 | 0.167 | 0.178 | 0.183 |
| 2,3,4-TRIMETHYLPENTANE | I8 | 0.034 | 0.036 | 0.034 |
| 2,3,3-TRIMETHYLPENTANE | I8 | 0.006 | 0.007 | 0.006 |
| TOLUENE | A7 | 5.646 | 4.854 | 4.094 |
| 2,3-DIMETHYLHEXANE | I8 | 0.327 | 0.348 | 0.360 |
| 2-METHYL-3-ETHYLPENTANE | I8 | 0.094 | 0.100 | 0.091 |
| 1,1,2-TRIMETHCYCLOPENTANE | N8 | 0.028 | 0.030 | 0.029 |
| 2-METHYLHEPTANE | I8 | 0.881 | 0.939 | 0.983 |
| 4-METHYLHEPTANE | I8 | 0.704 | 0.751 | 0.778 |
| 3-METHYL-3-ETHYLPENTANE | I8 | 0.071 | 0.075 | 0.069 |
| 3,4-DIMETHYLHEXANE | I8 | 0.069 | 0.073 | 0.074 |
| 1C,2C,4-TRIMETHYLCYCLOPENTANE | N8 | 0.168 | 0.176 | 0.166 |
| 3-METHYLHEPTANE | I8 | 0.804 | 0.857 | 0.886 |
| 1C,2T,3-TRIMETHYLCYCLOPENTANE | N8 | 1.406 | 1.472 | 1.366 |
| 3-ETHYLHEXANE | I8 | 0.330 | 0.352 | 0.360 |
| 1T,4-DIMETHYLCYCLOHEXANE | N8 | 1.783 | 1.867 | 1.789 |
| 1,1-DIMETHYLCYCLOHEXANE | N8 | 0.482 | 0.505 | 0.475 |
| 3C-ETHYLMETHYLCYCLOPENTANE | N8 | 0.047 | 0.049 | 0.046 |
| 3T-ETHYLMETHYLCYCLOPENTANE | N8 | 0.122 | 0.128 | 0.120 |
| 2T-ETHYLMETHYLCYCLOPENTANE | N8 | 0.068 | 0.071 | 0.063 |
| 1,1-METHYLETHYLCYCLOPENTANE | N8 | 0.119 | 0.124 | 0.114 |
| 2,2,4-TRIMETHYLHEXANE | I9 | 0.062 | 0.074 | 0.074 |
| 1T,2-DIMETHYLCYCLOHEXANE | N8 | 0.811 | 0.849 | 0.789 |
| N-OCTANE | P8 | 4.048 | 4.314 | 4.488 |
| I-PROPYLCYCLOPENTANE | N8 | 0.249 | 0.260 | 0.240 |
| 1C,2-DIMETHYLCYCLOHEXANE | N8 | 0.108 | 0.113 | 0.103 |
| 2,2-DIMETHYLHEPTANE | I9 | 0.073 | 0.087 | 0.086 |
| 2,3,5-TRIMETHYLHEXANE | I9 | 0.118 | 0.141 | 0.143 |
| 1,1,4-TRIMETHYLCYCLOHEXANE | N9 | 0.958 | 1.128 | 1.069 |
| 2,2,3-TRIMETHYLHEXANE | I9 | 0.442 | 0.528 | 0.543 |
| ETHYLCYCLOHEXANE | N9 | 0.267 | 0.314 | 0.297 |
| N-PROPYLCYCLOPENTANE | N8 | 0.309 | 0.323 | 0.303 |
| 1C,3C,5-TRIMETHYLCYCLOHEXANE | N9 | 0.125 | 0.148 | 0.137 |
| 3,5-DIMETHYLHEPTANE | I9 | 0.053 | 0.063 | 0.063 |
| 2,6-DIMETHYLHEPTANE | I9 | 0.013 | 0.015 | 0.017 |
| 2,5-DIMETHYLHEPTANE | I9 | 0.066 | 0.080 | 0.080 |
| 3,3-DIMETHYLHEPTANE | I9 | 0.096 | 0.115 | 0.114 |
| ETHYLBENZENE | A8 | 0.466 | 0.462 | 0.389 |
| 1C,2T,4T-TRIMETHYLCYCLOHEXANE | N9 | 0.130 | 0.153 | 0.143 |
| 1,3-DIMETHYLBENZENE (M-XYLENE) | A8 | 4.309 | 4.269 | 3.585 |
| 1,4-DIMETHYLBENZENE (P-XYLENE) | A8 | 1.485 | 1.471 | 1.235 |
| 3,4-DIMETHYLHEPTANE | I9 | 0.541 | 0.648 | 0.646 |
| 4-METHYLOCTANE | I9 | 0.258 | 0.309 | 0.314 |
| 2-METHYLOCTANE | I9 | 0.897 | 1.073 | 1.098 |
| 1C,2T,3-TRIMETHYLCYCLOHEXANE | N9 | 0.173 | 0.207 | 0.212 |

PROJECT NO. : **200705124** ANALYSIS NO. : **02**

COMPANY NAME : **ANADARKO** ANALYSIS DATE: **MAY 24, 2007**

| COMPONENT | PIANO # | MOLE % | MASS % | VOL % |
|---|---|---|---|---|
| 3-ETHYLHEPTANE | I9 | 0.119 | 0.143 | 0.143 |
| 3-METHYLOCTANE | I9 | 0.587 | 0.703 | 0.715 |
| 1C,2T,4C-TRIMETHYLCYCLOHEXANE | N9 | 0.150 | 0.177 | 0.166 |
| 1,1,2-TRIMETHYLCYCLOHEXANE | N9 | 0.015 | 0.018 | 0.017 |
| 1,2-DIMETHYLBENZENE (O-XYLENE) | A8 | 1.153 | 1.142 | 0.960 |
| I-BUTYCYCLOPENTANE | N9 | 0.325 | 0.382 | 0.349 |
| UNKNOWN OCTANE'S | U8 | 0.820 | 0.874 | 0.909 |
| N-NONANE | P9 | 3.108 | 3.719 | 3.785 |
| I-PROPYLBENZENE | A9 | 0.346 | 0.343 | 0.286 |
| I-PROPYLCYCLOHEXANE | N9 | 0.372 | 0.368 | 0.309 |
| 2,4-DIMETHYLOCTANE | I10 | 0.372 | 0.494 | 0.486 |
| 2,6-DIMETHYLOCTANE | I10 | 0.412 | 0.546 | 0.560 |
| N-BUTYCYCLOPENTANE | N9 | 0.599 | 0.706 | 0.640 |
| 3,3-DIMETHYLOCTANE | I10 | 0.346 | 0.460 | 0.452 |
| N-PROPYLBENZENE | A9 | 0.764 | 0.857 | 0.720 |
| 3,6-DIMETHYLOCTANE | I10 | 0.063 | 0.084 | 0.086 |
| 3-METHYL-5-ETHYLHEPTANE | I10 | 0.044 | 0.052 | 0.051 |
| UNKNOWN NONANE'S | U9 | 2.160 | 2.584 | 2.630 |
| N-DECANE | P10 | 2.501 | 3.485 | 3.488 |
| UNKNOWN DECANE'S | U10 | 4.293 | 5.981 | 5.986 |
| N-UNDECANE | P11 | 1.611 | 2.561 | 2.498 |
| UNKNOWN UNDECANE'S | U11 | 2.733 | 4.343 | 4.242 |
| DODECANES | C12'S | 2.384 | 3.788 | 3.699 |
| TRIDECANES | C13'S | 1.531 | 2.634 | 2.550 |
| TETRADECANES | C14'S | 0.784 | 1.350 | 1.304 |
| PENTADECANES | C15'S | 0.329 | 0.672 | 0.640 |
| HEXADECANES | C16'S | 0.114 | 0.241 | 0.229 |
| HEPTADECANES | C17'S | 0.024 | 0.054 | 0.051 |
| OCTADECANES | C18'S | 0.008 | 0.018 | 0.017 |
| NONADECANES | C19'S | 0.002 | 0.006 | 0.006 |
| EISCOSANE+ | C20'S | 0.005 | 0.014 | 0.011 |
| TOTALS | | 100.000 | 100.000 | 100.000 |

```
*******************************************************************************
*     Project Setup Information                                               *
*******************************************************************************
Project File              : C:\Documents and Settings\ehodek\My Documents\Uintah Old Well 072009.ept
Flowsheet Selection       : Oil Tank with Separator
Calculation Method        : RVP Distillation
Control Efficiency        : 100.0%
Known Separator Stream    : High Pressure Oil
Entering Air Composition  : No

Filed Name                : Greater Natural Buttes
Well Name                 : Old Well
Date                      : 2008.03.25


*******************************************************************************
*     Data Input                                                              *
*******************************************************************************

Separator Pressure        : 90.00[psig]
Separator Temperature     : 78.00[F]
Ambient Pressure          : 14.70[psia]
Ambient Temperature       : 70.00[F]
C10+ SG                   : 0.7400
C10+ MW                   : 159.67

-- High Pressure Oil ----------------------------------------------------------------
          Component             mol %
          H2S                   0.0000
No.       O2                    0.0000
 1        CO2                   0.4190
 2        N2                    0.0000
 3        C1                    4.0438
 4        C2                    1.9669
 5        C3                    1.9609
 6        i-C4                  0.9410
 7        n-C4                  1.7049
 8        i-C5                  1.6679
 9        n-C5                  2.1989
 10       C6                    6.2227
 11       C7                   17.1271
 12       C8                   15.6182
 13       C9                   12.5804
 14       C10+                 17.2661
 15       Benzene               0.9069
 16       Toluene               5.6567
 17       E-Benzene             0.4490
 18
 19
```

| | | |
|---|---|---|
| | Xylenes | 6.5727 |
| 20 | n-C6 | 2.6969 |
| 21 | 224Trimethylp | 0.0000 |
| 22 | | |

-- Sales Oil ----------

Production Rate : 3[bbl/day]
Days of Annual Operation : 365 [days/year]
API Gravity : 61.28
Reid Vapor Pressure : 7.25[psia]

**********
* Calculation Results *
**********

-- Emission Summary ----------

| Item | Uncontrolled | Uncontrolled [lb/hr] | Controlled [ton/yr] | Controlled [lb/hr] |
|---|---|---|---|---|
| Total HAPs | 0.080 | 0.018 | 0.013 | 0.003 |
| Page 1---------- E&P TANK | | | | |
| Total HC | 2.401 | 0.548 | 0.400 | 0.091 |
| VOCs, C2+ | 1.796 | 0.410 | 0.299 | 0.068 |
| VOCs, C3+ | 1.273 | 0.291 | 0.212 | 0.048 |

Uncontrolled Recovery Info.
167.4000 x1E-3 [MSCFD]
158.7100 x1E-3 [MSCFD]
55.80 [SCF/bbl]

-- Emission Composition ----------

| No. | Component | Uncontrolled | Uncontrolled [lb/hr] | Controlled [ton/yr] | Controlled [lb/hr] |
|---|---|---|---|---|---|
| 1 | H2S | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | O2 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | CO2 | 0.184 | 0.042 | 0.613 | 0.140 |
| 4 | N2 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | C1 | 0.605 | 0.138 | 0.101 | 0.023 |
| 6 | C2 | 0.522 | 0.119 | 0.087 | 0.020 |
| 7 | C3 | 0.427 | 0.097 | 0.071 | 0.016 |
| 8 | i-C4 | 0.133 | 0.030 | 0.022 | 0.005 |
| 9 | n-C4 | 0.177 | 0.040 | 0.030 | 0.007 |
| 10 | i-C5 | 0.090 | 0.021 | 0.015 | 0.003 |
| 11 | n-C5 | 0.089 | 0.020 | 0.015 | 0.003 |
| 12 | C6 | 0.106 | 0.024 | 0.018 | 0.004 |
| 13 | C7 | 0.116 | 0.026 | 0.019 | 0.004 |
| 14 | C8 | 0.040 | 0.009 | 0.007 | 0.002 |
| 15 | C9 | 0.013 | 0.003 | 0.002 | 0.000 |
| 16 | C10+ | 0.003 | 0.001 | 0.001 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| 17 | Benzene | 0.010 | 0.002 | 0.002 | 0.000 |
| 18 | Toluene | 0.022 | 0.005 | 0.004 | 0.001 |
| 19 | E-Benzene | 0.001 | 0.000 | 0.000 | 0.000 |
| 20 | Xylenes | 0.009 | 0.002 | 0.001 | 0.000 |
| 21 | n-C6 | 0.037 | 0.008 | 0.006 | 0.001 |
| 22 | 224Trimethylp | 0.000 | 0.000 | 0.000 | 0.000 |
| | | 2.584 | 0.590 | 0.431 | 0.098 |

-- Stream Data ----------

Total

| No. | Component | MW | LP Oil | Flash Oil mol % | Sale Oil mol % | Flash Gas mol % | W&S Gas mol % | Total Emissions mol % |
|---|---|---|---|---|---|---|---|---|
| 1 | H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | CO2 | 44.01 | 0.3769 | 0.0840 | 0.0484 | 5.2604 | 4.3922 | 5.1881 |
| 4 | N2 | 28.01 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 5 | C1 | 16.04 | 3.0671 | 0.2776 | 0.0764 | 49.5796 | 16.1487 | 46.7933 |
| 6 | C2 | 30.07 | 1.8755 | 0.7128 | 0.5332 | 21.2616 | 24.7510 | 21.5524 |
| 7 | C3 | 44.10 | 1.9500 | 1.3882 | 1.2657 | 11.3178 | 19.5050 | 12.0002 |
| 8 | i-C4 | 58.12 | 0.9460 | 0.8468 | 0.8174 | 2.5996 | 5.4619 | 2.8382 |
| 9 | n-C4 | 58.12 | 1.7176 | 1.6152 | 1.5774 | 3.4243 | 7.7374 | 3.7837 |
| 10 | i-C5 | 72.15 | 1.6854 | 1.7044 | 1.6948 | 1.3689 | 3.6023 | 1.5550 |
| 11 | n-C5 | 72.15 | 2.2232 | 2.2764 | 2.2705 | 1.3361 | 3.7528 | 1.5375 |
| 12 | C6 | 86.16 | 6.2976 | 6.5962 | 6.6208 | 1.3189 | 4.3371 | 1.5705 |
| 13 | C7 | 100.20 | 17.3395 | 18.3079 | 18.4224 | 1.1933 | 4.6814 | 1.4840 |
| 14 | C8 | 114.23 | 15.8140 | 16.7422 | 16.8634 | 0.3374 | 1.5895 | 0.4418 |
| 15 | C9 | 128.28 | 12.7386 | 13.4971 | 13.5994 | 0.0921 | 0.5165 | 0.1275 |
| 16 | C10+ | 159.67 | 17.4836 | 18.5312 | 18.6751 | 0.0163 | 0.1260 | 0.0255 |
| 17 | Benzene | 78.11 | 0.9180 | 0.9649 | 0.9696 | 0.1354 | 0.4661 | 0.1630 |
| 18 | Toluene | 92.13 | 5.7273 | 6.0569 | 6.0982 | 0.2326 | 0.9761 | 0.2946 |
| 19 | E-Benzene | 106.17 | 0.4546 | 0.4815 | 0.4851 | 0.0060 | 0.0296 | 0.0079 |
| 20 | Xylenes | 106.17 | 6.6553 | 7.0499 | 7.1026 | 0.0756 | 0.3871 | 0.1016 |
| 21 | n-C6 | 86.18 | 2.7297 | 2.8668 | 2.8797 | 0.4440 | 1.5392 | 0.5352 |
| 22 | 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | | 105.65 | 110.15 | 110.68 | 30.68 | 47.36 | 32.07 |
| | | | 1.0000 | 0.9434 | 0.9361 | 0.0566 | 0.0051 | 0.0617 |
| MW | | [BTU/SCF] | | | | 1659.60 | 2560.36 | 1734.67 |
| Stream Mole Ratio | | [Gas/Air] | | | | 1.06 | 1.63 | 1.11 |
| Heating Value | | [psia] | 115.65 | 19.44 | 11.71 | | | |
| Gas Gravity | | [psia] | 29.56 | 9.23 | 7.25 | | | |
| Bubble Pt. @ 100F | | | 0.679 | 0.684 | 0.685 | | | |
| RVP @ 100F | | | | | | | | |
| Spec. Gravity @ 100F | | | | | | | | |

mol %

Page 2 ---------- E&P TANK

## Project Setup Information

| | |
|---|---|
| Project File | : C:\Documents and Settings\ehodek\My Documents\Uintah New Well 072009.ept |
| Flowsheet Selection | : Oil Tank with Separator |
| Calculation Method | : RVP Distillation |
| Control Efficiency | : 100.0% |
| Known Separator Stream | : High Pressure Oil |
| Entering Air Composition | : No |
| Filed Name | : Greater Natural Buttes |
| Well Name | : Old Well |
| Date | : 2008.03.25 |

## Data Input

| | |
|---|---|
| Separator Pressure | : 90.00[psig] |
| Separator Temperature | : 78.00[F] |
| Ambient Pressure | : 14.70[psia] |
| Ambient Temperature | : 70.00[F] |
| C10+ SG | : 0.7400 |
| C10+ MW | : 159.67 |

-- High Pressure Oil ----------

| No. | Component | mol % |
|---|---|---|
| 1 | H2S | 0.0000 |
| 2 | O2 | 0.0000 |
| 3 | CO2 | 0.4190 |
| 4 | N2 | 0.0000 |
| 5 | C1 | 4.0438 |
| 6 | C2 | 1.9669 |
| 7 | C3 | 1.9609 |
| 8 | i-C4 | 0.9410 |
| 9 | n-C4 | 1.7049 |
| 10 | i-C5 | 1.6679 |
| 11 | n-C5 | 2.1989 |
| 12 | C6 | 6.2227 |
| 13 | C7 | 17.1271 |
| 14 | C8 | 15.6182 |
| 15 | C9 | 12.5804 |
| 16 | C10+ | 17.2661 |
| 17 | Benzene | 0.9069 |
| 18 | Toluene | 5.6567 |
| 19 | E-Benzene | 0.4490 |

| | | |
|---|---|---|
| | Xylenes | 6.5727 |
| 20 | n-C6 | 2.6969 |
| 21 | 224Trimethylp | 0.0000 |
| 22 | | |

-- Sales Oil ----------

Production Rate : 10[bbl/day]
Days of Annual Operation : 365 [days/year]
API Gravity : 61.28
Reid Vapor Pressure : 7.25[psia]

**********
* Calculation Results *
**********

-- Emission Summary ----------

| Item | Uncontrolled | Uncontrolled [lb/hr] | Controlled [ton/yr] | Controlled [lb/hr] |
|---|---|---|---|---|
| Total HAPs | 0.260 | 0.059 | 0.013 | 0.003 |
| Page 1---------- E&P TANK | | | | |
| Total HC | 8.002 | 1.827 | 0.400 | 0.091 |
| VOCs, C2+ | 5.985 | 1.366 | 0.299 | 0.068 |
| VOCs, C3+ | 4.244 | 0.969 | 0.212 | 0.048 |

Uncontrolled Recovery Info.
557.9900 x1E-3 [MSCFD]
529.0400 x1E-3 [MSCFD]
55.80 [SCF/bbl]

-- Emission Composition ----------

| No. | Component | Uncontrolled | Uncontrolled [lb/hr] | Controlled [ton/yr] | Controlled [lb/hr] |
|---|---|---|---|---|---|
| 1 | H2S | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | O2 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | CO2 | 0.613 | 0.140 | 0.613 | 0.140 |
| 4 | N2 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | C1 | 2.017 | 0.461 | 0.101 | 0.023 |
| 6 | C2 | 1.741 | 0.397 | 0.087 | 0.020 |
| 7 | C3 | 1.422 | 0.325 | 0.071 | 0.016 |
| 8 | i-C4 | 0.443 | 0.101 | 0.022 | 0.005 |
| 9 | n-C4 | 0.591 | 0.135 | 0.030 | 0.007 |
| 10 | i-C5 | 0.301 | 0.069 | 0.015 | 0.003 |
| 11 | n-C5 | 0.298 | 0.068 | 0.015 | 0.003 |
| 12 | C6 | 0.354 | 0.081 | 0.018 | 0.004 |
| 13 | C7 | 0.387 | 0.088 | 0.019 | 0.004 |
| 14 | C8 | 0.132 | 0.030 | 0.007 | 0.002 |
| 15 | C9 | 0.042 | 0.010 | 0.002 | 0.000 |
| 16 | C10+ | 0.011 | 0.003 | 0.001 | 0.000 |

Vapor
HC Vapor
GOR
[ton/yr]

| | | | | | |
|---|---|---|---|---|---|
| 17 | Benzene | 0.034 | 0.008 | 0.002 | 0.000 |
| 18 | Toluene | 0.073 | 0.017 | 0.004 | 0.001 |
| 19 | E-Benzene | 0.002 | 0.000 | 0.000 | 0.000 |
| 20 | Xylenes | 0.029 | 0.007 | 0.001 | 0.000 |
| 21 | n-C6 | 0.124 | 0.028 | 0.006 | 0.001 |
| 22 | 224Trimethylp | 0.000 | 0.000 | 0.000 | 0.000 |
| | | 8.614 | 1.967 | 0.431 | 0.098 |

-- Stream Data ----------

Total

| No. | Component | MW | LP Oil | Flash Oil mol % | Sale Oil mol % | Flash Gas mol % | W&S Gas mol % | Total Emissions mol % |
|---|---|---|---|---|---|---|---|---|
| 1 | H2S | 34.80 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | O2 | 32.00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | CO2 | 44.01 | 0.3769 | 0.0840 | 0.0484 | 5.2604 | 4.3922 | 5.1881 |
| 4 | N2 | 28.01 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 5 | C1 | 16.04 | 3.0671 | 0.2776 | 0.0764 | 49.5796 | 16.1487 | 46.7933 |
| 6 | C2 | 30.07 | 1.8755 | 0.7128 | 0.5332 | 21.2616 | 24.7510 | 21.5524 |
| 7 | C3 | 44.10 | 1.9500 | 1.3882 | 1.2657 | 11.3178 | 19.5050 | 12.0002 |
| 8 | i-C4 | 58.12 | 0.9460 | 0.8468 | 0.8174 | 2.5996 | 5.4619 | 2.8382 |
| 9 | n-C4 | 58.12 | 1.7176 | 1.6152 | 1.5774 | 3.4243 | 7.7374 | 3.7837 |
| 10 | i-C5 | 72.15 | 1.6854 | 1.7044 | 1.6948 | 1.3689 | 3.6023 | 1.5550 |
| 11 | n-C5 | 72.15 | 2.2232 | 2.2764 | 2.2705 | 1.3361 | 3.7528 | 1.5375 |
| 12 | C6 | 86.16 | 6.2976 | 6.5962 | 6.6208 | 1.3189 | 4.3371 | 1.5705 |
| 13 | C7 | 100.20 | 17.3395 | 18.3079 | 18.4224 | 1.1933 | 4.6814 | 1.4840 |
| 14 | C8 | 114.23 | 15.8140 | 16.7422 | 16.8634 | 0.3374 | 1.5895 | 0.4418 |
| 15 | C9 | 128.28 | 12.7386 | 13.4971 | 13.5994 | 0.0921 | 0.5165 | 0.1275 |
| 16 | C10+ | 159.67 | 17.4836 | 18.5312 | 18.6751 | 0.0163 | 0.1260 | 0.0255 |
| 17 | Benzene | 78.11 | 0.9180 | 0.9649 | 0.9696 | 0.1354 | 0.4661 | 0.1630 |
| 18 | Toluene | 92.13 | 5.7273 | 6.0569 | 6.0982 | 0.2326 | 0.9761 | 0.2946 |
| 19 | E-Benzene | 106.17 | 0.4546 | 0.4815 | 0.4851 | 0.0060 | 0.0296 | 0.0079 |
| 20 | Xylenes | 106.17 | 6.6553 | 7.0499 | 7.1026 | 0.0756 | 0.3871 | 0.1016 |
| 21 | n-C6 | 86.18 | 2.7297 | 2.8668 | 2.8797 | 0.4440 | 1.5392 | 0.5352 |
| 22 | 224Trimethylp | 114.24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | mol % | | | | | | | |
| | | | 105.65 | 110.15 | 110.68 | 30.68 | 47.36 | 32.07 |
| | | | 1.0000 | 0.9434 | 0.9361 | 0.0566 | 0.0051 | 0.0617 |
| MW | | [BTU/SCF] | | | | 1659.60 | 2560.36 | 1734.67 |
| Stream Mole Ratio | | [Gas/Air] | | | | 1.06 | 1.63 | 1.11 |
| Heating Value | | [psia] | 115.65 | 19.44 | 11.71 | | | |
| Gas Gravity | | [psia] | 29.56 | 9.23 | 7.25 | | | |
| Bubble Pt. @ 100F | | | | | | | | |
| RVP @ 100F | | | 0.679 | 0.684 | 0.685 | | | |
| Spec. Gravity @ 100F | | | | | | | | |

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Tank Indentification and Physical Characteristics

**Identification**

| | |
|---|---|
| User Identification: | GNB001 |
| City: | |
| State: | Utah |
| Company: | Anadarko Petroleum |
| Type of Tank: | Vertical Fixed Roof Tank |
| Description: | GNB Tank Battery Condensate Tank |

**Tank Dimensions**

| | |
|---|---|
| Shell Height (ft): | 16.00 |
| Diameter (ft): | 26.74 |
| Liquid Height (ft) : | 15.00 |
| Avg. Liquid Height (ft): | 7.50 |
| Volume (gallons): | 63,000.00 |
| Turnovers: | 162.80 |
| Net Throughput(gal/yr): | 10,256,400.00 |
| Is Tank Heated (y/n): | N |

**Paint Characteristics**

| | |
|---|---|
| Shell Color/Shade: | Gray/Medium |
| Shell Condition | Good |
| Roof Color/Shade: | Gray/Medium |
| Roof Condition: | Good |

**Roof Characteristics**

| | |
|---|---|
| Type: | Cone |
| Height (ft) | 1.00 |
| Slope (ft/ft) (Cone Roof) | 0.06 |

**Breather Vent Settings**

| | |
|---|---|
| Vacuum Settings (psig): | -0.03 |
| Pressure Settings (psig) | 0.03 |

Meterological Data used in Emissions Calculations: Grand Junction, Colorado (Avg Atmospheric Pressure = 12.37 psia)

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Liquid Contents of Storage Tank

### GNB001 - Vertical Fixed Roof Tank

| Mixture/Component | Month | Daily Liquid Surf. Temperature (deg F) Avg. | Min. | Max | Liquid Bulk Temp (deg F) | Vapor Pressure (psia) Avg. | Min. | Max | Vapor Mol Weight. | Liquid Mass Fract. | Vapor Mass Fract. | Mol. Weight | Basis for Vapor Pressure Calculations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNB Condensate | All | 63.14 | 51.01 | 75.26 | 56.01 | 5.0688 | 4.0662 | 6.2557 | 36.2400 | | | 110.68 | Option 4: RVP=7.25 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Detail Calculations (AP-42)

## GNB001 - Vertical Fixed Roof Tank

Annual Emission Calcaulations

| | |
|---|---|
| Standing Losses (lb): | 6,758.0928 |
| Vapor Space Volume (cu ft): | 4,960.6354 |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Space Expansion Factor: | 0.3645 |
| Vented Vapor Saturation Factor: | 0.2965 |
| | |
| Tank Vapor Space Volume: | |
| Vapor Space Volume (cu ft): | 4,960.6354 |
| Tank Diameter (ft): | 26.7400 |
| Vapor Spece Outage (ft): | 8.8333 |
| Tank Shell Height (ft): | 16.0000 |
| Average Liquid Height (ft): | 7.5000 |
| Roof Outage (ft): | 0.3333 |
| | |
| Roof Outage (Cone Roof) | |
| Roof Outage (ft): | 0.3333 |
| Roof Height (ft): | 1.0000 |
| Roof Slope (ft/ft): | 0.0600 |
| Shell Radius (ft): | 13.3700 |
| | |
| Vapor Density | |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Molecular Weight (lb/lb-mole): | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Daily Avg. Liquid Surface Temp. (deg. R): | 522.8068 |
| Daily Average Ambient Temp. (deg. F): | 52.9333 |
| Ideal Gas Constant R (psia cuft / (lb-mol-deg R)). | 10.731 |
| Liquid Bulk Temperature (deg. R): | 515.6833 |
| Tank Paint Solar Absorptance (Shell) | 0.6800 |
| Tank Paint Solar Absorptance (Roof): | 0.6600 |
| Daily Total Solar Insulation Factor (Btu/sqft dey): | 1,578.3125 |
| | |
| Vapor Space Expansion Factor | |
| Vapor Space Expansion Factor: | 0.3845 |
| Daily Vapor Temperature Range (deg. R): | 48.5071 |
| Daily Vapor Prassure Range (psia): | 2.1895 |
| Breather Vent Press. Setting Range(psia): | 0.0600 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia): | 4.0862 |
| Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia): | 6.2557 |
| Daily Avg. Liquid Surface Temp. (deg R): | 522.8068 |
| Daily Min. Liquid Surface Temp. (deg R). | 510.6801 |
| Daily Max. Liquid Surface Temp. (deg R): | 534.9336 |
| Daily Ambient Temp. Range (deg. R): | 25.6333 |
| | |
| Vented Vapor Saturation Factor | |
| Vented Vepor Saturation Factor: | 0.2965 |
| Vapor Pressure at Daily Average Liquid: Surface Temperature (psia): | 5.0688 |
| Vapor Space Outage (ft): | 8.8333 |
| | |
| Working Losses (lb): | 11,806.9025 |
| Vapor Molecular Weight (lb/lb-mole). | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Annual Net Throughput (gal/yr.). | 10,258,400.0000 |

| | |
|---|---|
| Annual Turnovers: | 162.8000 |
| Turnover Factor: | 0.3509 |
| Maximum Liquid Volume (gal): | 63,000.0000 |
| Maximum Liquid Height (ft): | 15.0000 |
| Tank Diameter (ft): | 26.7400 |
| Working Loss Product Factor: | 0.7500 |

| | |
|---|---|
| Total Losses (lb): | 18,564.9953 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Individual Tank Emission Totals

## Emissions Report for: Annual

### GNB001 - Vertical Fixed Roof Tank

| | Losses(lbs) | | |
|---|---|---|---|
| Components | Working Loss | Breathing Loss | Total Emissions |
| GNB Condensate | 11,806.90 | 6,758.09 | 18,565.00 |

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Tank Indentification and Physical Characteristics

**Identification**

| | |
|---|---|
| User Identification: | GNB002 |
| City: | |
| State: | Utah |
| Company: | Anadarko Petroleum |
| Type of Tank: | Vertical Fixed Roof Tank |
| Description: | GNB Tank Battery Total Fluid Tank |

**Tank Dimensions**

| | |
|---|---|
| Shell Height (ft): | 21.00 |
| Diameter (ft): | 32.20 |
| Liquid Height (ft) : | 20.00 |
| Avg. Liquid Height (ft): | 10.00 |
| Volume (gallons): | 121,800.00 |
| Turnovers: | 247.40 |
| Net Throughput(gal/yr): | 30,133,320.00 |
| Is Tank Heated (y/n): | N |

**Paint Characteristics**

| | |
|---|---|
| Shell Color/Shade: | Gray/Medium |
| Shell Condition | Good |
| Roof Color/Shade: | Gray/Medium |
| Roof Condition: | Good |

**Roof Characteristics**

| | |
|---|---|
| Type: | Cone |
| Height (ft) | 1.00 |
| Slope (ft/ft) (Cone Roof) | 0.06 |

**Breather Vent Settings**

| | |
|---|---|
| Vacuum Settings (psig): | -0.03 |
| Pressure Settings (psig) | 0.03 |

Meterological Data used in Emissions Calculations: Grand Junction, Colorado (Avg Atmospheric Pressure = 12.37 psia)

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Liquid Contents of Storage Tank

### GNB002 - Vertical Fixed Roof Tank

| Mixture/Component | Month | Daily Liquid Surf. Temperature (deg F) Avg. | Min. | Max. | Liquid Bulk Temp (deg F) | Vapor Pressure (psia) Avg. | Min. | Max. | Vapor Mol. Weight. | Liquid Mass Fract. | Vapor Mass Fract. | Mol. Weight | Basis for Vapor Pressure Calculations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNB Condensate | All | 63 14 | 51.01 | 75.26 | 56.01 | 5.0686 | 4 0662 | 6.2557 | 36.2400 | | | 110.68 | Option 4: RVP=7.25 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Detail Calculations (AP-42)

## GNB002 - Vertical Fixed Roof Tank

Annual Emission Calcaulations

| | |
|---|---|
| Standing Losses (lb): | 10,485.4259 |
| Vapor Space Volume (cu ft): | 9,229.0986 |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Space Expansion Factor. | 0.3845 |
| Vented Vapor Saturation Factor. | 0.2472 |
| | |
| Tank Vapor Space Volume: | |
| Vapor Space Volume (cu ft). | 9,229.0986 |
| Tank Diameter (ft): | 32.2000 |
| Vapor Space Outage (ft): | 11.3333 |
| Tank Shell Height (ft): | 21.0000 |
| Average Liquid Height (ft): | 10.0000 |
| Roof Outage (ft): | 0.3333 |
| | |
| Roof Outage (Cone Roof) | |
| Roof Outage (ft): | 0.3333 |
| Roof Height (ft): | 1.0000 |
| Roof Slope (ft/ft). | 0.0600 |
| Shell Radius (ft): | 18.1000 |
| | |
| Vapor Density | |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Molecular Weight (lb/lb-mole): | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Daily Avg. Liquid Surface Temp. (deg. R): | 522.8068 |
| Daily Average Ambient Temp. (deg. F): | 52.9333 |
| Ideal Gas Constant R (psia cuft / (lb-mol-deg R)): | 10.731 |
| Liquid Bulk Temperature (deg. R): | 515.6833 |
| Tank Paint Solar Absorptance (Shell): | 0.6800 |
| Tank Paint Solar Absorptance (Roof): | 0.6800 |
| Daily Total Solar Insulation Factor (Btu/sqft day) | 1,578.3125 |
| | |
| Vapor Space Expansion Factor | |
| Vapor Space Expansion Factor: | 0.3845 |
| Daily Vapor Temperature Range (deg. R): | 48.5071 |
| Daily Vapor Pressure Range (psia): | 2.1895 |
| Breather Vent Press. Setting Range(psia). | 0.0600 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia): | 4.0682 |
| Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia): | 6.2557 |
| Daily Avg. Liquid Surface Temp. (deg R): | 522.8068 |
| Daily Min. Liquid Surface Temp. (deg R): | 510.6801 |
| Daily Max. Liquid Surface Temp. (deg R): | 534.9336 |
| Daily Ambient Temp. Range (deg. R): | 25.6333 |
| | |
| Vented Vapor Saturation Factor | |
| Vented Vapor Saturation Factor: | 0.2472 |
| Vapor Pressure at Daily Average Liquid: Surface Temperature (psia): | 5.0688 |
| Vapor Space Outage (ft): | 11.3333 |
| | |
| Working Losses (lb): | 28,460.1000 |
| Vapor Molecular Weight (lb/lb-mole): | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Annual Net Throughput (gal/yr.): | 30,133,320.0000 |

| | |
|---|---|
| Annual Turnovers: | 247.4000 |
| Turnover Factor: | 0.2879 |
| Maximum Liquid Volume (gal): | 121,800.0000 |
| Maximum Liquid Height (ft): | 20.0000 |
| Tank Diameter (ft): | 32.2000 |
| Working Loss Product Factor: | 0.7500 |

| | |
|---|---|
| Total Losses (lb): | 38,945.5258 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Individual Tank Emission Totals

## Emissions Report for: Annual

### GNB002 - Vertical Fixed Roof Tank

| | Losses(lbs) | | |
|---|---|---|---|
| Components | Working Loss | Breathing Loss | Total Emissions |
| GNB Condensate | 28,460.10 | 10,485.43 | 38,945.53 |

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Tank Indentification and Physical Characteristics

**Identification**

| | |
|---|---|
| User Identification: | GNB001OR |
| City: | |
| State: | Utah |
| Company: | Anadarko Petroleum |
| Type of Tank: | Vertical Fixed Roof Tank |
| Description: | GNB Tank Battery Condensate Tank Optimal Recovery |

**Tank Dimensions**

| | | |
|---|---|---|
| Shell Height (ft): | | 16.00 |
| Diameter (ft): | | 26.74 |
| Liquid Height (ft) : | | 15.00 |
| Avg. Liquid Height (ft): | | 7.50 |
| Volume (gallons): | | 63,000.00 |
| Turnovers: | | 210.80 |
| Net Throughput(gal/yr): | | 13,280,400.00 |
| Is Tank Heated (y/n): | N | |

**Paint Characteristics**

| | |
|---|---|
| Shell Color/Shade: | Gray/Medium |
| Shell Condition | Good |
| Roof Color/Shade: | Gray/Medium |
| Roof Condition: | Good |

**Roof Characteristics**

| | | |
|---|---|---|
| Type: | Cone | |
| Height (ft) | | 1.00 |
| Slope (ft/ft) (Cone Roof) | | 0.06 |

**Breather Vent Settings**

| | |
|---|---|
| Vacuum Settings (psig): | -0.03 |
| Pressure Settings (psig) | 0.03 |

Meterological Data used in Emissions Calculations: Grand Junction, Colorado (Avg Atmospheric Pressure = 12.37 psia)

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Liquid Contents of Storage Tank

### GNB001OR - Vertical Fixed Roof Tank

| Mixture/Component | Month | Daily Liquid Surf. Temperature (deg F) Avg. | Min. | Max. | Liquid Bulk Tamp (deg F) | Vapor Pressure (psia) Avg. | Min. | Max. | Vapor Mol. Weight. | Liquid Mass Fract. | Vapor Mass Fract. | Mol. Weight | Basis for Vapor Pressure Calculations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNB Condensate | All | 63.14 | 51.01 | 75.26 | 56.01 | 5.0688 | 4.0662 | 6.2557 | 36.2400 | | | 110.68 | Option 4: RVP=7.25 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Detail Calculations (AP-42)

## GNB001OR - Vertical Fixed Roof Tank

| Annual Emission Calcaulations | |
|---|---|
| Standing Losses (lb): | 6,758.0928 |
| Vapor Space Volume (cu ft): | 4,960.6354 |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Space Expansion Factor: | 0.3845 |
| Vented Vapor Saturation Factor: | 0.2965 |
| Tank Vapor Space Volume: | |
| Vapor Space Volume (cu ft): | 4,960.6354 |
| Tank Diameter (ft): | 26.7400 |
| Vapor Space Outage (ft): | 8.8333 |
| Tank Shell Height (ft): | 16.0000 |
| Average Liquid Height (ft): | 7.5000 |
| Roof Outage (ft): | 0.3333 |
| Roof Outage (Cone Roof) | |
| Roof Outage (ft): | 0.3333 |
| Roof Height (ft): | 1.0000 |
| Roof Slope (ft/ft): | 0.0800 |
| Shell Radius (ft): | 13.3700 |
| Vapor Density | |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Molecular Weight (lb/lb-mole): | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Daily Avg. Liquid Surface Temp. (deg. R): | 522.8068 |
| Daily Average Ambient Temp. (deg. F): | 52.9333 |
| Ideal Gas Constant R (psia cuft / (lb-mol-deg R)): | 10.731 |
| Liquid Bulk Temperature (deg. R): | 515.6833 |
| Tank Paint Solar Absorptance (Shell): | 0.6800 |
| Tank Paint Solar Absorptance (Roof): | 0.6800 |
| Daily Total Solar Insulation Factor (Btu/sqft day): | 1,578.3125 |
| Vapor Space Expansion Factor | |
| Vapor Space Expansion Factor: | 0.3845 |
| Daily Vapor Temperature Range (deg. R): | 48.5071 |
| Daily Vapor Pressure Range (psia): | 2.1895 |
| Breather Vent Press. Setting Range(psia): | 0.0600 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia): | 4.0862 |
| Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia): | 6.2557 |
| Daily Avg. Liquid Surface Temp. (deg R): | 522.8068 |
| Daily Min. Liquid Surface Temp. (deg R): | 510.6801 |
| Daily Max. Liquid Surface Temp. (deg R): | 534.9336 |
| Daily Ambient Temp. Range (deg. R): | 25.8333 |
| Vented Vapor Saturation Factor | |
| Vented Vapor Saturation Factor: | 0.2965 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Vapor Space Outage (ft): | 8.8333 |
| Working Losses (lb): | 13,460.1444 |
| Vapor Molecular Weight (lb/lb-mole): | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Annual Net Throughput (gal/yr.): | 13,280,400.0000 |

| | |
|---|---|
| Annual Turnovers: | 210.8000 |
| Turnover Factor: | 0.3090 |
| Maximum Liquid Volume (gal): | 63,000.0000 |
| Maximum Liquid Height (ft): | 15.0000 |
| Tank Diameter (ft): | 26.7400 |
| Working Loss Product Factor: | 0.7500 |

| | |
|---|---|
| Total Losses (lb): | 20,218.2372 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Individual Tank Emission Totals

## Emissions Report for: Annual

### GNB001OR - Vertical Fixed Roof Tank

| | Losses(lbs) | | |
|---|---|---|---|
| Components | Working Loss | Breathing Loss | Total Emissions |
| GNB Condensate | 13,460.14 | 6,758.09 | 20,218.24 |

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Tank Indentification and Physical Characteristics

**Identification**

| | |
|---|---|
| User Identification: | GNB002OR |
| City: | |
| State: | Utah |
| Company: | Anadarko Petroleum |
| Type of Tank: | Vertical Fixed Roof Tank |
| Description: | GNB Tank Battery Total Fluid Tank Optimal Recovery |

**Tank Dimensions**

| | | |
|---|---|---|
| Shell Height (ft): | | 21.00 |
| Diameter (ft): | | 32.20 |
| Liquid Height (ft) : | | 20.00 |
| Avg. Liquid Height (ft): | | 10.00 |
| Volume (gallons): | | 121,800.00 |
| Turnovers: | | 368.10 |
| Net Throughput(gal/yr): | | 44,834,580.00 |
| Is Tank Heated (y/n): | N | |

**Paint Characteristics**

| | |
|---|---|
| Shell Color/Shade: | Gray/Medium |
| Shell Condition | Good |
| Roof Color/Shade: | Gray/Medium |
| Roof Condition: | Good |

**Roof Characteristics**

| | | |
|---|---|---|
| Type: | Cone | |
| Height (ft) | | 1.00 |
| Slope (ft/ft) (Cone Roof) | | 0.06 |

**Breather Vent Settings**

| | |
|---|---|
| Vacuum Settings (psig): | -0.03 |
| Pressure Settings (psig) | 0.03 |

Meterological Data used in Emissions Calculations: Grand Junction, Colorado (Avg Atmospheric Pressure = 12.37 psia)

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Liquid Contents of Storage Tank

## GNB002OR - Vertical Fixed Roof Tank

| Mixture/Component | Month | Daily Liquid Surf. Temperature (deg F) Avg. | Min. | Max. | Liquid Bulk Temp (deg F) | Vapor Pressure (psia) Avg. | Min. | Max. | Vapor Mol. Weight. | Liquid Mass Fract. | Vapor Mass Fract. | Mol. Weight | Basis for Vapor Pressure Calculations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNB Condensate | All | 63.14 | 51.01 | 75.26 | 56.01 | 5.0688 | 4.0662 | 6.2557 | 36.2400 | | | 110.68 | Option 4: RVP=7.25 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Detail Calculations (AP-42)

## GNB002OR - Vertical Fixed Roof Tank

Annual Emission Calcaulations

| | |
|---|---|
| Standing Losses (lb): | 10,485.4259 |
| Vapor Space Voluma (cu ft): | 9,229.0986 |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Space Expansion Factor: | 0.3845 |
| Vented Vapor Saturation Factor: | 0.2472 |
| Tank Vapor Space Volume: | |
| Vapor Space Volume (cu ft): | 9,229.0986 |
| Tank Diameter (ft): | 32.2000 |
| Vapor Space Outage (ft): | 11.3333 |
| Tank Shell Height (ft): | 21.0000 |
| Average Liquid Height (ft): | 10.0000 |
| Roof Outage (ft): | 0.3333 |
| Roof Outage (Cone Roof) | |
| Roof Outage (ft): | 0.3333 |
| Roof Height (ft): | 1.0000 |
| Roof Slope (ft/ft): | 0.0600 |
| Shell Radius (ft): | 16.1000 |
| Vapor Density | |
| Vapor Density (lb/cu ft): | 0.0327 |
| Vapor Molecular Weight (lb/lb-mole): | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 5.0688 |
| Daily Avg. Liquid Surface Temp. (deg. R): | 522.8068 |
| Daily Average Ambient Temp. (deg. F): | 52.9333 |
| Ideal Gas Constant R (psia cuft / (lb-mol-deg R)): | 10.731 |
| Liquid Bulk Temperature (deg. R): | 515.6833 |
| Tank Paint Solar Absorptance (Shell): | 0.6800 |
| Tank Paint Solar Absorptance (Roof): | 0.6800 |
| Daily Total Solar Insulation Factor (Btu/sqft day): | 1,578.3125 |
| Vapor Space Expansion Factor | |
| Vapor Space Expension Factor: | 0.3845 |
| Daily Vapor Temperature Range (deg. R): | 48.5071 |
| Daily Vapor Pressure Range (psia): | 2.1895 |
| Breather Vent Press. Setting Range(psia): | 0.0600 |
| Vapor Pressure at Daily Avarage Liquid Surface Temperature (psia): | 5.0688 |
| Vapor Pressure at Daily Minimum Liquid Surface Tamperature (psia): | 4.0862 |
| Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia): | 6.2557 |
| Daily Avg. Liquid Surface Temp. (deg R): | 522.8068 |
| Daily Min. Liquid Surface Temp. (deg R): | 510.6801 |
| Daily Max. Liquid Surface Temp. (deg R): | 534.9336 |
| Daily Ambient Temp. Range (deg. R): | 25.6333 |
| Vented Vapor Saturation Factor | |
| Vented Vapor Saturetion Factor: | 0.2472 |
| Vapor Pressura at Daily Average Liquid: Surface Temperature (psia): | 5.0688 |
| Vapor Space Outage (ft): | 11.3333 |
| Working Losses (lb). | 36,497.3814 |
| Vapor Molecular Weight (lb/lb-mole): | 36.2400 |
| Vapor Pressure at Daily Average Liquid Surfaca Temperature (psia): | 5.0688 |
| Annual Net Throughput (gal/yr.): | 44,834,580.0000 |

| | |
|---|---|
| Annual Turnovers: | 368.1000 |
| Turnover Factor: | 0.2482 |
| Maximum Liquid Volume (gal): | 121,800.0000 |
| Maximum Liquid Height (ft): | 20.0000 |
| Tank Diameter (ft): | 32.2000 |
| Working Loss Product Factor: | 0.7500 |

| | |
|---|---|
| Total Losses (lb): | 46,982.8072 |

# TANKS 4.0.9d
# Emissions Report - Detail Format
# Individual Tank Emission Totals

## Emissions Report for: Annual

### GNB002OR - Vertical Fixed Roof Tank

| | Losses(lbs) | | |
|---|---|---|---|
| Components | Working Loss | Breathing Loss | Total Emissions |
| GNB Condensate | 36,497.38 | 10,485.43 | 46,982.81 |

# G3412C LE

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

| | | | |
|---|---|---|---|
| ENGINE SPEED: | 1800 | FUEL: | NAT GAS |
| COMPRESSION RATIO: | 11.4:1 | FUEL SYSTEM: | LPG IMPCO |
| AFTERCOOLER - MAX. INLET (°F): | 130 | | |
| JACKET WATER - MAX. OUTLET (°F): | 210 | FUEL PRESS. RANGE (PSIG): | 1.5 - 5.0 |
| COOLING SYSTEM: | JW+OC, AC | MIN. METHANE NUMBER: | 80 |
| IGNITION SYSTEM: | EIS | RATED ALTITUDE (FT): | 4922 |
| EXHAUST MANIFOLD: | WC | AT AIR TO TURBO. TEMP. (°F): | 77 |
| COMBUSTION: | LOW EMISSION | NOx EMISSION LEVEL: | 2.0 g/bhp-hr |
| | | FUEL LHV (BTU/SCF): | 905 |
| | | APPLICATION: | 60 Hz GENSET |

| RATING AND EFFICIENCY | | NOTES | LOAD | 100% | 75% | 50% |
|---|---|---|---|---|---|---|
| ENGINE POWER | (WITHOUT FAN) | (1) | BHP | 637 | 478 | 318 |
| GENERATOR POWER | (WITH MECH FAN) | (2) | EKW | 375 | 259 | 154 |
| **ENGINE EFFICIENCY** | **(ISO 3046/1)** | (3) | % | **37.1** | **35.6** | **33.0** |
| ENGINE EFFICIENCY | (NOMINAL) | (3) | % | 36.2 | 34.7 | 32.2 |
| THERMAL EFFICIENCY | (NOMINAL) | (4) | % | 42.4 | 44.6 | 50.9 |
| TOTAL EFFICIENCY | (NOMINAL) | (5) | % | 78.6 | 79.3 | 83.1 |

| ENGINE DATA | | | | | | |
|---|---|---|---|---|---|---|
| **FUEL CONSUMPTION** | **(ISO 3046/1)** | (6) | **BTU/bhp-hr** | **6854** | **7158** | **7716** |
| FUEL CONSUMPTION | (NOMINAL) | (6) | BTU/bhp-hr | 7021 | 7332 | 7904 |
| AIR FLOW (77 °F, 14.7 psi) | | (7) | SCFM | 1354 | 1047 | 673 |
| AIR FLOW | | (7) | lb/hr | 6004 | 4641 | 2983 |
| COMPRESSOR OUT PRESSURE | | | In. HG (abs) | 66.3 | 63.3 | 47.4 |
| COMPRESSOR OUT TEMPERATURE | | | °F | 286 | 265 | 200 |
| AFTERCOOLER AIR OUT TEMPERATURE | | | °F | 148 | 145 | 140 |
| INLET MAN. PRESSURE | | (8) | in. HG (abs) | 59.5 | 52.9 | 47.9 |
| INLET MAN. TEMPERATURE | (MEASURED IN PLENUM) | (9) | °F | 148 | 145 | 140 |
| TIMING | | (10) | °BTDC | 27 | 27 | 27 |
| EXHAUST STACK TEMPERATURE | | (11) | °F | 700 | 700 | 727 |
| EXHAUST GAS FLOW (@ stack temp.) | | (12) | CFM | 3154 | 2440 | 1617 |
| EXHAUST MASS FLOW | | (12) | lb/hr | 6229 | 4818 | 3110 |

| EMISSIONS DATA | | | | | |
|---|---|---|---|---|---|
| NOx (as NO2) | (13) | g/bhp-hr | 2 | 2.1 | 5.5 |
| CO | (14) | g/bhp-hr | 1.94 | 1.96 | 2.06 |
| THC (molecular weight of 15.84) | (14) | g/bhp-hr | 5.36 | 5.88 | 5.05 |
| NMHC (molecular weight of 15.84) | (14) | g/bhp-hr | 0.81 | 0.89 | 0.76 |
| EXHAUST O2 | (15) | % DRY | 8.7 | 8.5 | 6.9 |
| LAMBDA | (15) | | 1.68 | 1.66 | 1.48 |

| HEAT BALANCE DATA | | | | | |
|---|---|---|---|---|---|
| LHV INPUT | (16) | BTU/min | 74534 | 58378 | 41956 |
| HEAT REJECTION TO JACKET | (17) | BTU/min | 21942 | 16031 | 13917 |
| HEAT REJECTION TO ATMOSPHERE | (18) | BTU/min | 2981 | 2335 | 1678 |
| HEAT REJECTION TO EXHAUST (LHV to 77°F) | (20) | BTU/min | 18965 | 14778 | 9862 |
| HEAT REJECTION TO EXHAUST (LHV to 350°F) | (20) | BTU/min | 9647 | 7467 | 5236 |
| HEAT REJECTION TO A/C | (21) | BTU/min | 3632 | 2440 | 792 |

**CONDITIONS AND DEFINITIONS**

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1STD. REF. CONDITIONS OF 77°F, 29.6 IN HG BAROMETRIC PRESSURE, 500 FT ALTITUDE). NO OVERLOAD PERMITTED AT RATING SHOWN. CONSULT ALTITUDE CHARTS FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE.

EMISSION LEVELS ARE BASED ON THE ENGINE OPERATING AT STEADY STATE CONDITIONS AND ADJUSTED TO THE SPECIFIED NOx LEVEL AT 100% LOAD. EMISSION TOLERANCES SPECIFIED ARE DEPENDANT UPON FUEL QUALITY. METHANE NUMBER CANNOT VARY MORE THAN ± 3. PUBLISHED PART LOAD DATA MAY REQUIRE ENGINE

ENGINE RATING IS WITHOUT ENGINE DRIVEN WATER PUMPS.

FOR NOTES INFORMATION CONSULT PAGE THREE.

NOTES

1 ENGINE RATING IS WITHOUT ENGINE DRIVEN WATER PUMPS. TOLERANCE IS ± 3% OF FULL LOAD.

2 GENERATOR POWER DETERMINED WITH AN ASSUMED GENERATOR EFFICIENCY OF 93% AND POWER FACTOR OF 0.8 [GENERATOR POWER = ENGINE POWER x GENERATOR EFFICIENCY].

3 ISO 3046/1 ENGINE EFFICIENCY TOLERANCE IS (+)0, (-)5% OF FULL LOAD % EFFICIENCY VALUE. NOMINAL ENGINE EFFICIENCY TOLERANCE IS ± 2.5% OF FULL LOAD % EFFICIENCY VALUE.

4 THERMAL EFFICIENCY: JACKET HEAT + LUBE OIL HEAT + EXH. HEAT TO 350°F.

5 TOTAL EFFICIENCY = ENGINE EFF. + THERMAL EFF. TOLERANCE IS ± 10% OF FULL LOAD DATA.

6 ISO 3046/1 FUEL CONSUMPTION TOLERANCE IS (+)5, (-)0% OF FULL LOAD DATA. NOMINAL FUEL CONSUMPTION TOLERANCE IS ± 2.5 % OF FULL LOAD DATA.

7 UNDRIED AIR. FLOW TOLERANCE IS ± 5 %

8 INLET MANIFOLD PRESSURE TOLERANCE IS ± 5 %

9 INLET MANIFOLD TEMPERATURE TOLERANCE IS ± 9°F.

10 TIMING INDICATED IS FOR USE WITH THE MINIMUM FUEL METHANE NUMBER SPECIFIED. CONSULT THE APPROPRIATE FUEL USAGE GUIDE FOR TIMING AT OTHER METHANE NUMBERS.

11 EXHAUST STACK TEMPERATURE TOLERANCE IS (+)63°F, (-)54°F.

12 WET EXHAUST. FLOW TOLERANCE IS ± 6 %

13 NOX VALUES ARE SET POINTS AND WILL VARY WITH OPERATING CONDITIONS.

14 CO, CO2, THC, and NMHC VALUES ARE "NOT TO EXCEED".

15 O2% TOLERANCE IS ± 0.5; LAMBDA TOLERANCE IS ± 0.05. LAMBDA AND O2 LEVEL ARE THE RESULT OF ADJUSTING THE ENGINE TO OPERATE AT THE SPECIFIED NOX LEVEL.

16 LHV RATE TOLERANCE IS ± 2.5%.

17 TOTAL JW HEAT (based on treated water) = JACKET HEAT + LUBE OIL HEAT. TOLERANCE IS ± 10 % OF FULL LOAD DATA. HEAT REJECTION BASED ON 0 GPM WATER FLOW.

18 RADIATION HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 50% OF FULL LOAD DATA.

19 LUBE OIL HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 20% OF FULL LOAD DATA.

20 EXHAUST HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 10% OF FULL LOAD DATA.

21 A/C HEAT (based on treated water) = A/C HEAT x A/C HEAT REJ. FACTOR. TOLERANCE IS ± 5 % OF FULL LOAD DATA. HEAT REJECTION BASED ON 151 GPM WATER FLOW.

# G3516 LE

GAS COMPRESSION APPLICATION

## GAS ENGINE PROJECT SPECIFIC TECHNICAL DATA
**Westport Field Services**
**Cottonwood Station**

CATERPILLAR®

| | |
|---|---|
| ENGINE SPEED (rpm): | 1400 |
| COMPRESSION RATIO: | 8:1 |
| AFTERCOOLER WATER INLET (°F): | 129 |
| JACKET WATER OUTLET (°F): | 210 |
| COOLING SYSTEM: | JW+OC , AC |
| IGNITION SYSTEM: | EIS |
| EXHAUST MANIFOLD: | ASWC |
| COMBUSTION: | Low Emission |
| NOx EMISSION LEVEL (g/bhp-hr NOx): | 1.5 |

| | |
|---|---|
| FUEL SYSTEM: | HPG IMPCO with Air Fuel Ratio Control |
| **SITE CONDITIONS:** | |
| FUEL: | Gas Analysis |
| FUEL PRESSURE RANGE (psig): | 35.0-40.0 |
| FUEL METHANE NUMBER: | 62.0 |
| FUEL LHV (Btu/scf): | 1013 |
| ALTITUDE (ft): | 5000 |
| MAXIMUM AIR TO TURBO TEMPERATURE (°F): | 100 |
| NAMEPLATE RATING: | 1340 bhp@1400rpm |

| | | | MAXIMUM RATING | SITE RATING AT MAXIMUM AIR TO TURBO TEMPERATURE | | |
|---|---|---|---|---|---|---|
| **RATING** | **Notes** | **LOAD** | **100%** | **100%** | **75%** | **52%** |
| ENGINE POWER | (1) | bhp | 1340 | 1280 | 960 | 670 |
| AIR TO TURBO TEMPERATURE | | °F | 75 | 100 | 100 | 100 |
| **ENGINE DATA** | | | | | | |
| FUEL CONSUMPTION | (2) | Btu/bhp-hr | 7569 | 7616 | 7897 | 8312 |
| INLET MANIFOLD PRESSURE | (3) | in Hg(abs) | 69.3 | 66.7 | 52.5 | 38.7 |
| IGNITION TIMING | | °BTDC | 28.0 | 28.0 | 28.0 | 28.0 |
| EXHAUST STACK TEMPERATURE | (4) | °F | 899 | 896 | 884 | 886 |
| EXHAUST GAS FLOW (@ stack temp, 14.5 psia) | (5) | ft3/min | 7900 | 7564 | 5753 | 3859 |
| EXHAUST GAS MASS FLOW | (5) | lb/hr | 13314 | 12772 | 9798 | 6548 |
| **EMISSIONS DATA** | | | | | | |
| NOx (as NO2) | (6) | g/bhp-hr | 1.50 | 1.50 | 1.50 | 1.50 |
| CO | (6) | g/bhp-hr | 2.42 | 2.44 | 2.51 | 2.43 |
| THC (molecular wt. of 15.84) | (6) | g/bhp-hr | 2.64 | 2.69 | 2.96 | 3.10 |
| NMHC (molecular wt. of 15.84) | (6) | g/bhp-hr | 0.56 | 0.57 | 0.63 | 0.66 |
| NMNEHC (molecular wt. of 15.84) | (6) | g/bhp-hr | 0.32 | 0.33 | 0.36 | 0.38 |
| HCHO (Formaldehyde) | (6) | g/bhp-hr | 0.28 | 0.28 | 0.32 | 0.34 |
| CO2 | (6) | g/bhp-hr | 500 | 503 | 524 | 550 |
| EXHAUST OXYGEN | (7) | % DRY | 8.0 | 7.9 | 7.7 | 7.5 |
| **HEAT REJECTION** | | | | | | |
| HEAT REJ. TO JACKET WATER | (8) | Btu/min | 39675 | 38773 | 33100 | 28953 |
| HEAT REJ. TO ATMOSPHERE | (8) | Btu/min | 5313 | 5154 | 4309 | 3543 |
| HEAT REJ. TO LUBE OIL | (8) | Btu/min | 6273 | 6131 | 5234 | 4578 |
| HEAT REJ. TO AFTERCOOLER | (8)(9) | Btu/min | 10792 | 14775 | 9975 | 3508 |
| **HEAT EXCHANGER SIZING CRITERIA** | | | | | | |
| HEAT REJ. TO JACKET WATER/LUBE OIL CIRCUIT | (10) | Btu/min | 51170 | | | |
| HEAT REJ. TO AFTERCOOLER | (9)(10) | Btu/min | 15514 | | | |

**CONDITIONS AND DEFINITIONS**
Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site air to turbo temperature.
100% rating at maximum air to turbo temperature is the maximum engine capability for the specified fuel at site altitude and maximum site air to turbo temperature.
Max. rating is the maximum capability for the specified fuel at site altitude and reduced air to turbo temperature.
Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

PREPARED BY: Scott Oltrogge, Compressor Systems, Inc.
Data generated by Gas Engine Rating Pro Version 1.00.00
Ref. Data Set DM5155-04, Master Data Set 1.0, Printed 26Aug2004

# Appendix C

# Spatially Distributed Project Alternatives Emissions Inventories

**Table C-1 Spatially Distributed Production and Drilling Emissions for the Proposed Action**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 336 | 10 | 3,339 | 2 | 13 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 8S | 20E | 33 | 08S20E33 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 8S | 20E | 34 | 08S20E34 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 8S | 20E | 35 | 08S20E35 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 8S | 20E | 36 | 08S20E36 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 8S | 21E | 31 | 08S21E31 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 8S | 21E | 32 | 08S21E32 | 2 | 0.06 | 13 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 5.32 | 5.32 | 0.07 | 4.84 | 0.86 | 25.02 |
| 8S | 21E | 33 | 08S21E33 | 2 | 0.06 | 20 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 6.15 | 6.06 | 0.10 | 5.65 | 1.03 | 38.34 |
| 8S | 21E | 34 | 08S21E34 | 2 | 0.06 | 18 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 5.91 | 5.85 | 0.09 | 5.42 | 0.98 | 34.53 |
| 8S | 21E | 35 | 08S21E35 | 2 | 0.06 | 12 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.43 | 1.28 | 0.05 | 1.39 | 0.30 | 22.84 | 5.20 | 5.21 | 0.06 | 4.72 | 0.83 | 23.11 |
| 8S | 21E | 36 | 08S21E36 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 8S | 22E | 31 | 08S22E31 | 2 | 0.06 | 14 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 5.44 | 5.42 | 0.07 | 4.95 | 0.88 | 26.92 |
| 8S | 23E | 33 | 08S23E33 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 8S | 23E | 34 | 08S23E34 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 8S | 23E | 35 | 08S23E35 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 9S | 20E | 1 | 09S20E01 | 2 | 0.06 | 9 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.07 | 0.96 | 0.04 | 1.04 | 0.23 | 17.13 | 4.84 | 4.89 | 0.05 | 4.37 | 0.76 | 17.40 |
| 9S | 20E | 2 | 09S20E02 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 9S | 20E | 3 | 09S20E03 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 9S | 20E | 4 | 09S20E04 | 2 | 0.06 | 9 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.07 | 0.96 | 0.04 | 1.04 | 0.23 | 17.13 | 4.84 | 4.89 | 0.05 | 4.37 | 0.76 | 17.40 |
| 9S | 20E | 9 | 09S20E09 | 2 | 0.06 | 12 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.43 | 1.28 | 0.05 | 1.39 | 0.30 | 22.84 | 5.20 | 5.21 | 0.06 | 4.72 | 0.83 | 23.11 |
| 9S | 20E | 10 | 09S20E10 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 20E | 11 | 09S20E11 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 9S | 20E | 12 | 09S20E12 | 2 | 0.06 | 18 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 5.91 | 5.85 | 0.09 | 5.42 | 0.98 | 34.53 |
| 9S | 20E | 13 | 09S20E13 | 3 | 0.09 | 6 | | | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 | 0.71 | 0.64 | 0.03 | 0.70 | 0.15 | 11.42 | 6.37 | 6.53 | 0.04 | 5.69 | 0.95 | 11.83 |
| 9S | 20E | 14 | 09S20E14 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 9S | 20E | 15 | 09S20E15 | 2 | 0.06 | 16 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 8.18 | 2.59 | 0.14 | 2.05 | 0.60 | 32.09 | 11.95 | 6.51 | 0.15 | 5.38 | 1.13 | 32.37 |
| 9S | 20E | 20 | 09S20E20 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 9S | 20E | 21 | 09S20E21 | 2 | 0.06 | 12 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.43 | 1.28 | 0.05 | 1.39 | 0.30 | 22.84 | 5.20 | 5.21 | 0.06 | 4.72 | 0.83 | 23.11 |
| 9S | 20E | 22 | 09S20E22 | 2 | 0.06 | 19 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.26 | 2.03 | 0.08 | 2.20 | 0.48 | 36.16 | 6.03 | 5.96 | 0.09 | 5.53 | 1.01 | 36.44 |
| 9S | 20E | 23 | 09S20E23 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 20E | 24 | 09S20E24 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 20E | 25 | 09S20E25 | 2 | 0.06 | 13 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 5.32 | 5.32 | 0.07 | 4.84 | 0.86 | 25.02 |
| 9S | 20E | 26 | 09S20E26 | 2 | 0.06 | 21 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 6.27 | 6.17 | 0.10 | 5.76 | 1.06 | 40.24 |
| 9S | 20E | 27 | 09S20E27 | 2 | 0.06 | 21 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 6.27 | 6.17 | 0.10 | 5.76 | 1.06 | 40.24 |
| 9S | 20E | 28 | 09S20E28 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 20E | 29 | 09S20E29 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 9S | 20E | 32 | 09S20E32 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 20E | 33 | 09S20E33 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 20E | 34 | 09S20E34 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 20E | 35 | 09S20E35 | 2 | 0.06 | 21 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 6.27 | 6.17 | 0.10 | 5.76 | 1.06 | 40.24 |
| 9S | 20E | 36 | 09S20E36 | 2 | 0.06 | 21 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 6.27 | 6.17 | 0.10 | 5.76 | 1.06 | 40.24 |
| 9S | 21E | 1 | 09S21E01 | 2 | 0.06 | 13 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.82 | 2.27 | 0.12 | 1.71 | 0.53 | 26.38 | 11.60 | 6.19 | 0.13 | 5.04 | 1.06 | 26.66 |
| 9S | 21E | 2 | 09S21E02 | 2 | 0.06 | 14 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 5.44 | 5.42 | 0.07 | 4.95 | 0.88 | 26.92 |
| 9S | 21E | 3 | 09S21E03 | 2 | 0.06 | 15 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 5.56 | 5.53 | 0.07 | 5.07 | 0.91 | 28.82 |
| 9S | 21E | 4 | 09S21E04 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 21E | 5 | 09S21E05 | 2 | 0.06 | 13 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 5.32 | 5.32 | 0.07 | 4.84 | 0.86 | 25.02 |
| 9S | 21E | 6 | 09S21E06 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 9S | 21E | 7 | 09S21E07 | 2 | 0.06 | 16 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 5.68 | 5.64 | 0.08 | 5.18 | 0.93 | 30.73 |
| 9S | 21E | 8 | 09S21E08 | 2 | 0.06 | 17 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 5.79 | 5.74 | 0.08 | 5.30 | 0.96 | 32.63 |
| 9S | 21E | 9 | 09S21E09 | 2 | 0.06 | 13 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 5.32 | 5.32 | 0.07 | 4.84 | 0.86 | 25.02 |
| 9S | 21E | 10 | 09S21E10 | 2 | 0.06 | 18 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 5.91 | 5.85 | 0.09 | 5.42 | 0.98 | 34.53 |
| 9S | 21E | 11 | 09S21E11 | 2 | 0.06 | 20 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 6.15 | 6.06 | 0.10 | 5.65 | 1.03 | 38.34 |
| 9S | 21E | 12 | 09S21E12 | 2 | 0.06 | 21 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 6.27 | 6.17 | 0.10 | 5.76 | 1.06 | 40.24 |

**Table C-1 Spatially Distributed Production and Drilling Emissions for the Proposed Action**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 336 | 10 | 3,339 | 2 | 13 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 9S | 21E | 13 | 09S21E13 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 9S | 21E | 14 | 09S21E14 | 2 | 0.06 | 12 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.43 | 1.28 | 0.05 | 1.39 | 0.30 | 22.84 | 5.20 | 5.21 | 0.06 | 4.72 | 0.83 | 23.11 |
| 9S | 21E | 15 | 09S21E15 | 2 | 0.06 | 13 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 5.32 | 5.32 | 0.07 | 4.84 | 0.86 | 25.02 |
| 9S | 21E | 16 | 09S21E16 | 2 | 0.06 | 15 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 5.56 | 5.53 | 0.07 | 5.07 | 0.91 | 28.82 |
| 9S | 21E | 17 | 09S21E17 | 2 | 0.06 | 17 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 5.79 | 5.74 | 0.08 | 5.30 | 0.96 | 32.63 |
| 9S | 21E | 18 | 09S21E18 | 2 | 0.06 | 15 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 5.56 | 5.53 | 0.07 | 5.07 | 0.91 | 28.82 |
| 9S | 21E | 19 | 09S21E19 | 2 | 0.06 | 17 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 8.30 | 2.70 | 0.14 | 2.17 | 0.63 | 33.99 | 12.07 | 6.62 | 0.15 | 5.50 | 1.16 | 34.27 |
| 9S | 21E | 20 | 09S21E20 | 2 | 0.06 | 17 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 5.79 | 5.74 | 0.08 | 5.30 | 0.96 | 32.63 |
| 9S | 21E | 21 | 09S21E21 | 2 | 0.06 | 11 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 5.08 | 5.10 | 0.06 | 4.60 | 0.81 | 21.21 |
| 9S | 21E | 22 | 09S21E22 | 2 | 0.06 | 16 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 5.68 | 5.64 | 0.08 | 5.18 | 0.93 | 30.73 |
| 9S | 21E | 23 | 09S21E23 | 2 | 0.06 | 18 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 5.91 | 5.85 | 0.09 | 5.42 | 0.98 | 34.53 |
| 9S | 21E | 24 | 09S21E24 | 2 | 0.06 | 21 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 6.27 | 6.17 | 0.10 | 5.76 | 1.06 | 40.24 |
| 9S | 21E | 25 | 09S21E25 | 2 | 0.06 | 14 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 5.44 | 5.42 | 0.07 | 4.95 | 0.88 | 26.92 |
| 9S | 21E | 26 | 09S21E26 | 2 | 0.06 | 13 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 5.32 | 5.32 | 0.07 | 4.84 | 0.86 | 25.02 |
| 9S | 21E | 27 | 09S21E27 | 2 | 0.06 | 12 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.43 | 1.28 | 0.05 | 1.39 | 0.30 | 22.84 | 5.20 | 5.21 | 0.06 | 4.72 | 0.83 | 23.11 |
| 9S | 21E | 28 | 09S21E28 | 2 | 0.06 | 9 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.07 | 0.96 | 0.04 | 1.04 | 0.23 | 17.13 | 4.84 | 4.89 | 0.05 | 4.37 | 0.76 | 17.40 |
| 9S | 21E | 29 | 09S21E29 | 2 | 0.06 | 16 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 5.68 | 5.64 | 0.08 | 5.18 | 0.93 | 30.73 |
| 9S | 21E | 30 | 09S21E30 | 2 | 0.06 | 17 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 5.79 | 5.74 | 0.08 | 5.30 | 0.96 | 32.63 |
| 9S | 21E | 31 | 09S21E31 | 2 | 0.06 | 21 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 6.27 | 6.17 | 0.10 | 5.76 | 1.06 | 40.24 |
| 9S | 21E | 32 | 09S21E32 | 2 | 0.06 | 20 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 6.15 | 6.06 | 0.10 | 5.65 | 1.03 | 38.34 |
| 9S | 21E | 33 | 09S21E33 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 9S | 21E | 34 | 09S21E34 | 2 | 0.06 | 14 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 5.44 | 5.42 | 0.07 | 4.95 | 0.88 | 26.92 |
| 9S | 21E | 35 | 09S21E35 | 2 | 0.06 | 14 | 1 | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.94 | 2.38 | 0.13 | 1.82 | 0.55 | 33.11 | 11.71 | 6.30 | 0.14 | 5.15 | 1.08 | 33.38 |
| 9S | 21E | 36 | 09S21E36 | 2 | 0.06 | 14 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 5.44 | 5.42 | 0.07 | 4.95 | 0.88 | 26.92 |
| 9S | 22E | 6 | 09S22E06 | 2 | 0.06 | 11 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 5.08 | 5.10 | 0.06 | 4.60 | 0.81 | 21.21 |
| 9S | 22E | 7 | 09S22E07 | 2 | 0.06 | 11 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 5.08 | 5.10 | 0.06 | 4.60 | 0.81 | 21.21 |
| 9S | 22E | 15 | 09S22E15 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 22E | 18 | 09S22E18 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 9S | 22E | 19 | 09S22E19 | 2 | 0.06 | 18 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 5.91 | 5.85 | 0.09 | 5.42 | 0.98 | 34.53 |
| 9S | 22E | 20 | 09S22E20 | 2 | 0.06 | 10 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 4.96 | 4.99 | 0.05 | 4.49 | 0.78 | 19.31 |
| 9S | 22E | 29 | 09S22E29 | 2 | 0.06 | 17 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 5.79 | 5.74 | 0.08 | 5.30 | 0.96 | 32.63 |
| 9S | 22E | 30 | 09S22E30 | 2 | 0.06 | 15 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 8.06 | 2.48 | 0.13 | 1.94 | 0.58 | 30.19 | 11.83 | 6.41 | 0.14 | 5.27 | 1.11 | 30.46 |
| 9S | 22E | 31 | 09S22E31 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 9S | 22E | 32 | 09S22E32 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 22E | 33 | 09S22E33 | 1 | 0.03 | 10 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 3.08 | 3.03 | 0.05 | 2.82 | 0.52 | 19.17 |
| 9S | 22E | 34 | 09S22E34 | 2 | 0.06 | 5 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 4.37 | 4.46 | 0.03 | 3.91 | 0.66 | 9.79 |
| 9S | 22E | 35 | 09S22E35 | 1 | 0.03 | 12 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.43 | 1.28 | 0.05 | 1.39 | 0.30 | 22.84 | 3.31 | 3.25 | 0.06 | 3.06 | 0.57 | 22.98 |
| 9S | 22E | 36 | 09S22E36 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 9S | 23E | 1 | 09S23E01 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 23E | 2 | 09S23E02 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 9S | 23E | 3 | 09S23E03 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 23E | 4 | 09S23E04 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 9S | 23E | 8 | 09S23E05 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 9S | 23E | 9 | 09S23E06 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 9S | 23E | 10 | 09S23E10 | 1 | 0.03 | 10 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 3.08 | 3.03 | 0.05 | 2.82 | 0.52 | 19.17 |
| 9S | 23E | 11 | 09S23E11 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 9S | 23E | 12 | 09S23E12 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 9S | 23E | 13 | 09S23E13 | 1 | 0.03 | 11 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 3.19 | 3.14 | 0.05 | 2.94 | 0.54 | 21.07 |
| 9S | 23E | 14 | 09S23E14 | 1 | 0.03 | 11 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 3.19 | 3.14 | 0.05 | 2.94 | 0.54 | 21.07 |
| 9S | 23E | 15 | 09S23E15 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 9S | 23E | 23 | 09S23E23 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 9S | 23E | 24 | 09S23E24 | 1 | 0.03 | 11 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 3.19 | 3.14 | 0.05 | 2.94 | 0.54 | 21.07 |

**Table C-1 Spatially Distributed Production and Drilling Emissions for the Proposed Action**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 336 | 10 | 3,339 | 2 | 13 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 9S | 23E | 25 | 09S23E25 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 23E | 26 | 09S23E26 | 3 | 0.09 | 6 | | | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 | 0.71 | 0.64 | 0.03 | 0.70 | 0.15 | 11.42 | 6.37 | 6.53 | 0.04 | 5.69 | 0.95 | 11.83 |
| 9S | 23E | 31 | 09S23E31 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |
| 9S | 23E | 35 | 09S23E35 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 9S | 23E | 36 | 09S23E36 | - | - | 15 | | | - | - | - | - | - | - | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 |
| 9S | 24E | 21 | 09S24E21 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 24E | 28 | 09S24E28 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 24E | 29 | 09S24E29 | 2 | 0.06 | 6 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.71 | 0.64 | 0.03 | 0.70 | 0.15 | 11.42 | 4.49 | 4.57 | 0.04 | 4.02 | 0.68 | 11.69 |
| 9S | 24E | 30 | 09S24E30 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 9S | 24E | 31 | 09S24E31 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 9S | 24E | 32 | 09S24E32 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 24E | 33 | 09S24E33 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9S | 24E | 34 | 09S24E34 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 10S | 20E | 1 | 10S20E01 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 10S | 20E | 2 | 10S20E02 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 10S | 20E | 11 | 10S20E11 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 10S | 20E | 12 | 10S20E12 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 20E | 13 | 10S20E13 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 20E | 14 | 10S20E14 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 10S | 20E | 23 | 10S20E23 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 10S | 20E | 24 | 10S20E24 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 10S | 20E | 25 | 10S20E25 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 10S | 20E | 26 | 10S20E26 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 10S | 20E | 35 | 10S20E35 | 1 | 0.03 | 19 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.26 | 2.03 | 0.08 | 2.20 | 0.48 | 36.16 | 4.15 | 4.00 | 0.09 | 3.87 | 0.74 | 36.30 |
| 10S | 20E | 36 | 10S20E36 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 10S | 21E | 1 | 10S21E01 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 21E | 2 | 10S21E02 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |
| 10S | 21E | 3 | 10S21E03 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |
| 10S | 21E | 4 | 10S21E04 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 21E | 5 | 10S21E05 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 10S | 21E | 6 | 10S21E06 | 2 | 0.06 | 17 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 5.79 | 5.74 | 0.08 | 5.30 | 0.96 | 32.63 |
| 10S | 21E | 7 | 10S21E07 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 10S | 21E | 8 | 10S21E08 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 10S | 21E | 9 | 10S21E09 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 21E | 10 | 10S21E10 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 10S | 21E | 11 | 10S21E11 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 10S | 21E | 12 | 10S21E12 | 1 | 0.03 | 19 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.26 | 2.03 | 0.08 | 2.20 | 0.48 | 36.16 | 4.15 | 4.00 | 0.09 | 3.87 | 0.74 | 36.30 |
| 10S | 21E | 13 | 10S21E13 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |
| 10S | 21E | 14 | 10S21E14 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |
| 10S | 21E | 15 | 10S21E15 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 21E | 16 | 10S21E16 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 21E | 17 | 10S21E17 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |
| 10S | 21E | 18 | 10S21E18 | 1 | 0.03 | 19 | | 1 | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 8.54 | 2.91 | 0.15 | 2.40 | 0.68 | 37.80 | 10.42 | 4.87 | 0.15 | 4.07 | 0.94 | 37.94 |
| 10S | 21E | 19 | 10S21E19 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 10S | 21E | 20 | 10S21E20 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 21E | 21 | 10S21E21 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 21E | 22 | 10S21E22 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 10S | 21E | 23 | 10S21E23 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 21E | 24 | 10S21E24 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 10S | 21E | 25 | 10S21E25 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 21E | 26 | 10S21E26 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 21E | 27 | 10S21E27 | 3 | 0.09 | 6 | | | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 | 0.71 | 0.64 | 0.03 | 0.70 | 0.15 | 11.42 | 6.37 | 6.53 | 0.04 | 5.69 | 0.95 | 11.83 |

**Table C-1 Spatially Distributed Production and Drilling Emissions for the Proposed Action**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 336 | 10 | 3,339 | 2 | 13 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 10S | 21E | 28 | 10S21E28 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 21E | 29 | 10S21E29 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 21E | 30 | 10S21E30 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 10S | 21E | 31 | 10S21E31 | 2 | 0.06 | 15 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 8.06 | 2.48 | 0.13 | 1.94 | 0.58 | 30.19 | 11.83 | 6.41 | 0.14 | 5.27 | 1.11 | 30.46 |
| 10S | 21E | 32 | 10S21E32 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 21E | 33 | 10S21E33 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10S | 21E | 34 | 10S21E34 | 1 | 0.03 | 11 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 3.19 | 3.14 | 0.05 | 2.94 | 0.54 | 21.07 |
| 10S | 21E | 35 | 10S21E35 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 21E | 36 | 10S21E36 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 22E | 1 | 10S22E01 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |
| 10S | 22E | 2 | 10S22E02 | 2 | 0.06 | 5 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 4.37 | 4.46 | 0.03 | 3.91 | 0.66 | 9.79 |
| 10S | 22E | 3 | 10S22E03 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 10S | 22E | 4 | 10S22E04 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 10S | 22E | 5 | 10S22E05 | 1 | 0.03 | 12 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.43 | 1.28 | 0.05 | 1.39 | 0.30 | 22.84 | 3.31 | 3.25 | 0.06 | 3.06 | 0.57 | 22.98 |
| 10S | 22E | 6 | 10S22E06 | 1 | 0.03 | 11 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 3.19 | 3.14 | 0.05 | 2.94 | 0.54 | 21.07 |
| 10S | 22E | 7 | 10S22E07 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 22E | 8 | 10S22E08 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 10S | 22E | 9 | 10S22E09 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 22E | 10 | 10S22E10 | 1 | 0.03 | 10 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 3.08 | 3.03 | 0.05 | 2.82 | 0.52 | 19.17 |
| 10S | 22E | 11 | 10S22E11 | 2 | 0.06 | 7 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.11 | 1.63 | 0.10 | 1.01 | 0.37 | 14.96 | 10.88 | 5.55 | 0.11 | 4.34 | 0.91 | 15.24 |
| 10S | 22E | 12 | 10S22E12 | 1 | 0.03 | 10 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.19 | 1.07 | 0.04 | 1.16 | 0.25 | 19.03 | 3.08 | 3.03 | 0.05 | 2.82 | 0.52 | 19.17 |
| 10S | 22E | 13 | 10S22E13 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 10S | 22E | 14 | 10S22E14 | 2 | 0.06 | 5 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 4.37 | 4.46 | 0.03 | 3.91 | 0.66 | 9.79 |
| 10S | 22E | 15 | 10S22E15 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 10S | 22E | 16 | 10S22E16 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 22E | 17 | 10S22E17 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 10S | 22E | 18 | 10S22E18 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 10S | 22E | 19 | 10S22E19 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 22E | 20 | 10S22E20 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 22E | 21 | 10S22E21 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 10S | 22E | 22 | 10S22E22 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 10S | 22E | 23 | 10S22E23 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 22E | 24 | 10S22E24 | 3 | 0.09 | | | | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 | - | - | - | - | - | - | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 |
| 10S | 22E | 25 | 10S22E25 | 3 | 0.09 | 6 | | | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 | 0.71 | 0.64 | 0.03 | 0.70 | 0.15 | 11.42 | 6.37 | 6.53 | 0.04 | 5.69 | 0.95 | 11.83 |
| 10S | 22E | 26 | 10S22E26 | 1 | 0.03 | 21 | | 1 | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 8.77 | 3.13 | 0.16 | 2.63 | 0.73 | 41.61 | 10.66 | 5.09 | 0.16 | 4.30 | 0.99 | 41.75 |
| 10S | 22E | 27 | 10S22E27 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 10S | 22E | 28 | 10S22E28 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 10S | 22E | 29 | 10S22E29 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 10S | 22E | 30 | 10S22E30 | 1 | 0.03 | 15 | 1 | 1 | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 8.06 | 2.48 | 0.13 | 1.94 | 0.58 | 35.01 | 9.95 | 4.45 | 0.14 | 3.60 | 0.84 | 35.15 |
| 10S | 22E | 31 | 10S22E31 | 1 | 0.03 | 19 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.26 | 2.03 | 0.08 | 2.20 | 0.48 | 36.16 | 4.15 | 4.00 | 0.09 | 3.87 | 0.74 | 36.30 |
| 10S | 22E | 32 | 10S22E32 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 22E | 33 | 10S22E33 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 22E | 34 | 10S22E34 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 22E | 35 | 10S22E35 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 10S | 22E | 36 | 10S22E36 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 10S | 23E | 1 | 10S23E01 | 1 | 0.03 | 16 | | 1 | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 8.18 | 2.59 | 0.14 | 2.05 | 0.60 | 32.09 | 10.07 | 4.55 | 0.14 | 3.72 | 0.87 | 32.23 |
| 10S | 23E | 2 | 10S23E02 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 23E | 3 | 10S23E03 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 23E | 4 | 10S23E04 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 23E | 5 | 10S23E05 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 23E | 6 | 10S23E06 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 23E | 7 | 10S23E07 | 1 | 0.03 | 14 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.66 | 1.50 | 0.06 | 1.62 | 0.35 | 26.65 | 3.55 | 3.46 | 0.07 | 3.29 | 0.62 | 26.78 |

**Table C-1 Spatially Distributed Production and Drilling Emissions for the Proposed Action**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 336 | 10 | 3,339 | 2 | 13 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 10S | 23E | 8 | 10S23E08 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 10S | 23E | 9 | 10S23E09 | 1 | 0.03 | 17 | | 1 | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 8.30 | 2.70 | 0.14 | 2.17 | 0.63 | 33.99 | 10.18 | 4.66 | 0.14 | 3.83 | 0.89 | 34.13 |
| 10S | 23E | 10 | 10S23E10 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 23E | 11 | 10S23E11 | 1 | 0.03 | 17 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.02 | 1.82 | 0.07 | 1.97 | 0.43 | 32.36 | 3.91 | 3.78 | 0.08 | 3.64 | 0.69 | 32.49 |
| 10S | 23E | 12 | 10S23E12 | 4 | 0.12 | | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | - | - | - | - | - | - | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 |
| 10S | 23E | 13 | 10S23E13 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10S | 23E | 14 | 10S23E14 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 10S | 23E | 15 | 10S23E15 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 10S | 23E | 16 | 10S23E16 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 10S | 23E | 17 | 10S23E17 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 10S | 23E | 18 | 10S23E18 | 2 | 0.06 | 7 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.83 | 0.75 | 0.03 | 0.81 | 0.18 | 13.32 | 4.61 | 4.67 | 0.04 | 4.14 | 0.71 | 13.60 |
| 10S | 23E | 22 | 10S23E22 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11S | 21E | 1 | 11S21E01 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11S | 21E | 2 | 11S21E02 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 11S | 21E | 3 | 11S21E03 | 1 | 0.03 | 20 | | 1 | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 8.66 | 3.02 | 0.15 | 2.52 | 0.70 | 39.70 | 10.54 | 4.98 | 0.16 | 4.18 | 0.97 | 39.84 |
| 11S | 21E | 4 | 11S21E04 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 11S | 21E | 5 | 11S21E05 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 11S | 21E | 7 | 11S21E07 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 11S | 21E | 8 | 11S21E08 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 11S | 21E | 9 | 11S21E09 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 11S | 21E | 10 | 11S21E10 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 11S | 21E | 11 | 11S21E11 | 1 | 0.03 | 21 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.50 | 2.25 | 0.09 | 2.43 | 0.53 | 39.97 | 4.38 | 4.21 | 0.10 | 4.10 | 0.79 | 40.11 |
| 11S | 21E | 12 | 11S21E12 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 11S | 21E | 13 | 11S21E13 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 11S | 21E | 14 | 11S21E14 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 11S | 21E | 15 | 11S21E15 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 11S | 21E | 16 | 11S21E16 | 1 | 0.03 | 15 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.78 | 1.61 | 0.06 | 1.74 | 0.38 | 28.55 | 3.67 | 3.57 | 0.07 | 3.40 | 0.64 | 28.69 |
| 11S | 21E | 17 | 11S21E17 | 1 | 0.03 | 22 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 4.50 | 4.32 | 0.10 | 4.21 | 0.82 | 42.01 |
| 11S | 21E | 18 | 11S21E18 | 1 | 0.03 | 11 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 3.19 | 3.14 | 0.05 | 2.94 | 0.54 | 21.07 |
| 11S | 21E | 24 | 11S21E24 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11S | 22E | 2 | 11S22E02 | 1 | 0.03 | 18 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.14 | 1.93 | 0.08 | 2.09 | 0.45 | 34.26 | 4.03 | 3.89 | 0.08 | 3.75 | 0.72 | 34.40 |
| 11S | 22E | 3 | 11S22E03 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 11S | 22E | 4 | 11S22E04 | 1 | 0.03 | 16 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.90 | 1.71 | 0.07 | 1.85 | 0.40 | 30.45 | 3.79 | 3.67 | 0.07 | 3.52 | 0.67 | 30.59 |
| 11S | 22E | 5 | 11S22E05 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 11S | 22E | 6 | 11S22E06 | 1 | 0.03 | 11 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 3.19 | 3.14 | 0.05 | 2.94 | 0.54 | 21.07 |
| 11S | 22E | 7 | 11S22E07 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11S | 22E | 8 | 11S22E08 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11S | 22E | 9 | 11S22E09 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 11S | 22E | 10 | 11S22E10 | 3 | 0.09 | 5 | | | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 6.25 | 6.42 | 0.04 | 5.57 | 0.92 | 9.93 |
| 11S | 22E | 15 | 11S22E15 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11S | 22E | 16 | 11S22E16 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 11S | 22E | 17 | 11S22E17 | 3 | 0.09 | 5 | | | 5.66 | 5.88 | 0.02 | 4.99 | 0.80 | 0.41 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 6.25 | 6.42 | 0.04 | 5.57 | 0.92 | 9.93 |
| 11S | 22E | 18 | 11S22E18 | 1 | 0.03 | 20 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 4.26 | 4.10 | 0.09 | 3.98 | 0.77 | 38.20 |
| 11S | 22E | 19 | 11S22E19 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 11S | 22E | 20 | 11S22E20 | 2 | 0.06 | 5 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 4.37 | 4.46 | 0.03 | 3.91 | 0.66 | 9.79 |
| 11S | 22E | 21 | 11S22E21 | 1 | 0.03 | 13 | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | 1.55 | 1.39 | 0.06 | 1.51 | 0.33 | 24.74 | 3.43 | 3.35 | 0.06 | 3.17 | 0.59 | 24.88 |
| 11S | 22E | 22 | 11S22E22 | 1 | 0.03 | | | | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 | - | - | - | - | - | - | 1.89 | 1.96 | 0.01 | 1.66 | 0.27 | 0.14 |
| 11S | 22E | 23 | 11S22E23 | - | - | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | | 336 | 10.1 | 3339 | 2 | 13 | 633.8 | 659.1 | 1.8 | 559.3 | 89.2 | 46.2 | 478.7 | 368.9 | 15.2 | 389.6 | 86.4 | 6,386.0 | 1,112.5 | 1,028.0 | 16.9 | 948.9 | 175.6 | 6,432.3 |

**Table C-2 Spatially Distributed Production and Drilling Emissions for the Optimal Recovery Alternative**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 672 | 20 | 12,774 | 5 | 23 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 8S | 20E | 33 | 08S20E33 | 2 | 0.06 | 57 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 10.55 | 10.03 | 0.25 | 9.94 | 1.96 | 108.76 |
| 8S | 20E | 34 | 08S20E34 | 2 | 0.06 | 57 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 10.55 | 10.03 | 0.25 | 9.94 | 1.96 | 108.76 |
| 8S | 20E | 35 | 08S20E35 | 2 | 0.06 | 56 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 10.43 | 9.92 | 0.25 | 9.82 | 1.94 | 106.86 |
| 8S | 20E | 36 | 08S20E36 | 2 | 0.06 | 57 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 10.55 | 10.03 | 0.25 | 9.94 | 1.96 | 108.76 |
| 8S | 21E | 31 | 08S21E31 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 8S | 21E | 32 | 08S21E32 | 4 | 0.12 | 45 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.35 | 4.82 | 0.19 | 5.22 | 1.13 | 85.65 | 12.90 | 12.66 | 0.21 | 11.87 | 2.19 | 86.20 |
| 8S | 21E | 33 | 08S21E33 | 4 | 0.12 | 52 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 13.73 | 13.41 | 0.24 | 12.69 | 2.37 | 99.52 |
| 8S | 21E | 34 | 08S21E34 | 4 | 0.12 | 49 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 13.37 | 13.09 | 0.23 | 12.34 | 2.29 | 93.81 |
| 8S | 21E | 35 | 08S21E35 | 4 | 0.12 | 42 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.99 | 4.50 | 0.18 | 4.87 | 1.05 | 79.94 | 12.54 | 12.34 | 0.20 | 11.53 | 2.12 | 80.49 |
| 8S | 21E | 36 | 08S21E36 | 4 | 0.12 | 41 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.88 | 4.39 | 0.18 | 4.75 | 1.03 | 78.03 | 12.42 | 12.24 | 0.20 | 11.41 | 2.09 | 78.59 |
| 8S | 22E | 31 | 08S22E31 | 4 | 0.12 | 45 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.35 | 4.82 | 0.19 | 5.22 | 1.13 | 85.65 | 12.90 | 12.66 | 0.21 | 11.87 | 2.19 | 86.20 |
| 8S | 23E | 33 | 08S23E33 | 2 | 0.06 | 62 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.37 | 6.64 | 0.27 | 7.19 | 1.56 | 118.00 | 11.15 | 10.56 | 0.28 | 10.52 | 2.09 | 118.28 |
| 8S | 23E | 34 | 08S23E34 | 4 | 0.12 | 60 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 14.68 | 14.27 | 0.28 | 13.61 | 2.57 | 114.75 |
| 8S | 23E | 35 | 08S23E35 | 4 | 0.12 | 57 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 14.32 | 13.95 | 0.27 | 13.27 | 2.49 | 109.04 |
| 9S | 20E | 1 | 09S20E01 | 4 | 0.12 | 57 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 14.32 | 13.95 | 0.27 | 13.27 | 2.49 | 109.04 |
| 9S | 20E | 2 | 09S20E02 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 9S | 20E | 3 | 09S20E03 | 2 | 0.06 | 44 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 9.01 | 8.63 | 0.20 | 8.43 | 1.64 | 84.02 |
| 9S | 20E | 4 | 09S20E04 | 4 | 0.12 | 48 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 13.25 | 12.99 | 0.23 | 12.22 | 2.27 | 91.91 |
| 9S | 20E | 9 | 09S20E09 | 4 | 0.12 | 56 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 14.20 | 13.84 | 0.26 | 13.15 | 2.47 | 107.13 |
| 9S | 20E | 10 | 09S20E10 | 4 | 0.12 | 60 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 14.68 | 14.27 | 0.28 | 13.61 | 2.57 | 114.75 |
| 9S | 20E | 11 | 09S20E11 | 2 | 0.06 | 62 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 13.65 | 7.52 | 0.33 | 7.39 | 1.76 | 119.64 | 17.42 | 11.44 | 0.34 | 10.71 | 2.29 | 119.92 |
| 9S | 20E | 12 | 09S20E12 | 4 | 0.12 | 50 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 13.49 | 13.20 | 0.24 | 12.45 | 2.32 | 95.71 |
| 9S | 20E | 13 | 09S20E13 | 6 | 0.18 | 57 | | | 11.32 | 11.77 | 0.03 | 9.99 | 1.59 | 0.83 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 18.10 | 17.87 | 0.28 | 16.59 | 3.02 | 109.31 |
| 9S | 20E | 14 | 09S20E14 | 4 | 0.12 | 58 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.90 | 6.21 | 0.25 | 6.72 | 1.46 | 110.39 | 14.44 | 14.06 | 0.27 | 13.38 | 2.52 | 110.94 |
| 9S | 20E | 15 | 09S20E15 | 4 | 0.12 | 47 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 13.13 | 12.88 | 0.22 | 12.11 | 2.24 | 90.01 |
| 9S | 20E | 20 | 09S20E20 | 2 | 0.06 | 56 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 10.43 | 9.92 | 0.25 | 9.82 | 1.94 | 106.86 |
| 9S | 20E | 21 | 09S20E21 | 4 | 0.12 | 56 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 14.20 | 13.84 | 0.26 | 13.15 | 2.47 | 107.13 |
| 9S | 20E | 22 | 09S20E22 | 4 | 0.12 | 50 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 13.49 | 13.20 | 0.24 | 12.45 | 2.32 | 95.71 |
| 9S | 20E | 23 | 09S20E23 | 4 | 0.12 | 60 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 14.68 | 14.27 | 0.28 | 13.61 | 2.57 | 114.75 |
| 9S | 20E | 24 | 09S20E24 | 4 | 0.12 | 59 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 14.56 | 14.16 | 0.27 | 13.50 | 2.54 | 112.84 |
| 9S | 20E | 25 | 09S20E25 | 4 | 0.12 | 44 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 12.78 | 12.56 | 0.21 | 11.76 | 2.17 | 84.30 |
| 9S | 20E | 26 | 09S20E26 | 4 | 0.12 | 53 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 13.85 | 13.52 | 0.25 | 12.80 | 2.39 | 101.42 |
| 9S | 20E | 27 | 09S20E27 | 4 | 0.12 | 53 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 13.85 | 13.52 | 0.25 | 12.80 | 2.39 | 101.42 |
| 9S | 20E | 28 | 09S20E28 | - | - | 65 | | 1 | - | - | - | - | - | - | 14.01 | 7.84 | 0.35 | 7.73 | 1.83 | 125.35 | 14.01 | 7.84 | 0.35 | 7.73 | 1.83 | 125.35 |
| 9S | 20E | 29 | 09S20E29 | 2 | 0.06 | 63 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.49 | 6.75 | 0.27 | 7.30 | 1.58 | 119.91 | 11.26 | 10.67 | 0.28 | 10.63 | 2.11 | 120.18 |
| 9S | 20E | 32 | 09S20E32 | - | - | 65 | | | - | - | - | - | - | - | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 |
| 9S | 20E | 33 | 09S20E33 | - | - | 65 | | | - | - | - | - | - | - | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 |
| 9S | 20E | 34 | 09S20E34 | - | - | 65 | | | - | - | - | - | - | - | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 |
| 9S | 20E | 35 | 09S20E35 | 4 | 0.12 | 52 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 13.73 | 13.41 | 0.24 | 12.69 | 2.37 | 99.52 |
| 9S | 20E | 36 | 09S20E36 | 4 | 0.12 | 52 | | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 12.46 | 6.45 | 0.29 | 6.23 | 1.50 | 100.61 | 20.01 | 14.29 | 0.31 | 12.88 | 2.57 | 101.16 |
| 9S | 21E | 1 | 09S21E01 | 4 | 0.12 | 37 | | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 10.68 | 4.84 | 0.23 | 4.49 | 1.13 | 72.06 | 18.22 | 12.69 | 0.25 | 11.15 | 2.19 | 72.61 |
| 9S | 21E | 2 | 09S21E02 | 4 | 0.12 | 40 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.76 | 4.28 | 0.17 | 4.64 | 1.00 | 76.13 | 12.30 | 12.13 | 0.19 | 11.30 | 2.07 | 76.68 |
| 9S | 21E | 3 | 09S21E03 | 4 | 0.12 | 41 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.88 | 4.39 | 0.18 | 4.75 | 1.03 | 78.03 | 12.42 | 12.24 | 0.20 | 11.41 | 2.09 | 78.59 |
| 9S | 21E | 4 | 09S21E04 | 4 | 0.12 | 38 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.52 | 4.07 | 0.16 | 4.40 | 0.95 | 72.32 | 12.06 | 11.91 | 0.18 | 11.06 | 2.02 | 72.88 |
| 9S | 21E | 5 | 09S21E05 | 4 | 0.12 | 43 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.11 | 4.60 | 0.18 | 4.98 | 1.08 | 81.84 | 12.66 | 12.45 | 0.21 | 11.64 | 2.14 | 82.39 |
| 9S | 21E | 6 | 09S21E06 | 4 | 0.12 | 34 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.04 | 3.64 | 0.15 | 3.94 | 0.85 | 64.71 | 11.59 | 11.49 | 0.17 | 10.60 | 1.92 | 65.26 |
| 9S | 21E | 7 | 09S21E07 | 4 | 0.12 | 47 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 13.13 | 12.88 | 0.22 | 12.11 | 2.24 | 90.01 |
| 9S | 21E | 8 | 09S21E08 | 4 | 0.12 | 48 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 13.25 | 12.99 | 0.23 | 12.22 | 2.27 | 91.91 |
| 9S | 21E | 9 | 09S21E09 | 4 | 0.12 | 45 | | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 11.63 | 5.70 | 0.26 | 5.41 | 1.33 | 87.29 | 19.17 | 13.54 | 0.28 | 12.07 | 2.39 | 87.84 |
| 9S | 21E | 10 | 09S21E10 | 4 | 0.12 | 49 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 13.37 | 13.09 | 0.23 | 12.34 | 2.29 | 93.81 |
| 9S | 21E | 11 | 09S21E11 | 4 | 0.12 | 52 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 13.73 | 13.41 | 0.24 | 12.69 | 2.37 | 99.52 |
| 9S | 21E | 12 | 09S21E12 | 4 | 0.12 | 52 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 13.73 | 13.41 | 0.24 | 12.69 | 2.37 | 99.52 |
| 9S | 21E | 13 | 09S21E13 | 4 | 0.12 | 42 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.99 | 4.50 | 0.18 | 4.87 | 1.05 | 79.94 | 12.54 | 12.34 | 0.20 | 11.53 | 2.12 | 80.49 |

**Table C-2 Spatially Distributed Production and Drilling Emissions for the Optimal Recovery Alternative**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 672 | 20 | 12,774 | 5 | 23 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 9S | 21E | 14 | 09S21E14 | 4 | 0.12 | 43 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.11 | 4.60 | 0.18 | 4.98 | 1.08 | 81.84 | 12.66 | 12.45 | 0.21 | 11.64 | 2.14 | 82.39 |
| 9S | 21E | 15 | 09S21E15 | 4 | 0.12 | 44 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 12.78 | 12.56 | 0.21 | 11.76 | 2.17 | 84.30 |
| 9S | 21E | 16 | 09S21E16 | 4 | 0.12 | 47 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 13.13 | 12.88 | 0.22 | 12.11 | 2.24 | 90.01 |
| 9S | 21E | 17 | 09S21E17 | 4 | 0.12 | 48 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 13.25 | 12.99 | 0.23 | 12.22 | 2.27 | 91.91 |
| 9S | 21E | 18 | 09S21E18 | 4 | 0.12 | 46 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 13.02 | 12.77 | 0.22 | 11.99 | 2.22 | 88.10 |
| 9S | 21E | 19 | 09S21E19 | 4 | 0.12 | 48 | 1 | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 11.98 | 6.02 | 0.27 | 5.76 | 1.40 | 99.72 | 19.53 | 13.86 | 0.29 | 12.42 | 2.47 | 100.27 |
| 9S | 21E | 20 | 09S21E20 | 4 | 0.12 | 49 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 13.37 | 13.09 | 0.23 | 12.34 | 2.29 | 93.81 |
| 9S | 21E | 21 | 09S21E21 | 4 | 0.12 | 42 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.99 | 4.50 | 0.18 | 4.87 | 1.05 | 79.94 | 12.54 | 12.34 | 0.20 | 11.53 | 2.12 | 80.49 |
| 9S | 21E | 22 | 09S21E22 | 4 | 0.12 | 48 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 13.25 | 12.99 | 0.23 | 12.22 | 2.27 | 91.91 |
| 9S | 21E | 23 | 09S21E23 | 4 | 0.12 | 50 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 13.49 | 13.20 | 0.24 | 12.45 | 2.32 | 95.71 |
| 9S | 21E | 24 | 09S21E24 | 4 | 0.12 | 53 | | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 12.58 | 6.55 | 0.29 | 6.34 | 1.53 | 102.51 | 20.12 | 14.40 | 0.31 | 13.00 | 2.59 | 103.06 |
| 9S | 21E | 25 | 09S21E25 | 4 | 0.12 | 46 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 13.02 | 12.77 | 0.22 | 11.99 | 2.22 | 88.10 |
| 9S | 21E | 26 | 09S21E26 | 4 | 0.12 | 44 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 12.78 | 12.56 | 0.21 | 11.76 | 2.17 | 84.30 |
| 9S | 21E | 27 | 09S21E27 | 4 | 0.12 | 44 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 12.78 | 12.56 | 0.21 | 11.76 | 2.17 | 84.30 |
| 9S | 21E | 28 | 09S21E28 | 4 | 0.12 | 41 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.88 | 4.39 | 0.18 | 4.75 | 1.03 | 78.03 | 12.42 | 12.24 | 0.20 | 11.41 | 2.09 | 78.59 |
| 9S | 21E | 29 | 09S21E29 | 4 | 0.12 | 47 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 13.13 | 12.88 | 0.22 | 12.11 | 2.24 | 90.01 |
| 9S | 21E | 30 | 09S21E30 | 4 | 0.12 | 48 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 13.25 | 12.99 | 0.23 | 12.22 | 2.27 | 91.91 |
| 9S | 21E | 31 | 09S21E31 | 4 | 0.12 | 52 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 13.73 | 13.41 | 0.24 | 12.69 | 2.37 | 99.52 |
| 9S | 21E | 32 | 09S21E32 | 4 | 0.12 | 52 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 13.73 | 13.41 | 0.24 | 12.69 | 2.37 | 99.52 |
| 9S | 21E | 33 | 09S21E33 | 4 | 0.12 | 42 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.99 | 4.50 | 0.18 | 4.87 | 1.05 | 79.94 | 12.54 | 12.34 | 0.20 | 11.53 | 2.12 | 80.49 |
| 9S | 21E | 34 | 09S21E34 | 4 | 0.12 | 46 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 13.02 | 12.77 | 0.22 | 11.99 | 2.22 | 88.10 |
| 9S | 21E | 35 | 09S21E35 | 4 | 0.12 | 46 | 1 | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 11.75 | 5.80 | 0.26 | 5.53 | 1.35 | 95.91 | 19.29 | 13.65 | 0.28 | 12.19 | 2.42 | 96.46 |
| 9S | 21E | 36 | 09S21E36 | 4 | 0.12 | 44 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 12.78 | 12.56 | 0.21 | 11.76 | 2.17 | 84.30 |
| 9S | 22E | 6 | 09S22E06 | 4 | 0.12 | 42 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.99 | 4.50 | 0.18 | 4.87 | 1.05 | 79.94 | 12.54 | 12.34 | 0.20 | 11.53 | 2.12 | 80.49 |
| 9S | 22E | 7 | 09S22E07 | 4 | 0.12 | 39 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.64 | 4.18 | 0.17 | 4.52 | 0.98 | 74.23 | 12.18 | 12.02 | 0.19 | 11.18 | 2.04 | 74.78 |
| 9S | 22E | 15 | 09S22E15 | - | - | 5 | | | - | - | - | - | - | - | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 |
| 9S | 22E | 18 | 09S22E18 | 4 | 0.12 | 38 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.52 | 4.07 | 0.16 | 4.40 | 0.95 | 72.32 | 12.06 | 11.91 | 0.18 | 11.06 | 2.02 | 72.88 |
| 9S | 22E | 19 | 09S22E19 | 4 | 0.12 | 50 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 13.49 | 13.20 | 0.24 | 12.45 | 2.32 | 95.71 |
| 9S | 22E | 20 | 09S22E20 | 4 | 0.12 | 38 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.52 | 4.07 | 0.16 | 4.40 | 0.95 | 72.32 | 12.06 | 11.91 | 0.18 | 11.06 | 2.02 | 72.88 |
| 9S | 22E | 29 | 09S22E29 | 4 | 0.12 | 48 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 13.25 | 12.99 | 0.23 | 12.22 | 2.27 | 91.91 |
| 9S | 22E | 30 | 09S22E30 | 4 | 0.12 | 46 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 13.02 | 12.77 | 0.22 | 11.99 | 2.22 | 88.10 |
| 9S | 22E | 31 | 09S22E31 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 9S | 22E | 32 | 09S22E32 | 4 | 0.12 | 41 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.88 | 4.39 | 0.18 | 4.75 | 1.03 | 78.03 | 12.42 | 12.24 | 0.20 | 11.41 | 2.09 | 78.59 |
| 9S | 22E | 33 | 09S22E33 | 2 | 0.06 | 42 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 4.99 | 4.50 | 0.18 | 4.87 | 1.05 | 79.94 | 8.77 | 8.42 | 0.19 | 8.20 | 1.59 | 80.21 |
| 9S | 22E | 34 | 09S22E34 | 4 | 0.12 | 19 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 2.26 | 2.03 | 0.08 | 2.20 | 0.48 | 36.16 | 9.80 | 9.88 | 0.10 | 8.86 | 1.54 | 36.71 |
| 9S | 22E | 35 | 09S22E35 | 2 | 0.06 | 39 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 4.64 | 4.18 | 0.17 | 4.52 | 0.98 | 74.23 | 8.41 | 8.10 | 0.18 | 7.85 | 1.51 | 74.50 |
| 9S | 22E | 36 | 09S22E36 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 9S | 23E | 1 | 09S23E01 | 4 | 0.12 | 60 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 14.68 | 14.27 | 0.28 | 13.61 | 2.57 | 114.75 |
| 9S | 23E | 2 | 09S23E02 | 2 | 0.06 | 62 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.37 | 6.64 | 0.27 | 7.19 | 1.56 | 118.00 | 11.15 | 10.56 | 0.28 | 10.52 | 2.09 | 118.28 |
| 9S | 23E | 3 | 09S23E03 | 4 | 0.12 | 59 | | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 13.29 | 7.20 | 0.32 | 7.04 | 1.68 | 113.93 | 20.84 | 15.04 | 0.34 | 13.70 | 2.74 | 114.48 |
| 9S | 23E | 4 | 09S23E04 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 9S | 23E | 8 | 09S23E05 | 2 | 0.06 | 63 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.49 | 6.75 | 0.27 | 7.30 | 1.58 | 119.91 | 11.26 | 10.67 | 0.28 | 10.63 | 2.11 | 120.18 |
| 9S | 23E | 9 | 09S23E06 | 4 | 0.12 | 59 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 14.56 | 14.16 | 0.27 | 13.50 | 2.54 | 112.84 |
| 9S | 23E | 10 | 09S23E10 | 2 | 0.06 | 45 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.35 | 4.82 | 0.19 | 5.22 | 1.13 | 85.65 | 9.12 | 8.74 | 0.20 | 8.55 | 1.66 | 85.92 |
| 9S | 23E | 11 | 09S23E11 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 9S | 23E | 12 | 09S23E12 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 9S | 23E | 13 | 09S23E13 | 2 | 0.06 | 59 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 10.79 | 10.24 | 0.26 | 10.17 | 2.01 | 112.57 |
| 9S | 23E | 14 | 09S23E14 | 2 | 0.06 | 59 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 10.79 | 10.24 | 0.26 | 10.17 | 2.01 | 112.57 |
| 9S | 23E | 15 | 09S23E15 | 2 | 0.06 | 58 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.90 | 6.21 | 0.25 | 6.72 | 1.46 | 110.39 | 10.67 | 10.13 | 0.26 | 10.05 | 1.99 | 110.67 |
| 9S | 23E | 23 | 09S23E23 | 2 | 0.06 | 56 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 10.43 | 9.92 | 0.25 | 9.82 | 1.94 | 106.86 |
| 9S | 23E | 24 | 09S23E24 | 2 | 0.06 | 60 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 10.91 | 10.35 | 0.27 | 10.28 | 2.04 | 114.47 |
| 9S | 23E | 25 | 09S23E25 | - | - | 65 | | 1 | - | - | - | - | - | - | 14.01 | 7.84 | 0.35 | 7.73 | 1.83 | 125.35 | 14.01 | 7.84 | 0.35 | 7.73 | 1.83 | 125.35 |
| 9S | 23E | 26 | 09S23E26 | 6 | 0.18 | 35 | | | 11.32 | 11.77 | 0.03 | 9.99 | 1.59 | 0.83 | 4.16 | 3.75 | 0.15 | 4.06 | 0.88 | 66.62 | 15.48 | 15.52 | 0.18 | 14.04 | 2.47 | 67.44 |

**Table C-2 Spatially Distributed Production and Drilling Emissions for the Optimal Recovery Alternative**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 672 | 20 | 12,774 | 5 | 23 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 9S | 23E | 31 | 09S23E31 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 9S | 23E | 35 | 09S23E35 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 9S | 23E | 36 | 09S23E36 | - | - | 49 | | | - | - | - | - | - | - | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 |
| 9S | 24E | 21 | 09S24E21 | - | - | 66 | | | - | - | - | - | - | - | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 |
| 9S | 24E | 28 | 09S24E28 | - | - | 65 | | | - | - | - | - | - | - | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 |
| 9S | 24E | 29 | 09S24E29 | 4 | 0.12 | 59 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 14.56 | 14.16 | 0.27 | 13.50 | 2.54 | 112.84 |
| 9S | 24E | 30 | 09S24E30 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 9S | 24E | 31 | 09S24E31 | 2 | 0.06 | 59 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 10.79 | 10.24 | 0.26 | 10.17 | 2.01 | 112.57 |
| 9S | 24E | 32 | 09S24E32 | - | - | 66 | | 1 | - | - | - | - | - | - | 14.13 | 7.95 | 0.35 | 7.85 | 1.86 | 127.26 | 14.13 | 7.95 | 0.35 | 7.85 | 1.86 | 127.26 |
| 9S | 24E | 33 | 09S24E33 | - | - | 66 | | | - | - | - | - | - | - | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 |
| 9S | 24E | 34 | 09S24E34 | 2 | 0.06 | 63 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.49 | 6.75 | 0.27 | 7.30 | 1.58 | 119.91 | 11.26 | 10.67 | 0.28 | 10.63 | 2.11 | 120.18 |
| 10S | 20E | 1 | 10S20E01 | 2 | 0.06 | 53 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 10.08 | 9.60 | 0.24 | 9.47 | 1.86 | 101.15 |
| 10S | 20E | 2 | 10S20E02 | 2 | 0.06 | 57 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 10.55 | 10.03 | 0.25 | 9.94 | 1.96 | 108.76 |
| 10S | 20E | 11 | 10S20E11 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 10S | 20E | 12 | 10S20E12 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 20E | 13 | 10S20E13 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 20E | 14 | 10S20E14 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 10S | 20E | 23 | 10S20E23 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 10S | 20E | 24 | 10S20E24 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 10S | 20E | 25 | 10S20E25 | 2 | 0.06 | 63 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.49 | 6.75 | 0.27 | 7.30 | 1.58 | 119.91 | 11.26 | 10.67 | 0.28 | 10.63 | 2.11 | 120.18 |
| 10S | 20E | 26 | 10S20E26 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 10S | 20E | 35 | 10S20E35 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 10S | 20E | 36 | 10S20E36 | 2 | 0.06 | 53 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 10.08 | 9.60 | 0.24 | 9.47 | 1.86 | 101.15 |
| 10S | 21E | 1 | 10S21E01 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 10S | 21E | 2 | 10S21E02 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 21E | 3 | 10S21E03 | 2 | 0.06 | 45 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.35 | 4.82 | 0.19 | 5.22 | 1.13 | 85.65 | 9.12 | 8.74 | 0.20 | 8.55 | 1.66 | 85.92 |
| 10S | 21E | 4 | 10S21E04 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 21E | 5 | 10S21E05 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 21E | 6 | 10S21E06 | 4 | 0.12 | 49 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 13.37 | 13.09 | 0.23 | 12.34 | 2.29 | 93.81 |
| 10S | 21E | 7 | 10S21E07 | 2 | 0.06 | 55 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 12.82 | 6.77 | 0.30 | 6.57 | 1.58 | 106.32 | 16.59 | 10.69 | 0.31 | 9.90 | 2.11 | 106.59 |
| 10S | 21E | 8 | 10S21E08 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 10S | 21E | 9 | 10S21E09 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 21E | 10 | 10S21E10 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 21E | 11 | 10S21E11 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 21E | 12 | 10S21E12 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 10S | 21E | 13 | 10S21E13 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 21E | 14 | 10S21E14 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 21E | 15 | 10S21E15 | 2 | 0.06 | 47 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 11.87 | 5.91 | 0.27 | 5.65 | 1.38 | 91.09 | 15.64 | 9.83 | 0.28 | 8.98 | 1.91 | 91.37 |
| 10S | 21E | 16 | 10S21E16 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 10S | 21E | 17 | 10S21E17 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 21E | 18 | 10S21E18 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 10S | 21E | 19 | 10S21E19 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 10S | 21E | 20 | 10S21E20 | 2 | 0.06 | 58 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.90 | 6.21 | 0.25 | 6.72 | 1.46 | 110.39 | 10.67 | 10.13 | 0.26 | 10.05 | 1.99 | 110.67 |
| 10S | 21E | 21 | 10S21E21 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 21E | 22 | 10S21E22 | 2 | 0.06 | 56 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 10.43 | 9.92 | 0.25 | 9.82 | 1.94 | 106.86 |
| 10S | 21E | 23 | 10S21E23 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 21E | 24 | 10S21E24 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 10S | 21E | 25 | 10S21E25 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 21E | 26 | 10S21E26 | 2 | 0.06 | 59 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 10.79 | 10.24 | 0.26 | 10.17 | 2.01 | 112.57 |
| 10S | 21E | 27 | 10S21E27 | 6 | 0.18 | 58 | | | 11.32 | 11.77 | 0.03 | 9.99 | 1.59 | 0.83 | 6.90 | 6.21 | 0.25 | 6.72 | 1.46 | 110.39 | 18.22 | 17.98 | 0.28 | 16.71 | 3.05 | 111.22 |
| 10S | 21E | 28 | 10S21E28 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 10S | 21E | 29 | 10S21E29 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 10S | 21E | 30 | 10S21E30 | 2 | 0.06 | 54 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 12.70 | 6.66 | 0.30 | 6.46 | 1.55 | 104.42 | 16.47 | 10.58 | 0.31 | 9.79 | 2.09 | 104.69 |

**Table C-2 Spatially Distributed Production and Drilling Emissions for the Optimal Recovery Alternative**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 672 | 20 | 12,774 | 5 | 23 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 10S | 21E | 31 | 10S21E31 | 4 | 0.12 | 47 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 13.13 | 12.88 | 0.22 | 12.11 | 2.24 | 90.01 |
| 10S | 21E | 32 | 10S21E32 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 21E | 33 | 10S21E33 | - | - | 65 | | | - | - | - | - | - | - | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 | 7.73 | 6.96 | 0.28 | 7.53 | 1.63 | 123.71 |
| 10S | 21E | 34 | 10S21E34 | 2 | 0.06 | 60 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 10.91 | 10.35 | 0.27 | 10.28 | 2.04 | 114.47 |
| 10S | 21E | 35 | 10S21E35 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 21E | 36 | 10S21E36 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 22E | 1 | 10S22E01 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 22E | 2 | 10S22E02 | 4 | 0.12 | 20 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 2.38 | 2.14 | 0.09 | 2.32 | 0.50 | 38.07 | 9.92 | 9.99 | 0.11 | 8.98 | 1.56 | 38.62 |
| 10S | 22E | 3 | 10S22E03 | 4 | 0.12 | 40 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.76 | 4.28 | 0.17 | 4.64 | 1.00 | 76.13 | 12.30 | 12.13 | 0.19 | 11.30 | 2.07 | 76.68 |
| 10S | 22E | 4 | 10S22E04 | 4 | 0.12 | 11 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 1.31 | 1.18 | 0.05 | 1.27 | 0.28 | 20.94 | 8.85 | 9.02 | 0.07 | 7.93 | 1.34 | 21.49 |
| 10S | 22E | 5 | 10S22E05 | 2 | 0.06 | 11 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.58 | 2.06 | 0.11 | 1.47 | 0.48 | 22.57 | 11.36 | 5.98 | 0.12 | 4.80 | 1.01 | 22.85 |
| 10S | 22E | 6 | 10S22E06 | 2 | 0.06 | 43 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.11 | 4.60 | 0.18 | 4.98 | 1.08 | 81.84 | 8.89 | 8.53 | 0.19 | 8.31 | 1.61 | 82.12 |
| 10S | 22E | 7 | 10S22E07 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 22E | 8 | 10S22E08 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 22E | 9 | 10S22E09 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 22E | 10 | 10S22E10 | 2 | 0.06 | 42 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 4.99 | 4.50 | 0.18 | 4.87 | 1.05 | 79.94 | 8.77 | 8.42 | 0.19 | 8.20 | 1.59 | 80.21 |
| 10S | 22E | 11 | 10S22E11 | 4 | 0.12 | 25 | 1 | 1 | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 9.25 | 3.56 | 0.17 | 3.10 | 0.83 | 55.94 | 16.79 | 11.40 | 0.19 | 9.76 | 1.89 | 56.49 |
| 10S | 22E | 12 | 10S22E12 | 2 | 0.06 | 30 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 3.57 | 3.21 | 0.13 | 3.48 | 0.75 | 57.10 | 7.34 | 7.14 | 0.14 | 6.81 | 1.28 | 57.37 |
| 10S | 22E | 13 | 10S22E13 | 2 | 0.06 | 33 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 3.92 | 3.53 | 0.14 | 3.82 | 0.83 | 62.81 | 7.70 | 7.46 | 0.15 | 7.15 | 1.36 | 63.08 |
| 10S | 22E | 14 | 10S22E14 | 4 | 0.12 | 24 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 2.85 | 2.57 | 0.10 | 2.78 | 0.60 | 45.68 | 10.40 | 10.42 | 0.12 | 9.44 | 1.66 | 46.23 |
| 10S | 22E | 15 | 10S22E15 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 10S | 22E | 16 | 10S22E16 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 22E | 17 | 10S22E17 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 10S | 22E | 18 | 10S22E18 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 10S | 22E | 19 | 10S22E19 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 22E | 20 | 10S22E20 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 22E | 21 | 10S22E21 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 10S | 22E | 22 | 10S22E22 | 2 | 0.06 | 53 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 10.08 | 9.60 | 0.24 | 9.47 | 1.86 | 101.15 |
| 10S | 22E | 23 | 10S22E23 | 2 | 0.06 | 44 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 9.01 | 8.63 | 0.20 | 8.43 | 1.64 | 84.02 |
| 10S | 22E | 24 | 10S22E24 | 6 | 0.18 | 22 | | | 11.32 | 11.77 | 0.03 | 9.99 | 1.59 | 0.83 | 2.62 | 2.36 | 0.09 | 2.55 | 0.55 | 41.87 | 13.93 | 14.12 | 0.13 | 12.54 | 2.14 | 42.70 |
| 10S | 22E | 25 | 10S22E25 | 6 | 0.18 | 57 | | | 11.32 | 11.77 | 0.03 | 9.99 | 1.59 | 0.83 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 18.10 | 17.87 | 0.28 | 16.59 | 3.02 | 109.31 |
| 10S | 22E | 26 | 10S22E26 | 2 | 0.06 | 53 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 10.08 | 9.60 | 0.24 | 9.47 | 1.86 | 101.15 |
| 10S | 22E | 27 | 10S22E27 | 2 | 0.06 | 53 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 10.08 | 9.60 | 0.24 | 9.47 | 1.86 | 101.15 |
| 10S | 22E | 28 | 10S22E28 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 10S | 22E | 29 | 10S22E29 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 10S | 22E | 30 | 10S22E30 | 2 | 0.06 | 47 | 1 | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 11.87 | 5.91 | 0.27 | 5.65 | 1.38 | 97.81 | 15.64 | 9.83 | 0.28 | 8.98 | 1.91 | 98.09 |
| 10S | 22E | 31 | 10S22E31 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 10S | 22E | 32 | 10S22E32 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 22E | 33 | 10S22E33 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 22E | 34 | 10S22E34 | 2 | 0.06 | 58 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 13.17 | 7.09 | 0.32 | 6.92 | 1.65 | 112.03 | 16.95 | 11.01 | 0.33 | 10.25 | 2.19 | 112.30 |
| 10S | 22E | 35 | 10S22E35 | 2 | 0.06 | 56 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 10.43 | 9.92 | 0.25 | 9.82 | 1.94 | 106.86 |
| 10S | 22E | 36 | 10S22E36 | 2 | 0.06 | 51 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.07 | 5.46 | 0.22 | 5.91 | 1.28 | 97.07 | 9.84 | 9.38 | 0.23 | 9.24 | 1.81 | 97.34 |
| 10S | 23E | 1 | 10S23E01 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 10S | 23E | 2 | 10S23E02 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 23E | 3 | 10S23E03 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 23E | 4 | 10S23E04 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 23E | 5 | 10S23E05 | 2 | 0.06 | 47 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.59 | 5.03 | 0.20 | 5.45 | 1.18 | 89.45 | 9.36 | 8.96 | 0.21 | 8.78 | 1.71 | 89.73 |
| 10S | 23E | 6 | 10S23E06 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 23E | 7 | 10S23E07 | 2 | 0.06 | 46 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.47 | 4.93 | 0.20 | 5.33 | 1.15 | 87.55 | 9.24 | 8.85 | 0.21 | 8.66 | 1.69 | 87.83 |
| 10S | 23E | 8 | 10S23E08 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 10S | 23E | 9 | 10S23E09 | 2 | 0.06 | 49 | 1 | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 12.10 | 6.13 | 0.28 | 5.88 | 1.43 | 101.62 | 15.88 | 10.05 | 0.29 | 9.21 | 1.96 | 101.90 |
| 10S | 23E | 10 | 10S23E10 | 2 | 0.06 | 50 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.95 | 5.35 | 0.21 | 5.80 | 1.25 | 95.16 | 9.72 | 9.28 | 0.22 | 9.12 | 1.79 | 95.44 |
| 10S | 23E | 11 | 10S23E11 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |

**Table C-2 Spatially Distributed Production and Drilling Emissions for the Optimal Recovery Alternative**

| Total Planned | | | | Drilling | | Production and Operation | | | Drilling and Completion | | | | | | Production and Operation | | | | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 672 | 20 | 12,774 | 5 | 23 | | | | | | | | | | | | | | | | | | |
| TN | RG | SE | Model ID | Producing Wellbores | Non-producing | Wells (above | Water Tank | Water Injection | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | VOC |
| | | | | (number of sites) | | | | | (tons per year) | | | | | | (tons per year) | | | | | | (tons per year) | | | | | |
| 10S | 23E | 12 | 10S23E12 | 8 | 0.24 | 26 | | | 15.09 | 15.69 | 0.04 | 13.32 | 2.12 | 1.10 | 3.09 | 2.78 | 0.11 | 3.01 | 0.65 | 49.49 | 18.18 | 18.48 | 0.15 | 16.33 | 2.78 | 50.59 |
| 10S | 23E | 13 | 10S23E13 | - | - | 55 | | | - | - | - | - | - | - | 6.54 | 5.89 | 0.24 | 6.37 | 1.38 | 104.68 | 6.54 | 5.89 | 0.24 | 6.37 | 1.38 | 104.68 |
| 10S | 23E | 14 | 10S23E14 | 4 | 0.12 | 37 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 4.40 | 3.96 | 0.16 | 4.29 | 0.93 | 70.42 | 11.95 | 11.81 | 0.18 | 10.95 | 1.99 | 70.97 |
| 10S | 23E | 15 | 10S23E15 | 2 | 0.06 | 44 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.23 | 4.71 | 0.19 | 5.10 | 1.10 | 83.74 | 9.01 | 8.63 | 0.20 | 8.43 | 1.64 | 84.02 |
| 10S | 23E | 16 | 10S23E16 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 10S | 23E | 17 | 10S23E17 | 2 | 0.06 | 43 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.11 | 4.60 | 0.18 | 4.98 | 1.08 | 81.84 | 8.89 | 8.53 | 0.19 | 8.31 | 1.61 | 82.12 |
| 10S | 23E | 18 | 10S23E18 | 4 | 0.12 | 30 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 3.57 | 3.21 | 0.13 | 3.48 | 0.75 | 57.10 | 11.11 | 11.06 | 0.15 | 10.14 | 1.81 | 57.65 |
| 10S | 23E | 22 | 10S23E22 | - | - | 55 | | | - | - | - | - | - | - | 6.54 | 5.89 | 0.24 | 6.37 | 1.38 | 104.68 | 6.54 | 5.89 | 0.24 | 6.37 | 1.38 | 104.68 |
| 11S | 21E | 1 | 11S21E01 | - | - | 66 | | | - | - | - | - | - | - | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 |
| 11S | 21E | 2 | 11S21E02 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 11S | 21E | 3 | 11S21E03 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 11S | 21E | 4 | 11S21E04 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 11S | 21E | 5 | 11S21E05 | 2 | 0.06 | 55 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.54 | 5.89 | 0.24 | 6.37 | 1.38 | 104.68 | 10.31 | 9.81 | 0.25 | 9.70 | 1.91 | 104.96 |
| 11S | 21E | 7 | 11S21E07 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 11S | 21E | 8 | 11S21E08 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 11S | 21E | 9 | 11S21E09 | 2 | 0.06 | 54 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 12.70 | 6.66 | 0.30 | 6.46 | 1.55 | 104.42 | 16.47 | 10.58 | 0.31 | 9.79 | 2.09 | 104.69 |
| 11S | 21E | 10 | 11S21E10 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 11S | 21E | 11 | 11S21E11 | 2 | 0.06 | 54 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.42 | 5.78 | 0.23 | 6.26 | 1.36 | 102.78 | 10.19 | 9.70 | 0.24 | 9.59 | 1.89 | 103.05 |
| 11S | 21E | 12 | 11S21E12 | 2 | 0.06 | 56 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 12.94 | 6.87 | 0.31 | 6.69 | 1.60 | 108.22 | 16.71 | 10.80 | 0.32 | 10.02 | 2.14 | 108.50 |
| 11S | 21E | 13 | 11S21E13 | 2 | 0.06 | 57 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 10.55 | 10.03 | 0.25 | 9.94 | 1.96 | 108.76 |
| 11S | 21E | 14 | 11S21E14 | 2 | 0.06 | 58 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.90 | 6.21 | 0.25 | 6.72 | 1.46 | 110.39 | 10.67 | 10.13 | 0.26 | 10.05 | 1.99 | 110.67 |
| 11S | 21E | 15 | 11S21E15 | 2 | 0.06 | 57 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 10.55 | 10.03 | 0.25 | 9.94 | 1.96 | 108.76 |
| 11S | 21E | 16 | 11S21E16 | 2 | 0.06 | 48 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.71 | 5.14 | 0.21 | 5.56 | 1.20 | 91.36 | 9.48 | 9.06 | 0.22 | 8.89 | 1.74 | 91.63 |
| 11S | 21E | 17 | 11S21E17 | 2 | 0.06 | 55 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.54 | 5.89 | 0.24 | 6.37 | 1.38 | 104.68 | 10.31 | 9.81 | 0.25 | 9.70 | 1.91 | 104.96 |
| 11S | 21E | 18 | 11S21E18 | 2 | 0.06 | 60 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 10.91 | 10.35 | 0.27 | 10.28 | 2.04 | 114.47 |
| 11S | 21E | 24 | 11S21E24 | - | - | 5 | | | - | - | - | - | - | - | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 | 0.59 | 0.54 | 0.02 | 0.58 | 0.13 | 9.52 |
| 11S | 22E | 2 | 11S22E02 | 2 | 0.06 | 49 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 5.83 | 5.25 | 0.21 | 5.68 | 1.23 | 93.26 | 9.60 | 9.17 | 0.22 | 9.01 | 1.76 | 93.54 |
| 11S | 22E | 3 | 11S22E03 | 2 | 0.06 | 56 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 10.43 | 9.92 | 0.25 | 9.82 | 1.94 | 106.86 |
| 11S | 22E | 4 | 11S22E04 | 2 | 0.06 | 58 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.90 | 6.21 | 0.25 | 6.72 | 1.46 | 110.39 | 10.67 | 10.13 | 0.26 | 10.05 | 1.99 | 110.67 |
| 11S | 22E | 5 | 11S22E05 | 2 | 0.06 | 56 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 10.43 | 9.92 | 0.25 | 9.82 | 1.94 | 106.86 |
| 11S | 22E | 6 | 11S22E06 | 2 | 0.06 | 60 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.14 | 6.42 | 0.26 | 6.95 | 1.51 | 114.20 | 10.91 | 10.35 | 0.27 | 10.28 | 2.04 | 114.47 |
| 11S | 22E | 7 | 11S22E07 | - | - | 66 | | | - | - | - | - | - | - | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 | 7.85 | 7.07 | 0.28 | 7.65 | 1.66 | 125.62 |
| 11S | 22E | 8 | 11S22E08 | - | - | 66 | | 1 | - | - | - | - | - | - | 14.13 | 7.95 | 0.35 | 7.85 | 1.86 | 127.26 | 14.13 | 7.95 | 0.35 | 7.85 | 1.86 | 127.26 |
| 11S | 22E | 9 | 11S22E09 | 2 | 0.06 | 62 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.37 | 6.64 | 0.27 | 7.19 | 1.56 | 118.00 | 11.15 | 10.56 | 0.28 | 10.52 | 2.09 | 118.28 |
| 11S | 22E | 10 | 11S22E10 | 6 | 0.18 | 53 | | | 11.32 | 11.77 | 0.03 | 9.99 | 1.59 | 0.83 | 6.30 | 5.67 | 0.23 | 6.14 | 1.33 | 100.87 | 17.62 | 17.44 | 0.26 | 16.13 | 2.92 | 101.70 |
| 11S | 22E | 15 | 11S22E15 | - | - | 57 | | | - | - | - | - | - | - | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 | 6.78 | 6.10 | 0.24 | 6.61 | 1.43 | 108.49 |
| 11S | 22E | 16 | 11S22E16 | 2 | 0.06 | 62 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.37 | 6.64 | 0.27 | 7.19 | 1.56 | 118.00 | 11.15 | 10.56 | 0.28 | 10.52 | 2.09 | 118.28 |
| 11S | 22E | 17 | 11S22E17 | 6 | 0.18 | 56 | | | 11.32 | 11.77 | 0.03 | 9.99 | 1.59 | 0.83 | 6.66 | 6.00 | 0.24 | 6.49 | 1.41 | 106.58 | 17.98 | 17.77 | 0.27 | 16.48 | 3.00 | 107.41 |
| 11S | 22E | 18 | 11S22E18 | 2 | 0.06 | 52 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 6.18 | 5.57 | 0.22 | 6.03 | 1.31 | 98.97 | 9.96 | 9.49 | 0.23 | 9.36 | 1.84 | 99.25 |
| 11S | 22E | 19 | 11S22E19 | 2 | 0.06 | 59 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 10.79 | 10.24 | 0.26 | 10.17 | 2.01 | 112.57 |
| 11S | 22E | 20 | 11S22E20 | 4 | 0.12 | 59 | | | 7.55 | 7.85 | 0.02 | 6.66 | 1.06 | 0.55 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 14.56 | 14.16 | 0.27 | 13.50 | 2.54 | 112.84 |
| 11S | 22E | 21 | 11S22E21 | 2 | 0.06 | 59 | | | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 7.02 | 6.32 | 0.25 | 6.84 | 1.48 | 112.29 | 10.79 | 10.24 | 0.26 | 10.17 | 2.01 | 112.57 |
| 11S | 22E | 22 | 11S22E22 | 2 | 0.06 | 62 | | 1 | 3.77 | 3.92 | 0.01 | 3.33 | 0.53 | 0.28 | 13.65 | 7.52 | 0.33 | 7.39 | 1.76 | 119.64 | 17.42 | 11.44 | 0.34 | 10.71 | 2.29 | 119.92 |
| 11S | 22E | 23 | 11S22E23 | - | - | 62 | | | - | - | - | - | - | - | 7.37 | 6.64 | 0.27 | 7.19 | 1.56 | 118.00 | 7.37 | 6.64 | 0.27 | 7.19 | 1.56 | 118.00 |
| | | | | 672 | 20.2 | 12774 | 5 | 23 | 1,267.6 | 1,318.1 | 3.5 | 1,118.7 | 178.4 | 92.5 | 1,663.5 | 1,388.0 | 56.3 | 1,485.2 | 325.2 | 24,383.9 | 2,931.1 | 2,706.1 | 59.8 | 2,603.8 | 503.6 | 24,476.4 |

# Appendix D

# Project Alternatives Emissions Inputs to CALPUFF

**Table D-1 CALPUFF Model Inputs: 2018 Non-Project Point Sources Less Than 100 TPY**

| Source_ID | Grid Cell Assignment | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_le_pt1 | 0 | 38.4583 | -113.0627 | -1383.5843 | -47.8729 | 1540.0 | 7.27 | 0.28 | 345.29 | 3.73 | 19.09684 | 2.02562 | 11.15479 | 3.42953 | 0.00000 | 0.00000 | 0.00000 | 0.01886 | 3.41067 |
| nog_le_pt2 | 1 | 40.7386 | -113.6436 | -1387.1471 | 209.0673 | 1288.0 | 12.48 | 0.66 | 398.64 | 7.77 | 36.11201 | 0.04630 | 16.92711 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt3 | 2 | 38.2268 | -112.9523 | -1378.6435 | -74.7533 | 1705.0 | 3.05 | 0.01 | 295.37 | 0.00 | 2.95733 | 0.21102 | 2.66366 | 1.68486 | 0.04390 | 0.01329 | 0.00009 | 0.01089 | 1.61663 |
| nog_le_pt4 | 3 | 38.3906 | -112.9987 | -1379.4398 | -56.2156 | 1581.0 | 3.05 | 0.01 | 295.37 | 0.00 | 4.70366 | 0.25367 | 7.31878 | 7.08492 | 0.00924 | 2.36360 | 0.00176 | 0.12550 | 4.58492 |
| nog_le_pt5 | 4 | 37.8257 | -112.6223 | -1357.9961 | -123.4109 | 2743.0 | 5.90 | 0.40 | 394.48 | 3.80 | 21.16310 | 5.95129 | 5.00040 | 3.34623 | 0.06698 | 0.52818 | 0.00135 | 0.08894 | 2.66076 |
| nog_le_pt6 | 5 | 40.8117 | -113.2086 | -1349.8483 | 210.4710 | 1421.0 | 13.38 | 0.68 | 417.59 | 9.12 | 3.44743 | 0.23953 | 18.46028 | 12.09074 | 0.36660 | 2.21534 | 0.00008 | 0.67509 | 8.83351 |
| nog_le_pt7 | 6 | 38.8500 | -112.5041 | -1328.5914 | -13.5492 | 1459.0 | 17.22 | 2.59 | 763.15 | 0.30 | 34.88999 | 2.01203 | 0.09061 | 0.00496 | 0.00000 | 0.00298 | 0.00003 | 0.00099 | 0.00096 |
| nog_le_pt8 | 7 | 38.6634 | -112.2642 | -1311.6782 | -37.3715 | 2066.0 | 3.05 | 0.01 | 295.37 | 0.00 | 3.22934 | 1.38422 | 3.72104 | 3.49866 | 0.09907 | 0.05340 | 0.00087 | 0.12467 | 3.22064 |
| nog_le_pt9 | 8 | 38.6838 | -112.1480 | -1301.4117 | -36.8180 | 1636.0 | 13.38 | 0.68 | 417.59 | 9.12 | 16.90804 | 0.36560 | 13.55786 | 0.29646 | 0.01456 | 0.01466 | 0.00075 | 0.07135 | 0.19514 |
| nog_le_pt10 | 9 | 39.5688 | -112.4011 | -1306.4453 | 63.2883 | 1477.0 | 3.05 | 0.01 | 295.37 | 0.00 | 6.92606 | 0.68877 | 6.28284 | 1.77134 | 0.00264 | 0.02445 | 0.00063 | 0.02076 | 1.72288 |
| nog_le_pt11 | 10 | 40.4719 | -112.5240 | -1299.7923 | 163.4768 | 1753.0 | 11.93 | 0.59 | 400.48 | 7.84 | 0.30280 | 0.02523 | 1.61985 | 0.39528 | 0.00431 | 0.01851 | 0.00079 | 0.04181 | 0.32986 |
| nog_le_pt12 | 11 | 40.6878 | -112.5288 | -1296.1296 | 187.0775 | 1278.0 | 14.82 | 1.12 | 377.40 | 7.20 | 9.36371 | 0.06370 | 44.90778 | 3.45246 | 0.00000 | 0.00000 | 0.00000 | 0.01899 | 3.43348 |
| nog_le_pt13 | 12 | 40.7508 | -112.6588 | -1305.6782 | 195.8048 | 1279.0 | 12.81 | 0.93 | 340.33 | 10.46 | 19.46001 | 1.87297 | 1.06768 | 32.58972 | 0.24741 | 0.08192 | 0.00060 | 3.23774 | 29.02184 |
| nog_le_pt14 | 13 | 38.7152 | -112.0226 | -1290.1656 | -35.1818 | 2050.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.87491 | 0.08058 | 1.88775 | 0.65648 | 0.02389 | 0.00723 | 0.00005 | 0.00449 | 0.62081 |
| nog_le_pt15 | 14 | 40.3209 | -112.3173 | -1285.4526 | 144.0764 | 2024.0 | 20.53 | 1.03 | 425.56 | 13.33 | 62.26067 | 22.87453 | 1.06810 | 5.32947 | 1.11692 | 0.66913 | 0.01069 | 0.50405 | 3.02873 |
| nog_le_pt16 | 15 | 40.4685 | -112.3604 | -1286.2891 | 160.7784 | 2283.0 | 3.05 | 0.01 | 295.37 | 0.00 | 3.56871 | 0.96701 | 5.07655 | 3.10125 | 0.15165 | 0.17891 | 0.00612 | 0.16214 | 2.60245 |
| nog_le_pt17 | 16 | 40.5407 | -112.3584 | -1284.7800 | 168.6218 | 1494.0 | 7.96 | 0.35 | 374.55 | 5.56 | 62.61010 | 12.37046 | 7.68350 | 10.09331 | 0.50149 | 0.86969 | 0.02676 | 1.37358 | 7.32193 |
| nog_le_pt18 | 17 | 38.8578 | -111.9539 | -1281.7362 | -20.6007 | 1950.0 | 11.05 | 0.57 | 413.61 | 9.17 | 18.06734 | 0.12695 | 43.26303 | 3.83874 | 0.03109 | 0.20324 | 0.00549 | 0.11548 | 3.48345 |
| nog_le_pt19 | 18 | 40.0567 | -112.1684 | -1277.9276 | 113.1689 | 2070.0 | 45.72 | 5.03 | 349.82 | 8.55 | 27.39982 | 0.90002 | 9.49986 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt20 | 19 | 40.6325 | -112.2846 | -1276.9652 | 177.5913 | 1707.0 | 3.05 | 0.01 | 295.37 | 0.00 | 20.95057 | 22.17591 | 3.91799 | 8.51916 | 0.08232 | 3.35501 | 0.03094 | 1.12049 | 3.93021 |
| nog_le_pt21 | 20 | 41.1200 | -112.4327 | -1280.1055 | 232.8352 | 1265.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.51985 | 0.00032 | 3.89660 | 0.00160 | 0.00000 | 0.00096 | 0.00001 | 0.00032 | 0.00031 |
| nog_le_pt22 | 21 | 37.8300 | -111.6020 | -1270.0203 | -137.6948 | 2072.0 | 18.90 | 0.87 | 699.82 | 9.53 | 3.49393 | 0.00000 | 3.15634 | 8.40559 | 1.17680 | 3.27821 | 0.00000 | 0.67244 | 3.27821 |
| nog_le_pt23 | 22 | 39.0506 | -111.8668 | -1270.8657 | -0.7927 | 1566.0 | 12.90 | 0.68 | 412.15 | 13.89 | 1.10877 | 0.65060 | 10.56129 | 4.73127 | 0.09760 | 0.15960 | 0.00255 | 0.13143 | 4.34012 |
| nog_le_pt24 | 23 | 39.1492 | -111.8132 | -1264.5553 | 9.2165 | 1706.0 | 13.38 | 0.68 | 417.59 | 9.12 | 16.13074 | 4.20018 | 4.94954 | 11.54098 | 0.20705 | 1.74255 | 0.04328 | 1.46170 | 8.08618 |
| nog_le_pt25 | 24 | 40.1559 | -112.0282 | -1264.4184 | 122.0268 | 1577.0 | 13.88 | 2.14 | 689.98 | 2.17 | 50.92652 | 2.37346 | 9.24489 | 5.05232 | 0.02296 | 0.30000 | 0.00575 | 0.01032 | 4.71331 |
| nog_le_pt26 | 25 | 40.2833 | -112.0165 | -1261.1255 | 135.7613 | 1785.0 | 3.05 | 0.01 | 295.37 | 0.00 | 14.92558 | 0.00000 | 0.00000 | 0.00181 | 0.00000 | 0.00109 | 0.00001 | 0.00036 | 0.00035 |
| nog_le_pt27 | 26 | 40.5110 | -112.0916 | -1263.2118 | 161.6426 | 1567.0 | 5.33 | 0.41 | 657.04 | 1.83 | 0.13473 | 0.00000 | 0.00040 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt28 | 27 | 40.5970 | -112.1179 | -1263.8177 | 171.3892 | 1651.0 | 10.09 | 0.47 | 378.70 | 6.22 | 10.67427 | 7.85102 | 22.04003 | 27.77132 | 0.16235 | 1.45822 | 0.02873 | 0.08369 | 26.03807 |
| nog_le_pt29 | 28 | 40.7263 | -112.1579 | -1264.7561 | 186.0496 | 1342.0 | 7.76 | 0.32 | 351.15 | 4.16 | 21.97855 | 2.77820 | 15.99665 | 8.80740 | 0.92392 | 0.44080 | 0.01106 | 0.57280 | 6.85891 |
| nog_le_pt30 | 29 | 39.8504 | -111.8205 | -1252.5846 | 85.8221 | 2804.0 | 3.05 | 0.01 | 295.37 | 0.00 | 3.68383 | 0.26612 | 3.85066 | 2.14783 | 0.13299 | 0.06415 | 0.00358 | 0.22523 | 1.72190 |
| nog_le_pt31 | 30 | 39.9720 | -111.8255 | -1250.8195 | 99.1590 | 1554.0 | 13.38 | 0.68 | 417.59 | 9.12 | 11.28471 | 11.90083 | 16.14501 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt32 | 31 | 40.4415 | -111.9214 | -1250.3510 | 151.7067 | 1645.0 | 9.12 | 0.41 | 367.52 | 5.38 | 93.79752 | 26.90185 | 91.59364 | 52.04833 | 0.33812 | 3.47625 | 0.06516 | 3.35342 | 44.81546 |
| nog_le_pt33 | 32 | 40.5623 | -112.0527 | -1259.0500 | 166.6989 | 1491.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.00220 | 0.00000 | 0.39195 | 20.95693 | 0.28278 | 1.21385 | 0.05194 | 2.71417 | 16.69410 |
| nog_le_pt34 | 33 | 40.6402 | -112.0380 | -1256.4124 | 174.9939 | 1419.0 | 17.91 | 1.39 | 476.16 | 12.17 | 162.54536 | 4.79788 | 86.84732 | 30.59133 | 0.10917 | 2.82394 | 0.02629 | 1.25102 | 26.38103 |
| nog_le_pt35 | 34 | 40.7575 | -111.9953 | -1250.7461 | 187.2030 | 1295.0 | 9.62 | 0.57 | 388.60 | 6.75 | 54.39266 | 1.94743 | 25.25487 | 24.67782 | 0.65512 | 8.72389 | 0.05432 | 1.61556 | 13.62876 |
| nog_le_pt36 | 35 | 40.8353 | -111.9878 | -1248.7133 | 195.5891 | 1302.0 | 3.05 | 0.01 | 295.37 | 0.00 | 2.51565 | 0.14382 | 0.01009 | 0.14382 | 0.05322 | 0.07762 | 0.00061 | 0.00244 | 0.00994 |
| nog_le_pt37 | 36 | 41.0320 | -112.0275 | -1248.4089 | 217.5986 | 1315.0 | 3.05 | 0.01 | 295.37 | 0.00 | 14.26787 | 1.27971 | 15.01811 | 5.22182 | 0.01932 | 0.28459 | 0.00574 | 0.00209 | 4.91008 |
| nog_le_pt38 | 37 | 41.1569 | -112.1548 | -1256.5928 | 232.9815 | 1283.0 | 13.38 | 0.68 | 417.59 | 9.12 | 4.73332 | 0.61608 | 15.70054 | 6.48112 | 0.01584 | 0.45705 | 0.00447 | 0.03350 | 5.97008 |
| nog_le_pt39 | 38 | 40.0541 | -111.7284 | -1241.2344 | 106.7867 | 1405.0 | 8.70 | 0.30 | 480.42 | 11.73 | 7.91541 | 0.02805 | 3.14261 | 32.11606 | 3.04013 | 14.85681 | 0.02025 | 1.03354 | 13.16489 |
| nog_le_pt40 | 39 | 40.0982 | -111.6757 | -1236.0477 | 110.8815 | 1419.0 | 3.05 | 0.01 | 295.37 | 0.00 | 24.64955 | 15.53090 | 6.97662 | 3.09484 | 0.22828 | 0.18492 | 0.01507 | 0.94251 | 1.72405 |
| nog_le_pt41 | 40 | 40.2231 | -111.7192 | -1237.4520 | 125.1057 | 1388.0 | 13.38 | 0.68 | 417.59 | 9.12 | 2.28388 | 0.00825 | 0.01778 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt42 | 41 | 40.3096 | -111.7664 | -1239.8376 | 135.1896 | 1426.0 | 9.88 | 0.62 | 387.82 | 9.04 | 30.10829 | 14.33700 | 69.98156 | 22.30456 | 0.54769 | 2.26936 | 0.02779 | 1.79161 | 17.66796 |
| nog_le_pt43 | 42 | 40.4245 | -111.8313 | -1243.1738 | 148.6155 | 1502.0 | 11.49 | 0.82 | 918.52 | 12.03 | 52.07647 | 5.11629 | 25.10209 | 7.32238 | 0.06517 | 0.25713 | 0.01535 | 0.99083 | 5.99388 |
| nog_le_pt44 | 43 | 40.5526 | -111.8702 | -1244.0973 | 163.1271 | 1524.0 | 12.60 | 0.63 | 408.41 | 8.43 | 5.47736 | 0.00023 | 56.88028 | 5.97472 | 0.02077 | 0.20815 | 0.00352 | 0.14454 | 5.59774 |
| nog_le_pt45 | 44 | 40.6583 | -111.8724 | -1242.3750 | 174.6922 | 1358.0 | 9.40 | 0.57 | 447.34 | 10.38 | 136.35460 | 7.36807 | 70.24726 | 31.63198 | 4.67583 | 3.82359 | 0.03666 | 1.71239 | 21.38382 |
| nog_le_pt46 | 45 | 40.7454 | -111.9012 | -1243.1865 | 184.5914 | 1393.0 | 10.87 | 0.57 | 436.34 | 11.87 | 242.44248 | 9.74612 | 123.05599 | 37.00526 | 1.29125 | 20.19260 | 0.07435 | 3.71718 | 11.72992 |
| nog_le_pt47 | 46 | 40.8444 | -111.9223 | -1243.1409 | 195.6841 | 1645.0 | 7.47 | 0.66 | 355.73 | 3.51 | 163.98132 | 38.46965 | 45.18932 | 20.63693 | 0.59227 | 1.41891 | 0.03208 | 2.38120 | 16.21243 |
| nog_le_pt48 | 47 | 40.9768 | -111.8934 | -1238.3653 | 209.7396 | 2444.0 | 12.99 | 0.65 | 412.94 | 8.77 | 4.70620 | 0.31541 | 6.57664 | 16.62045 | 0.01216 | 0.62086 | 0.00003 | 0.08847 | 15.89900 |
| nog_le_pt49 | 48 | 41.1031 | -111.9432 | -1240.1814 | 224.2038 | 1997.0 | 12.69 | 1.01 | 432.57 | 7.42 | 71.18001 | 0.46869 | 102.97054 | 53.39824 | 0.45185 | 2.16119 | 0.07880 | 3.49764 | 47.20883 |
| nog_le_pt50 | 49 | 41.2009 | -111.9862 | -1241.9415 | 235.4653 | 1465.0 | 11.61 | 0.55 | 389.62 | 9.20 | 28.03898 | 1.60940 | 128.98722 | 12.46147 | 0.35310 | 2.47549 | 0.03138 | 0.41437 | 9.18704 |
| nog_le_pt51 | 50 | 38.9153 | -111.4163 | -1235.0473 | -21.7701 | 2562.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.06974 | 0.00076 | 21.58962 | 1.14799 | 0.00195 | 0.00837 | 0.00036 | 0.02424 | 1.11309 |
| nog_le_pt52 | 51 | 39.4742 | -111.5189 | -1233.9314 | 40.6389 | 1886.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.21873 | 0.02302 | 0.77550 | 0.32189 | 0.01790 | 0.01669 | 0.00166 | 0.10514 | 0.18051 |
| nog_le_pt53 | 52 | 40.0614 | -111.6006 | -1230.4281 | 105.8455 | 2056.0 | 11.09 | 0.52 | 351.26 | 6.68 | 81.15210 | 3.26948 | 27.94461 | 11.34760 | 0.73435 | 0.29269 | 0.00427 | 0.10106 | 10.21519 |
| nog_le_pt54 | 53 | 40.1447 | -111.6318 | -1231.5579 | 115.3611 | 1461.0 | 13.37 | 0.71 | 462.39 | 14.50 | 127.94882 | 2.06231 | 23.28168 | 4.01821 | 0.10408 | 0.30005 | 0.02145 | 1.21014 | 2.38249 |
| nog_le_pt55 | 54 | 40.2262 | -111.6503 | -1231.6549 | 124.5080 | 2316.0 | 11.59 | 0.55 | 404.87 | 7.59 | 6.38720 | 0.65369 | 2.69260 | 13.00423 | 0.82455 | 3.99114 | 0.00451 | 0.17540 | 8.00858 |
| nog_le_pt56 | 55 | 40.7649 | -111.7728 | -1232.2201 | 184.9710 | 2016.0 | 10.56 | 0.53 | 429.73 | 7.15 | 15.41160 | 1.26289 | 8.63625 | 2.96164 | 0.51584 | 0.17646 | 0.00188 | 0.06103 | 2.20639 |
| nog_le_pt57 | 56 | 40.8489 | -111.6979 | -1224.5310 | 193.1286 | 2560.0 | 11.80 | 0.80 | 462.20 | 12.49 | 8.67847 | 2.41278 | 0.03600 | 0.06335 | 0.00000 | 0.03801 | 0.00035 | 0.01267 | 0.01232 |
| nog_le_pt58 | 57 | 41.2168 | -111.8600 | -1231.2904 | 235.4836 | 1890.0 | 3.05 | 0.01 | 295.37 | 0.00 | 1.08701 | 0.08524 | 0.17076 | 0.15270 | 0.01223 | 0.00908 | 0.00080 | 0.05051 | 0.08009 |
| nog_le_pt59 | 58 | 39.5256 | -111.4071 | -1223.6126 | 44.7388 | 2584.0 | 3.05 | 0.01 | 295.37 | 0.00 | 12.16352 | 0.93878 | 11.05073 | 21.53432 | 0.14867 | 0.04502 | 0.00032 | 0.12394 | 21.21651 |
| nog_le_pt60 | 59 | 40.5931 | -111.6117 | -1221.9415 | 164.0405 | 3149.0 | 8.04 | 0.33 | 418.05 | 9.12 | 1.99983 | 0.06582 | 0.22722 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt61 | 60 | 40.6640 | -111.5086 | -1212.1464 | 170.4015 | 2255.0 | 3.05 | 0.01 | 295.37 | 0.00 | 1.94552 | 0.18419 | 6.09602 | 2.84241 | 0.16167 | 0.15140 | 0.01513 | 0.96025 | 1.55400 |
| nog_le_pt62 | 61 | 41.0471 | -111.6282 | -1215.2603 | 213.8345 | 2059.0 | 3.05 | 0.01 | 295.37 | 0.00 | 14.87180 | 1.59303 | 4.85749 | 3.24063 | 0.73241 | 0.22177 | 0.00158 | 0.04490 | 2.24001 |
| nog_le_pt63 | 62 | 41.0898 | -111.7286 | -1222.7660 | 219.8438 | 2073.0 | 3.05 | 0.01 | 295.37 | 0.00 | 7.57421 | 0.74686 | 2.41519 | 1.01466 | 0.03511 | 0.01287 | 0.00018 | 0.01203 | 0.95447 |
| nog_le_pt64 | 63 | 39.3305 | -111.1239 | -1203.0952 | 19.6506 | 2796.0 | 3.14 | 0.02 | 295.89 | 0.19 | 46.42800 | 4.97444 | 28.44862 | 10.83058 | 0.01409 | 0.09593 | 0.00297 | 0.15311 | 10.56457 |
| nog_le_pt65 | 64 | 39.6842 | -111.2018 | -1203.5900 | 59.3171 | 2804.0 | 13.38 | 0.68 | 417.59 | 9.12 | 4.19082 | 0.03938 | 0.55446 | 0.00273 | 0.00001 | 0.00015 | 0.00000 | 0.00000 | 0.00256 |
| nog_le_pt66 | 65 | 40.4618 | -111.4287 | -1209.0633 | 147.2556 | 1910.0 | 12.28 | 0.61 | 404.62 | 8.15 | 0.74924 | 0.05601 | 6.90209 | 2.89176 | 0.09148 | 0.06067 | 0.00418 | 0.26316 | 2.47228 |
| nog_le_pt67 | 66 | 40.6334 | -111.4847 | -1210.7038 | 166.7412 | 2161.0 | 3.05 | 0.01 | 295.37 | 0.00 | 12.66155 | 1.31749 | 0.07713 | 1.16850 | 0.86300 | 0.26371 | 0.00189 | 0.03911 | 0.00078 |
| nog_le_pt68 | 67 | 40.6823 | -111.4657 | -1208.2718 | 171.8287 | 2194.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.41639 | 0.00000 | 30.14883 | 8.07220 | 0.08747 | 0.58113 | 0.01600 | 0.85098 | 6.53657 |
| nog_le_pt69 | 68 | 39.1750 | -111.0405 | -1198.6937 | 1.5611 | 1706.0 | 10.79 | 0.63 | 378.77 | 10.96 | 2.93365 | 0.31887 | 22.44446 | 2.33390 | 0.01971 | 0.12402 | 0.00405 | 0.15410 | 2.03199 |
| nog_le_pt70 | 69 | 39.4081 | -111.0961 | -1199.4207 | 27.7601 | 2683.0 | 3.05 | 0.01 | 295.37 | 0.00 | 8.37384 | 1.03066 | 9.29941 | 2.04459 | 0.11175 | 0.07249 | 0.00112 | 0.02637 | 1.83286 |
| nog_le_pt71 | 70 | 39.5274 | -111.0318 | -1191.9644 | 39.9475 | 2194.0 | 3.05 | 0.01 | 295.37 | 0.00 | 26.65440 | 4.78340 | 22.87423 | 5.45608 | 0.05483 | 0.39088 | 0.01251 | 0.55012 | 4.44771 |
| nog_le_pt72 | 71 | 39.6936 | -111.0494 | -1190.6178 | 58.3365 | 2682.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.00000 | 0.00000 | 1.13363 | 0.64760 | 0.00819 | 0.03982 | 0.00155 | 0.07406 | 0.52396 |
| nog_le_pt73 | 72 | 40.6053 | -111.2872 | -1194.8195 | 161.0580 | 2255.0 | 3.05 | 0.01 | 295.37 | 0.00 | 7.22956 | 0.69073 | 0.99381 | 1.11485 | 0.48648 | 0.15003 | 0.00111 | 0.02385 | 0.45340 |
| nog_le_pt74 | 73 | 40.7310 | -111.3220 | -1195.5236 | 175.2476 | 2166.0 | 4.33 | 0.15 | 417.59 | 9.12 | 20.50424 | 6.02907 | 0.16230 | 0.67148 | 0.00944 | 0.04051 | 0.00173 | 0.09042 | 0.52941 |
| nog_le_pt75 | 74 | 40.8432 | -111.3915 | -1199.3193 | 188.4200 | 2255.0 | 3.05 | 0.01 | 295.37 | 0.00 | 14.69751 | 1.00213 | 6.29281 | 2.93916 | 0.74218 | 0.22473 | 0.00160 | 0.04361 | 1.92708 |
| nog_le_pt76 | 75 | 40.9220 | -111.4037 | -1198.9516 | 197.1889 | 1889.0 | 3.05 | 0.01 | 295.37 | 0.00 | 1.32494 | 0.10192 | 2.08551 | 1.96576 | 0.00000 | 0.00000 | 0.00000 | 0.01081 | 1.95491 |
| nog_le_pt77 | 76 | 39.2160 | -110.8073 | -1178.2531 | 2.9916 | 2073.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.17268 | 0.01151 | 0.96469 | 0.38353 | 0.02043 | 0.02018 | 0.00206 | 0.13103 | 0.20983 |
| nog_le_pt78 | 77 | 39.5514 | -110.8743 | -1178.2864 | 40.5160 | 1768.0 | 3.05 | 0.01 | 295.37 | 0.00 | 4.52640 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt79 | 78 | 39.6562 | -110.9001 | -1178.6948 | 52.3035 | 1830.0 | 5.49 | 0.31 | 415.05 | 10.17 | 34.88577 | 1.30118 | 23.05331 | 8.45235 | 0.11722 | 0.42807 | 0.01707 | 0.87658 | 7.01321 |
| nog_le_pt80 | 79 | 40.8914 | -111.1922 | -1182.0175 | 191.0750 | 2444.0 | 8.27 | 0.62 | 496.96 | 0.30 | 87.07794 | 0.00000 | 0.00379 | 0.17350 | 0.00000 | 0.10410 | 0.00095 | 0.03470 | 0.03375 |
| nog_le_pt81 | 80 | 39.5170 | -110.7673 | -1169.8432 | 35.3739 | 1694.0 | 3.05 | 0.01 | 295.37 | 0.00 | 23.25214 | 1.53059 | 31.77505 | 12.20457 | 0.15138 | 0.67063 | 0.02803 | 1.43726 | 9.91744 |
| nog_le_pt82 | 81 | 39.5912 | -110.8024 | -1171.5615 | 43.9363 | 1726.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.48471 | 0.05102 | 0.06881 | 0.04587 | 0.00001 | 0.00021 | 0.00000 | 0.00023 | 0.04541 |

**Table D-1 CALPUFF Model Inputs: 2018 Non-Project Point Sources Less Than 100 TPY**

| Source_ID | Grid Cell Assignment | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_le_pt83 | 82 | 39.6508 | -110.8328 | -1173.1227 | 50.8426 | 1945.0 | 5.08 | 0.14 | 446.69 | 0.33 | 81.39299 | 2.40149 | 43.45291 | 18.45498 | 0.03994 | 0.26478 | 0.00755 | 0.47453 | 17.66825 |
| nog_le_pt84 | 83 | 39.8028 | -110.8586 | -1172.7406 | 67.7882 | 2288.0 | 3.05 | 0.01 | 295.37 | 0.00 | 13.72834 | 7.96077 | 0.68932 | 0.59721 | 0.21540 | 0.08905 | 0.00065 | 0.11143 | 0.18067 |
| nog_le_pt85 | 84 | 40.9211 | -111.0459 | -1169.4246 | 192.4282 | 2852.0 | 3.05 | 0.01 | 295.37 | 0.00 | 48.41339 | 0.00000 | 3.20787 | 0.55440 | 0.00000 | 0.55407 | 0.00000 | 0.00016 | 0.00016 |
| nog_le_pt86 | 85 | 41.0576 | -111.0695 | -1169.0452 | 207.6524 | 2316.0 | 3.96 | 0.11 | 358.62 | 6.05 | 7.24009 | 0.00000 | 0.00725 | 5.29327 | 0.00000 | 5.27942 | 0.00019 | 0.00693 | 0.00674 |
| nog_le_pt87 | 86 | 41.1880 | -111.0950 | -1168.9183 | 222.2349 | 2195.0 | 12.19 | 0.63 | 418.71 | 8.37 | 0.00000 | 0.00000 | 0.00066 | 0.00315 | 0.00000 | 0.00189 | 0.00002 | 0.00063 | 0.00061 |
| nog_le_pt88 | 87 | 39.5258 | -110.6858 | -1162.8246 | 35.2899 | 1768.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.90254 | 0.02302 | 0.55733 | 0.33421 | 0.01069 | 0.02073 | 0.00051 | 0.01305 | 0.28923 |
| nog_le_pt89 | 88 | 39.7028 | -110.7280 | -1163.4376 | 55.1791 | 2438.0 | 3.05 | 0.01 | 295.37 | 0.00 | 6.61393 | 0.43367 | 3.73822 | 1.22592 | 0.00457 | 0.03041 | 0.00070 | 0.03227 | 1.15800 |
| nog_le_pt90 | 89 | 39.6600 | -110.5830 | -1151.9458 | 48.6527 | 2410.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.00198 | 1.49570 | 5.15650 | 0.00745 | 0.00006 | 0.00043 | 0.00001 | 0.00047 | 0.00646 |
| nog_le_pt91 | 90 | 41.1369 | -110.8651 | -1150.8610 | 213.7136 | 2222.0 | 17.07 | 1.59 | 792.24 | 16.17 | 43.66244 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt92 | 91 | 41.3128 | -110.8698 | -1148.2892 | 233.0095 | 2318.0 | 12.70 | 1.15 | 460.99 | 23.28 | 69.52669 | 0.07582 | 0.02655 | 0.12686 | 0.00000 | 0.03014 | 0.00070 | 0.04943 | 0.04659 |
| nog_le_pt93 | 92 | 40.3183 | -110.3947 | -1125.4022 | 118.2893 | 1990.0 | 9.12 | 0.30 | 697.14 | 21.13 | 19.88070 | 0.00000 | 0.00190 | 1.27024 | 0.00000 | 1.27024 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt94 | 93 | 40.3723 | -110.3430 | -1120.2160 | 123.5582 | 2003.0 | 3.05 | 0.01 | 295.37 | 0.00 | 9.07244 | 0.02236 | 0.00576 | 0.02754 | 0.00000 | 0.01652 | 0.00015 | 0.00551 | 0.00536 |
| nog_le_pt95 | 94 | 41.2873 | -110.5468 | -1122.1676 | 226.1850 | 2262.0 | 12.52 | 0.97 | 585.04 | 4.25 | 8.30523 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt96 | 95 | 37.2646 | -109.6232 | -1107.7676 | -225.4246 | 1465.0 | 3.05 | 0.01 | 295.37 | 0.00 | 12.58531 | 1.25846 | 3.13699 | 2.44231 | 0.05889 | 0.01873 | 0.00017 | 0.01767 | 2.34685 |
| nog_le_pt97 | 96 | 38.6250 | -109.9419 | -1114.1952 | -72.5643 | 1584.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.49559 | 0.00000 | 0.00000 | 0.02351 | 0.00000 | 0.01410 | 0.00013 | 0.00470 | 0.00457 |
| nog_le_pt98 | 97 | 38.6358 | -109.9169 | -1111.8883 | -71.6884 | 1584.0 | 13.38 | 0.68 | 417.59 | 9.12 | 4.90209 | 0.00000 | 0.00000 | 0.10578 | 0.00000 | 0.06347 | 0.00058 | 0.02116 | 0.02058 |
| nog_le_pt99 | 98 | 40.2998 | -110.2480 | -1113.4618 | 114.4582 | 1829.0 | 3.05 | 0.01 | 295.37 | 0.00 | 6.63831 | 9.07751 | 0.66884 | 0.46011 | 0.00046 | 0.09996 | 0.00067 | 0.02090 | 0.33812 |
| nog_le_pt100 | 99 | 40.3553 | -110.2461 | -1112.4117 | 120.5078 | 1891.0 | 9.47 | 0.38 | 661.89 | 27.02 | 87.07277 | 0.00000 | 0.76377 | 6.90413 | 0.00000 | 6.90413 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt101 | 100 | 40.9633 | -110.3091 | -1107.8508 | 187.8121 | 2926.0 | 4.31 | 0.26 | 638.43 | 26.97 | 70.49806 | 0.07290 | 0.04244 | 0.06496 | 0.00000 | 0.03898 | 0.00036 | 0.01299 | 0.01263 |
| nog_le_pt102 | 101 | 38.5219 | -109.7519 | -1099.5404 | -86.1648 | 1829.0 | 13.38 | 0.68 | 417.59 | 9.12 | 5.86003 | 0.00000 | 0.00000 | 0.04813 | 0.00000 | 0.02888 | 0.00026 | 0.00963 | 0.00936 |
| nog_le_pt103 | 102 | 38.5988 | -109.8060 | -1102.9801 | -77.0901 | 1707.0 | 13.38 | 0.68 | 417.59 | 9.12 | 5.69537 | 0.00000 | 0.00000 | 0.05877 | 0.00000 | 0.03526 | 0.00032 | 0.01175 | 0.01143 |
| nog_le_pt104 | 103 | 40.0726 | -110.0718 | -1102.3573 | 87.4474 | 1627.0 | 3.05 | 0.01 | 295.37 | 0.00 | 36.22370 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt105 | 104 | 40.3052 | -109.9953 | -1092.2843 | 111.9825 | 1569.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.67044 | 0.00000 | 0.01928 | 0.05783 | 0.00202 | 0.00039 | 0.00000 | 0.00393 | 0.05148 |
| nog_le_pt106 | 105 | 40.3833 | -110.0833 | -1098.3906 | 121.5918 | 1727.0 | 8.61 | 0.33 | 659.89 | 18.19 | 99.39395 | 0.00000 | 0.01983 | 0.06441 | 0.00000 | 0.03865 | 0.00035 | 0.01288 | 0.01253 |
| nog_le_pt107 | 106 | 41.0163 | -110.2705 | -1103.8075 | 193.1432 | 2545.0 | 6.60 | 0.57 | 526.62 | 11.85 | 36.18684 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt108 | 107 | 41.1450 | -110.1630 | -1092.8736 | 205.9324 | 2560.0 | 9.20 | 0.61 | 596.48 | 59.89 | 25.70655 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt109 | 108 | 37.5708 | -109.4780 | -1090.4700 | -193.6330 | 1767.0 | 7.55 | 0.27 | 331.59 | 5.09 | 23.01827 | 2.31605 | 0.00000 | 1.96944 | 0.00000 | 0.25800 | 0.00000 | 0.39211 | 1.31933 |
| nog_le_pt110 | 109 | 37.6281 | -109.3761 | -1080.7598 | -188.5718 | 1877.0 | 3.05 | 0.01 | 295.37 | 0.00 | 1.87714 | 0.01458 | 0.00104 | 0.79372 | 0.00000 | 0.79174 | 0.00003 | 0.00099 | 0.00096 |
| nog_le_pt111 | 110 | 38.6039 | -109.5838 | -1083.8878 | -79.2052 | 1463.0 | 15.55 | 0.69 | 386.67 | 9.20 | 13.21351 | 0.08026 | 5.77052 | 15.69657 | 0.00112 | 0.00482 | 0.00021 | 1.49932 | 14.19106 |
| nog_le_pt112 | 111 | 38.9556 | -109.7311 | -1091.0626 | -38.9317 | 1584.0 | 3.05 | 0.01 | 295.37 | 0.00 | 37.40557 | 8.80698 | 0.09368 | 0.14833 | 0.00000 | 0.08900 | 0.00082 | 0.02967 | 0.02885 |
| nog_le_pt113 | 112 | 41.3958 | -110.0924 | -1083.0684 | 232.5490 | 2136.0 | 11.44 | 1.03 | 508.62 | 22.58 | 40.58697 | 1.34138 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt114 | 113 | 37.2984 | -109.2635 | -1075.8933 | -226.0421 | 1529.0 | 3.05 | 0.01 | 295.37 | 0.00 | 11.12499 | 33.40296 | 0.09004 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt115 | 114 | 37.4678 | -109.3162 | -1077.9566 | -206.8503 | 1596.0 | 3.05 | 0.01 | 295.37 | 0.00 | 15.33286 | 0.02916 | 0.00000 | 0.01413 | 0.00109 | 0.00054 | 0.00003 | 0.00454 | 0.00792 |
| nog_le_pt116 | 115 | 37.8699 | -109.3420 | -1074.1795 | -162.4805 | 2089.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.15769 | 0.03079 | 0.09753 | 0.16457 | 0.01308 | 0.00337 | 0.00002 | 0.01083 | 0.13728 |
| nog_le_pt117 | 116 | 38.4834 | -109.4572 | -1074.8727 | -93.9066 | 1767.0 | 3.05 | 0.01 | 295.37 | 0.00 | 21.55289 | 9.87077 | 2.34893 | 0.82519 | 0.08009 | 0.06942 | 0.00027 | 0.01101 | 0.66440 |
| nog_le_pt118 | 117 | 39.9477 | -109.7716 | -1079.1447 | 70.1718 | 1615.0 | 3.05 | 0.01 | 295.37 | 0.00 | 19.29463 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt119 | 118 | 37.2483 | -109.0272 | -1056.0161 | -234.3066 | 1584.0 | 3.05 | 1.52 | 523.71 | 23.99 | 12.35197 | 0.00640 | 0.00362 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt120 | 119 | 38.1486 | -109.3116 | -1067.3872 | -132.3011 | 1856.0 | 3.05 | 0.01 | 295.37 | 0.00 | 49.12462 | 2.82731 | 0.03545 | 0.05612 | 0.00000 | 0.03367 | 0.00031 | 0.01122 | 0.01092 |
| nog_le_pt121 | 120 | 38.9314 | -109.3519 | -1059.1310 | -46.0681 | 1340.0 | 15.64 | 0.91 | 699.64 | 0.92 | 54.05942 | 0.00000 | 0.05995 | 0.09386 | 0.00000 | 0.05631 | 0.00052 | 0.01877 | 0.01826 |
| nog_le_pt122 | 121 | 40.2042 | -109.5512 | -1056.7363 | 95.6719 | 1524.0 | 3.05 | 0.01 | 295.37 | 0.00 | 26.80451 | 0.00000 | 0.00000 | 0.18806 | 0.00000 | 0.11283 | 0.00103 | 0.03761 | 0.03658 |
| nog_le_pt123 | 122 | 40.2513 | -109.5658 | -1057.2398 | 101.0009 | 1524.0 | 12.69 | 0.64 | 409.46 | 8.51 | 10.62781 | 0.00000 | 0.04701 | 0.09403 | 0.00000 | 0.05642 | 0.00052 | 0.01881 | 0.01829 |
| nog_le_pt124 | 123 | 40.4340 | -109.5982 | -1057.1562 | 121.3901 | 1709.0 | 6.86 | 0.35 | 344.83 | 5.38 | 14.37987 | 0.85039 | 3.92188 | 1.09163 | 0.14504 | 0.09577 | 0.00066 | 0.02413 | 0.82603 |
| nog_le_pt125 | 124 | 40.9390 | -109.7600 | -1062.8272 | 178.5936 | 2073.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.00000 | 0.00000 | 1.75810 | 0.08408 | 0.00000 | 0.00000 | 0.00000 | 0.00046 | 0.08362 |
| nog_le_pt126 | 125 | 37.4720 | -108.9288 | -1044.1874 | -210.9131 | 1964.0 | 3.37 | 0.17 | 791.81 | 17.03 | 51.90884 | 0.05230 | 0.02250 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt127 | 126 | 37.5699 | -108.9877 | -1047.8891 | -199.5001 | 2042.0 | 3.11 | 0.18 | 604.34 | 6.71 | 92.90352 | 0.02731 | 0.03669 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt128 | 127 | 37.6539 | -108.9874 | -1046.6410 | -190.2936 | 2041.0 | 2.44 | 1.22 | 872.04 | 1.16 | 1.52738 | 0.00600 | 0.00460 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt129 | 128 | 39.2611 | -109.2658 | -1046.8879 | -10.9453 | 1585.0 | 6.33 | 0.30 | 954.78 | 19.38 | 35.41103 | 0.13363 | 0.00000 | 0.05742 | 0.00000 | 0.04611 | 0.00016 | 0.00565 | 0.00550 |
| nog_le_pt130 | 129 | 40.4487 | -109.5357 | -1051.7214 | 122.2752 | 1617.0 | 3.05 | 0.01 | 295.37 | 0.00 | 11.09710 | 0.35341 | 0.01013 | 0.01604 | 0.00000 | 0.00962 | 0.00009 | 0.00321 | 0.00312 |
| nog_le_pt131 | 130 | 40.6000 | -109.4833 | -1045.0615 | 138.2466 | 1829.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.32640 | 0.02648 | 59.64034 | 18.66125 | 0.10438 | 0.89377 | 0.02211 | 0.42785 | 17.21297 |
| nog_le_pt132 | 131 | 41.2951 | -109.6808 | -1050.7936 | 216.6855 | 1915.0 | 7.55 | 0.53 | 596.39 | 16.51 | 72.35786 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt133 | 132 | 37.2118 | -108.7592 | -1033.1391 | -241.3905 | 1831.0 | 2.13 | 0.21 | 523.71 | 7.25 | 2.60084 | 0.00080 | 0.00061 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt134 | 133 | 37.2471 | -108.7814 | -1034.5737 | -237.2655 | 2259.0 | 12.95 | 0.84 | 316.48 | 13.11 | 0.00000 | 0.00000 | 1.62261 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt135 | 134 | 37.4444 | -108.9018 | -1042.2362 | -214.2498 | 1950.0 | 3.23 | 0.28 | 802.91 | 24.99 | 69.74248 | 0.23452 | 0.54545 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt136 | 135 | 37.7458 | -108.8762 | -1035.6630 | -181.4909 | 2176.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.35104 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt137 | 136 | 37.7806 | -108.8838 | -1035.8201 | -177.5883 | 2255.0 | 5.47 | 0.24 | 844.72 | 58.87 | 108.37872 | 0.07304 | 0.06914 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt138 | 137 | 37.9094 | -108.9656 | -1041.0388 | -162.5316 | 2255.0 | 4.57 | 0.15 | 363.71 | 1.55 | 0.00086 | 0.00595 | 0.00051 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt139 | 138 | 38.1236 | -108.9014 | -1032.3919 | -139.7802 | 1777.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.51891 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt140 | 139 | 39.1688 | -109.1260 | -1036.3850 | -22.6614 | 1518.0 | 3.05 | 0.01 | 295.37 | 0.00 | 8.92024 | 0.74924 | 0.01063 | 0.01684 | 0.00000 | 0.01010 | 0.00009 | 0.00337 | 0.00327 |
| nog_le_pt141 | 140 | 40.5683 | -109.3308 | -1032.8479 | 133.0296 | 2110.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.75062 | 0.01458 | 0.01697 | 0.02687 | 0.00000 | 0.01612 | 0.00015 | 0.00537 | 0.00523 |
| nog_le_pt142 | 141 | 37.2100 | -108.7200 | -1029.7398 | -242.0328 | 1737.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 22.19294 | 9.63808 | 0.00051 | 0.28151 | 0.00015 | 0.05231 | 9.30331 |
| nog_le_pt143 | 142 | 37.2902 | -108.6727 | -1024.4704 | -233.7688 | 1830.0 | 12.95 | 0.84 | 316.48 | 13.11 | 0.00000 | 0.00000 | 7.30183 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt144 | 143 | 37.4716 | -108.7548 | -1029.0477 | -212.9418 | 2023.0 | 12.68 | 0.82 | 588.57 | 8.55 | 16.10986 | 23.28299 | 5.56487 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt145 | 144 | 37.5705 | -108.7152 | -1024.1939 | -202.5410 | 2187.0 | 15.85 | 1.22 | 802.59 | 31.30 | 32.59414 | 0.90397 | 0.03710 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt146 | 145 | 37.9767 | -108.7734 | -1023.4498 | -157.3354 | 1776.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.69045 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt147 | 146 | 38.0278 | -108.8299 | -1027.6000 | -151.0944 | 1749.0 | 4.57 | 0.25 | 533.15 | 15.24 | 0.01414 | 0.00004 | 0.00003 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt148 | 147 | 38.6796 | -108.9688 | -1030.1310 | -78.0644 | 2133.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 19.26142 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt149 | 148 | 39.2586 | -108.9971 | -1024.1256 | -14.2810 | 1493.0 | 3.05 | 0.01 | 295.37 | 0.00 | 3.54178 | 0.00120 | 0.00092 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt150 | 149 | 39.3308 | -109.0011 | -1023.4139 | -6.3224 | 1527.0 | 7.62 | 0.44 | 541.48 | 13.99 | 19.03694 | 0.01441 | 0.01105 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt151 | 150 | 39.3952 | -108.9774 | -1020.4688 | 0.4699 | 1950.0 | 6.10 | 0.24 | 523.71 | 3.99 | 21.91460 | 0.01881 | 0.01442 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt152 | 151 | 39.8014 | -109.0775 | -1022.9956 | 46.1171 | 1950.0 | 3.05 | 0.01 | 295.37 | 0.00 | 45.27935 | 0.09896 | 0.09368 | 0.14833 | 0.00000 | 0.08900 | 0.00082 | 0.02967 | 0.02885 |
| nog_le_pt153 | 152 | 41.4750 | -109.4760 | -1031.2061 | 234.0565 | 2073.0 | 12.50 | 1.22 | 479.26 | 20.12 | 4.58277 | 0.00000 | 0.02843 | 0.01531 | 0.00000 | 0.01531 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt154 | 153 | 36.8833 | -108.4832 | -1013.6013 | -280.5462 | 1727.0 | 32.49 | 0.61 | 321.30 | 20.97 | 0.00000 | 0.00000 | 0.94225 | 0.96885 | 0.03323 | 0.04650 | 0.00533 | 0.34045 | 0.54332 |
| nog_le_pt155 | 154 | 37.3046 | -108.5841 | -1016.5341 | -233.1838 | 1942.0 | 3.28 | 0.06 | 373.79 | 0.56 | 0.00742 | 0.01237 | 0.63639 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt156 | 155 | 37.3645 | -108.5737 | -1014.7849 | -226.7276 | 1861.0 | 2.02 | 0.52 | 402.22 | 12.75 | 4.61049 | 0.11818 | 0.92159 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt157 | 156 | 38.0463 | -108.6426 | -1011.1587 | -151.1666 | 2003.0 | 5.30 | 0.17 | 592.01 | 12.83 | 79.06156 | 0.12283 | 0.09417 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt158 | 157 | 38.1217 | -108.7314 | -1017.7548 | -141.9061 | 1955.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.77664 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt159 | 158 | 39.1911 | -108.8034 | -1008.6510 | -23.8469 | 1432.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.03445 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt160 | 159 | 39.3679 | -108.9232 | -1016.2725 | -3.1300 | 1584.0 | 7.61 | 0.40 | 413.73 | 10.98 | 108.12534 | 0.37141 | 0.34772 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt161 | 160 | 39.6966 | -108.9433 | -1013.2130 | 33.1264 | 2229.0 | 1.83 | 0.06 | 523.71 | 70.16 | 1.49971 | 0.00240 | 0.00184 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt162 | 161 | 39.8312 | -108.9062 | -1008.1393 | 47.4694 | 2194.0 | 0.91 | 0.05 | 523.71 | 15.11 | 1.66020 | 0.00023 | 0.00018 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt163 | 162 | 39.8516 | -108.9622 | -1012.5576 | 50.3283 | 2133.0 | 4.70 | 0.28 | 712.71 | 23.97 | 40.48098 | 0.10493 | 0.02075 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt164 | 163 | 40.0365 | -108.9747 | -1010.9232 | 70.7367 | 1648.0 | 2.44 | 0.05 | 523.71 | 13.02 | 5.47865 | 0.00320 | 0.00245 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

**Table D-1 CALPUFF Model Inputs: 2018 Non-Project Point Sources Less Than 100 TPY**

| Source_ID | Grid Cell Assignment | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_le_pt165 | 164 | 41.5230 | -109.3180 | -1017.5093 | 237.5383 | 1969.0 | 8.53 | 0.61 | 674.26 | 36.27 | 42.32810 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt166 | 165 | 36.7000 | -108.3000 | -1000.0303 | -302.6999 | 1798.0 | 9.14 | 0.91 | 310.93 | 64.71 | 63.87902 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt167 | 166 | 36.7717 | -108.3226 | -1001.0340 | -294.5781 | 1706.0 | 4.03 | 0.32 | 790.27 | 37.89 | 22.92605 | 0.00000 | 0.00000 | 0.07480 | 0.00000 | 0.04488 | 0.00041 | 0.01496 | 0.01455 |
| nog_le_pt168 | 167 | 37.0851 | -108.3525 | -999.3431 | -259.8422 | 2133.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 5.54725 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt169 | 168 | 37.4215 | -108.4360 | -1001.9841 | -222.0009 | 2255.0 | 5.75 | 0.41 | 677.86 | 68.07 | 43.75766 | 0.11430 | 6.12813 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt170 | 169 | 38.0667 | -108.5339 | -1001.4835 | -150.1326 | 2076.0 | 5.49 | 0.15 | 363.71 | 1.55 | 0.00246 | 0.01699 | 0.00144 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt171 | 170 | 38.2204 | -108.5601 | -1001.5900 | -132.9843 | 1770.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 15.46177 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt172 | 171 | 38.2652 | -108.5499 | -1000.0830 | -128.1827 | 1837.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 83.65873 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt173 | 172 | 38.4817 | -108.5645 | -998.3022 | -104.2756 | 2865.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 7.35366 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt174 | 173 | 39.1581 | -108.7460 | -1004.2436 | -28.1007 | 1383.0 | 6.50 | 1.28 | 443.95 | 8.26 | 56.87770 | 1.45500 | 56.53869 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt175 | 174 | 39.4419 | -108.7684 | -1002.0958 | 3.2637 | 2255.0 | 3.36 | 0.02 | 295.35 | 0.18 | 0.00000 | 0.00000 | 17.13733 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt176 | 175 | 39.8194 | -108.7758 | -997.3287 | 44.7368 | 1979.0 | 8.04 | 0.28 | 610.55 | 31.59 | 102.10240 | 0.26082 | 0.19015 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt177 | 176 | 39.8575 | -108.8829 | -1005.7985 | 50.0945 | 2127.0 | 4.65 | 0.27 | 544.65 | 20.12 | 69.03654 | 0.40870 | 0.08693 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt178 | 177 | 39.9682 | -108.8807 | -1004.0176 | 62.2068 | 1877.0 | 0.50 | 0.15 | 523.71 | 7.25 | 3.52349 | 0.00133 | 0.00184 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt179 | 178 | 40.1082 | -108.8924 | -1002.9805 | 77.6855 | 1645.0 | 7.69 | 0.61 | 483.28 | 9.81 | 31.40391 | 3.39224 | 7.25810 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt180 | 179 | 41.3641 | -109.1200 | -1003.5900 | 217.9109 | 2222.0 | 7.66 | 0.33 | 725.52 | 16.32 | 54.29859 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt181 | 180 | 41.5165 | -109.1850 | -1006.6855 | 235.3442 | 2073.0 | 9.08 | 0.70 | 645.93 | 33.96 | 45.13521 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt182 | 181 | 36.7219 | -108.1851 | -989.6160 | -301.5527 | 1676.0 | 18.87 | 2.08 | 504.34 | 19.00 | 69.46081 | 0.00000 | 0.06663 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt183 | 182 | 36.7442 | -108.1843 | -989.2426 | -299.1124 | 1706.0 | 6.77 | 0.31 | 683.91 | 36.64 | 160.79356 | 0.00000 | 2.56925 | 4.29297 | 0.05085 | 0.23107 | 0.00979 | 0.40475 | 3.59650 |
| nog_le_pt184 | 183 | 36.9092 | -108.1641 | -985.2276 | -281.2119 | 1828.0 | 5.37 | 0.30 | 753.37 | 30.58 | 23.88779 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt185 | 184 | 37.3304 | -108.3493 | -995.6827 | -232.9520 | 2133.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 9.46790 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt186 | 185 | 37.6541 | -108.3937 | -995.0803 | -196.9410 | 2654.0 | 15.24 | 0.58 | 523.71 | 37.34 | 23.18626 | 0.14163 | 0.10858 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt187 | 186 | 37.9743 | -108.4272 | -993.5494 | -161.4406 | 2621.0 | 7.15 | 0.36 | 308.09 | 7.71 | 0.00000 | 0.00000 | 2.50831 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt188 | 187 | 38.1243 | -108.4505 | -993.4800 | -144.7292 | 2088.0 | 4.83 | 0.13 | 774.14 | 13.52 | 66.40007 | 0.01448 | 0.00522 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt189 | 188 | 38.1709 | -108.4057 | -988.9684 | -140.1054 | 2065.0 | 3.00 | 0.01 | 302.64 | 0.16 | 2.71166 | 0.12206 | 115.24026 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt190 | 189 | 38.2820 | -108.4128 | -988.0420 | -127.8394 | 1966.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 17.55523 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt191 | 190 | 39.0730 | -108.5832 | -991.5969 | -39.2204 | 1422.0 | 5.11 | 0.26 | 311.46 | 3.55 | 108.23901 | 1.36457 | 190.89234 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt192 | 191 | 39.1210 | -108.6328 | -995.1423 | -33.4142 | 1402.0 | 8.30 | 0.46 | 314.37 | 9.14 | 80.71300 | 6.28046 | 17.38799 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt193 | 192 | 39.2303 | -108.6475 | -994.8482 | -21.2671 | 1534.0 | 6.10 | 0.25 | 999.82 | 11.13 | 9.64695 | 0.00729 | 0.00268 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt194 | 193 | 39.3314 | -108.5917 | -988.6861 | -10.7889 | 2072.0 | 6.40 | 0.34 | 510.93 | 6.80 | 6.41050 | 0.07290 | 0.00335 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt195 | 194 | 39.8307 | -108.7011 | -990.8768 | 45.1587 | 2013.0 | 5.58 | 0.25 | 485.08 | 8.94 | 35.99298 | 0.01246 | 5.39709 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt196 | 195 | 39.9091 | -108.7466 | -993.5909 | 54.2528 | 1950.0 | 4.78 | 0.32 | 743.26 | 17.12 | 66.64565 | 0.15179 | 0.10555 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt197 | 196 | 40.1488 | -108.7081 | -986.9469 | 80.1197 | 1706.0 | 3.08 | 0.01 | 295.47 | 0.05 | 0.01117 | 0.00343 | 4.49300 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt198 | 197 | 40.1948 | -108.7235 | -987.5834 | 85.3318 | 1706.0 | 4.63 | 0.06 | 295.28 | 0.91 | 0.00000 | 0.00000 | 97.14555 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt199 | 198 | 36.6686 | -108.0610 | -979.4068 | -308.7514 | 1767.0 | 4.25 | 0.26 | 772.32 | 33.94 | 26.92709 | 0.00000 | 0.00000 | 0.03995 | 0.00399 | 0.01918 | 0.00002 | 0.00080 | 0.01596 |
| nog_le_pt200 | 199 | 36.7876 | -108.0448 | -976.3829 | -295.8544 | 1802.0 | 7.32 | 0.44 | 790.93 | 17.47 | 35.13636 | 0.00000 | 0.00000 | 0.00831 | 0.00000 | 0.00499 | 0.00005 | 0.00166 | 0.00162 |
| nog_le_pt201 | 200 | 36.9392 | -108.0617 | -975.8327 | -279.0222 | 1979.0 | 3.66 | 0.43 | 882.50 | 16.54 | 21.09521 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt202 | 201 | 37.1188 | -108.1083 | -977.5003 | -258.7983 | 2133.0 | 3.14 | 0.05 | 452.59 | 4.23 | 7.34369 | 2.85010 | 20.05243 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt203 | 202 | 37.2513 | -108.1095 | -975.8179 | -244.2366 | 2377.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 61.08458 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt204 | 203 | 37.7857 | -108.2479 | -980.6153 | -184.0838 | 3163.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.53980 | 0.00000 | 0.06622 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt205 | 204 | 38.1377 | -108.2330 | -974.5235 | -145.6140 | 2294.0 | 14.50 | 0.34 | 296.00 | 6.94 | 0.00246 | 0.01699 | 3.08022 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt206 | 205 | 38.1525 | -108.2514 | -975.9095 | -143.7924 | 2278.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 4.87932 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt207 | 206 | 38.7942 | -108.3201 | -973.0218 | -72.6464 | 1767.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 8.22747 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt208 | 207 | 38.8858 | -108.3575 | -974.9573 | -62.1961 | 1630.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 4.43804 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt209 | 208 | 38.9787 | -108.4425 | -980.9255 | -51.0904 | 1454.0 | 4.72 | 0.11 | 296.82 | 1.57 | 0.00000 | 0.00000 | 71.14913 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt210 | 209 | 39.0559 | -108.4442 | -979.9984 | -42.6038 | 1493.0 | 3.09 | 0.01 | 299.30 | 0.07 | 0.25157 | 0.32682 | 65.54874 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt211 | 210 | 39.5064 | -108.5145 | -979.6918 | 7.5686 | 2255.0 | 6.71 | 0.34 | 500.93 | 13.50 | 14.09192 | 0.01511 | 0.00104 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt212 | 211 | 39.8713 | -108.5255 | -975.5192 | 47.7118 | 2197.0 | 6.64 | 0.26 | 533.05 | 56.84 | 16.31258 | 0.04298 | 0.03295 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt213 | 212 | 39.9203 | -108.5510 | -976.9790 | 53.3605 | 2222.0 | 4.43 | 0.23 | 402.80 | 7.15 | 5.81069 | 0.01361 | 0.01043 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt214 | 213 | 40.1678 | -108.6094 | -978.4047 | 81.1363 | 1718.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.70439 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt215 | 214 | 40.9743 | -108.6942 | -974.0647 | 170.5190 | 2075.0 | 6.29 | 0.30 | 586.76 | 20.96 | 71.35378 | 0.21615 | 2.21578 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt216 | 215 | 41.3584 | -108.8184 | -978.8407 | 213.9960 | 2195.0 | 5.59 | 0.43 | 588.43 | 16.93 | 33.06120 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt217 | 216 | 36.7034 | -107.9676 | -970.7133 | -305.9307 | 1709.0 | 7.34 | 0.51 | 723.85 | 40.56 | 349.91929 | 0.44625 | 0.03134 | 0.07230 | 0.00000 | 0.04338 | 0.00040 | 0.01446 | 0.01406 |
| nog_le_pt218 | 217 | 36.8305 | -107.9925 | -971.2093 | -291.7026 | 1801.0 | 6.98 | 0.33 | 664.88 | 39.44 | 593.30826 | 0.00000 | 0.00381 | 0.22410 | 0.00000 | 0.19640 | 0.00038 | 0.01385 | 0.01347 |
| nog_le_pt219 | 218 | 36.9238 | -107.9073 | -962.4819 | -282.3603 | 1889.0 | 12.09 | 0.54 | 704.25 | 39.99 | 178.88527 | 0.00000 | 0.16097 | 0.00582 | 0.00000 | 0.00349 | 0.00003 | 0.00116 | 0.00113 |
| nog_le_pt220 | 219 | 36.9901 | -107.9629 | -966.4816 | -274.4876 | 2072.0 | 6.46 | 0.52 | 752.54 | 29.76 | 26.50148 | 0.00160 | 0.00123 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt221 | 220 | 37.1213 | -107.9397 | -962.7031 | -260.3236 | 2011.0 | 5.54 | 0.27 | 574.88 | 24.17 | 102.35735 | 0.17223 | 0.06079 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt222 | 221 | 37.2025 | -108.0275 | -969.3043 | -250.4727 | 2392.0 | 14.57 | 0.34 | 295.54 | 6.98 | 0.00000 | 0.00000 | 6.50175 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt223 | 222 | 37.3841 | -108.0615 | -969.8390 | -230.1692 | 3752.0 | 3.50 | 0.09 | 297.15 | 0.34 | 0.42993 | 0.07974 | 99.03807 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt224 | 223 | 37.4336 | -108.0056 | -964.3004 | -225.3289 | 3068.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.00671 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt225 | 224 | 38.7690 | -108.2258 | -965.3010 | -76.4170 | 1584.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.72129 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt226 | 225 | 38.9064 | -108.2887 | -968.7996 | -60.6719 | 1950.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 57.70617 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt227 | 226 | 39.0812 | -108.2443 | -962.6234 | -41.9647 | 3048.0 | 5.83 | 0.23 | 408.73 | 28.11 | 31.10110 | 3.81543 | 0.06149 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt228 | 227 | 39.1550 | -108.3203 | -968.0823 | -33.0603 | 1950.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 59.73203 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt229 | 228 | 39.3688 | -108.2912 | -962.6770 | -9.9126 | 1649.0 | 3.66 | 0.09 | 438.15 | 49.90 | 12.78340 | 0.00460 | 0.00353 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt230 | 229 | 39.8592 | -108.4447 | -968.8846 | 45.5200 | 2164.0 | 3.05 | 0.01 | 295.37 | 0.00 | 5.85460 | 0.00209 | 0.00160 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt231 | 230 | 40.9564 | -108.5821 | -965.0300 | 167.3590 | 2072.0 | 4.57 | 0.30 | 523.71 | 28.38 | 8.68846 | 0.02245 | 0.01721 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt232 | 231 | 40.9868 | -108.5997 | -966.0603 | 170.8818 | 2145.0 | 3.35 | 0.15 | 777.54 | 32.56 | 13.29695 | 0.00520 | 0.00276 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt233 | 232 | 36.7636 | -107.7351 | -949.4471 | -301.7726 | 1945.0 | 6.78 | 0.38 | 653.81 | 40.00 | 573.13204 | 0.00000 | 0.00000 | 0.49582 | 0.00000 | 0.49462 | 0.00002 | 0.00060 | 0.00058 |
| nog_le_pt234 | 233 | 36.8061 | -107.7568 | -950.8020 | -296.8757 | 1912.0 | 11.93 | 0.32 | 728.42 | 40.09 | 87.75403 | 0.00000 | 0.00000 | 0.00077 | 0.00000 | 0.00046 | 0.00000 | 0.00015 | 0.00015 |
| nog_le_pt235 | 234 | 36.9366 | -107.8451 | -956.8508 | -281.6110 | 2139.0 | 6.83 | 0.30 | 718.47 | 35.89 | 54.64379 | 0.00000 | 0.00000 | 0.00029 | 0.00000 | 0.00018 | 0.00000 | 0.00006 | 0.00006 |
| nog_le_pt236 | 235 | 37.1365 | -107.8061 | -950.8025 | -260.0605 | 2011.0 | 9.97 | 0.65 | 478.75 | 23.86 | 182.79123 | 2.51173 | 23.94169 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt237 | 236 | 37.2341 | -107.8305 | -951.6555 | -249.0842 | 2143.0 | 5.80 | 0.23 | 374.16 | 7.49 | 62.39324 | 0.29631 | 62.51051 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt238 | 237 | 37.3656 | -107.8450 | -951.1916 | -234.4890 | 2812.0 | 3.31 | 0.03 | 295.31 | 0.32 | 0.00000 | 0.00000 | 11.94874 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt239 | 238 | 37.8553 | -107.8831 | -948.0464 | -180.3144 | 3662.0 | 14.57 | 0.34 | 294.26 | 6.98 | 0.00000 | 0.00000 | 48.80415 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt240 | 239 | 37.9578 | -107.9186 | -949.7654 | -168.6896 | 2986.0 | 3.46 | 0.05 | 295.83 | 1.42 | 0.29163 | 0.02856 | 1.97762 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt241 | 240 | 38.5404 | -108.0685 | -954.9132 | -103.1655 | 1775.0 | 15.24 | 0.91 | 523.71 | 1.10 | 35.00898 | 0.13102 | 0.13950 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt242 | 241 | 38.7043 | -108.0632 | -952.2575 | -85.2326 | 1569.0 | 3.15 | 0.11 | 295.31 | 1.10 | 0.00000 | 0.00000 | 1.99102 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt243 | 242 | 38.7454 | -108.0976 | -954.6501 | -80.3610 | 1526.0 | 3.08 | 0.01 | 299.58 | 0.03 | 9.62855 | 0.24746 | 49.06985 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt244 | 243 | 39.1694 | -108.1184 | -950.7091 | -33.6117 | 1828.0 | 23.31 | 0.44 | 359.86 | 7.47 | 4.66514 | 0.78986 | 10.09516 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt245 | 244 | 39.3370 | -108.2283 | -957.7749 | -14.0663 | 1676.0 | 5.27 | 0.26 | 361.90 | 6.33 | 58.80260 | 0.02857 | 13.26958 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt246 | 245 | 39.3883 | -108.2606 | -959.8150 | -8.0967 | 1706.0 | 6.97 | 0.25 | 531.70 | 36.27 | 29.38538 | 0.01800 | 0.01495 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

**Table D-1 CALPUFF Model Inputs: 2018 Non-Project Point Sources Less Than 100 TPY**

| Source_ID | Grid Cell Assignment | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_le_pt247 | 246 | 39.5693 | -108.2492 | -956.3772 | 11.6431 | 2606.0 | 5.63 | 0.37 | 487.92 | 17.48 | 25.48883 | 0.01733 | 0.01329 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt248 | 247 | 39.5938 | -108.2498 | -956.0935 | 14.3377 | 2560.0 | 13.89 | 1.65 | 350.04 | 15.07 | 22.02191 | 0.00972 | 0.00748 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt249 | 248 | 39.6966 | -108.2830 | -957.4929 | 25.9669 | 2451.0 | 4.27 | 0.17 | 762.94 | 45.81 | 18.42812 | 0.02278 | 0.01747 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt250 | 249 | 39.8399 | -108.2946 | -956.5080 | 41.8125 | 2011.0 | 4.09 | 0.14 | 519.38 | 12.37 | 43.08920 | 0.01634 | 0.04804 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt251 | 250 | 39.8977 | -108.3096 | -956.9783 | 48.3125 | 2072.0 | 3.57 | 0.04 | 359.46 | 10.22 | 21.20084 | 0.04102 | 0.03145 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt252 | 251 | 40.0456 | -108.2827 | -952.6886 | 64.2586 | 1950.0 | 5.87 | 0.19 | 484.70 | 10.99 | 13.61381 | 0.01529 | 17.64743 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt253 | 252 | 40.1676 | -108.3545 | -957.0384 | 78.4000 | 1828.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 15.11233 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt254 | 253 | 40.8052 | -108.3975 | -951.8226 | 148.8195 | 2012.0 | 3.28 | 0.09 | 785.35 | 25.37 | 97.88424 | 0.04664 | 0.03576 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt255 | 254 | 41.5902 | -108.5036 | -949.6707 | 236.0971 | 2105.0 | 12.08 | 0.43 | 686.26 | 14.33 | 94.56035 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt256 | 255 | 36.7059 | -107.6397 | -941.7942 | -309.1063 | 2072.0 | 3.37 | 0.04 | 462.79 | 9.94 | 18.11510 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt257 | 256 | 36.8546 | -107.6306 | -939.0719 | -292.8584 | 1923.0 | 5.79 | 0.26 | 710.30 | 29.51 | 99.89299 | 0.00000 | 0.00469 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt258 | 257 | 36.9138 | -107.6676 | -941.5582 | -285.9701 | 2072.0 | 7.85 | 0.50 | 647.59 | 36.31 | 27.13914 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt259 | 258 | 37.0865 | -107.6863 | -940.9594 | -266.8005 | 2011.0 | 3.44 | 0.19 | 675.08 | 41.30 | 143.18432 | 0.12097 | 0.09275 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt260 | 259 | 37.1496 | -107.7455 | -945.3244 | -259.2536 | 2037.0 | 2.49 | 0.12 | 720.13 | 23.45 | 19.49644 | 0.05775 | 0.04428 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt261 | 260 | 37.2387 | -107.6940 | -939.6575 | -249.9993 | 2257.0 | 1.84 | 0.08 | 438.15 | 73.80 | 10.19920 | 0.01694 | 0.00399 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt262 | 261 | 38.4890 | -107.9086 | -941.8656 | -110.4762 | 1772.0 | 6.12 | 0.21 | 302.91 | 3.15 | 3.41295 | 1.66910 | 117.21830 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt263 | 262 | 38.5192 | -107.8717 | -938.2963 | -107.5425 | 1915.0 | 6.09 | 0.61 | 478.25 | 12.48 | 14.31995 | 0.04804 | 0.18886 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt264 | 263 | 38.6272 | -107.9914 | -947.1362 | -94.4453 | 1642.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 10.58135 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt265 | 264 | 38.7868 | -107.9504 | -941.4990 | -77.3527 | 1706.0 | 7.39 | 0.29 | 294.87 | 4.66 | 0.00000 | 0.00000 | 72.07968 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt266 | 265 | 38.9089 | -107.9506 | -939.8933 | -63.9481 | 1974.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.49483 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt267 | 266 | 39.2393 | -107.9978 | -939.5145 | -27.1944 | 1889.0 | 5.80 | 0.29 | 555.87 | 8.57 | 45.35267 | 0.03638 | 12.39477 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt268 | 267 | 39.2908 | -108.0556 | -943.7368 | -20.9431 | 2438.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.47460 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt269 | 268 | 39.4673 | -108.0703 | -942.6140 | -1.4194 | 1712.0 | 6.72 | 0.36 | 656.70 | 45.20 | 129.20135 | 0.37035 | 0.54338 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt270 | 269 | 39.4805 | -108.1184 | -946.5111 | 0.5292 | 2032.0 | 7.31 | 0.42 | 565.30 | 22.04 | 94.44397 | 0.50737 | 0.18324 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt271 | 270 | 39.9017 | -108.1929 | -947.0995 | 47.5288 | 2260.0 | 7.84 | 0.33 | 671.82 | 15.43 | 89.77270 | 0.06701 | 5.19533 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt272 | 271 | 39.9326 | -108.1681 | -944.5928 | 50.6618 | 2255.0 | 3.51 | 0.16 | 783.77 | 9.37 | 15.00516 | 0.01032 | 5.01667 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt273 | 272 | 40.1019 | -108.1938 | -944.4552 | 69.5091 | 1841.0 | 5.93 | 0.57 | 700.42 | 22.49 | 172.59638 | 0.67703 | 3.31082 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt274 | 273 | 40.1365 | -108.1960 | -944.1697 | 73.3292 | 2011.0 | 2.44 | 0.05 | 523.71 | 14.08 | 3.70767 | 0.00200 | 0.00153 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt275 | 274 | 40.9450 | -108.3025 | -942.0117 | 163.1742 | 2072.0 | 3.11 | 0.14 | 575.99 | 45.81 | 49.50699 | 0.01555 | 0.01452 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt276 | 275 | 41.5961 | -108.4142 | -942.2475 | 235.8143 | 2160.0 | 45.87 | 0.40 | 997.65 | 16.18 | 15.14527 | 45.21313 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt277 | 276 | 36.7538 | -107.5477 | -933.0736 | -304.7907 | 2072.0 | 10.11 | 0.49 | 707.83 | 42.41 | 144.55570 | 0.00000 | 1.05861 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt278 | 277 | 36.8121 | -107.5160 | -929.5370 | -298.7075 | 2011.0 | 9.84 | 0.45 | 624.69 | 18.25 | 55.73208 | 0.00000 | 0.00671 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt279 | 278 | 36.9084 | -107.5645 | -932.5688 | -287.6266 | 1970.0 | 12.66 | 0.60 | 677.57 | 45.07 | 61.65553 | 0.00000 | 0.00402 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt280 | 279 | 37.1103 | -107.6092 | -933.8949 | -264.9808 | 2011.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 18.96504 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt281 | 280 | 37.1914 | -107.5817 | -930.4427 | -256.3516 | 2133.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 10.08240 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt282 | 281 | 38.0875 | -107.7108 | -930.0877 | -156.5971 | 2926.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.22241 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt283 | 282 | 38.1824 | -107.7381 | -931.2102 | -145.8962 | 2214.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 12.48672 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt284 | 283 | 38.5114 | -107.7869 | -931.1142 | -109.2711 | 2164.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 23.20415 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt285 | 284 | 39.2654 | -107.8845 | -929.5373 | -25.4945 | 2255.0 | 2.67 | 0.04 | 437.12 | 19.57 | 10.40396 | 0.00360 | 6.36252 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt286 | 285 | 39.2888 | -107.8332 | -924.8694 | -23.4491 | 2438.0 | 2.44 | 0.10 | 647.22 | 27.10 | 17.52621 | 0.00640 | 0.00491 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt287 | 286 | 39.4870 | -107.9544 | -932.5315 | -0.4529 | 1719.0 | 3.37 | 0.16 | 442.78 | 32.38 | 38.79330 | 0.05075 | 0.03891 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt288 | 287 | 39.5260 | -107.9355 | -930.4127 | 3.6344 | 2133.0 | 6.32 | 0.37 | 585.62 | 27.45 | 143.29427 | 0.32077 | 11.81762 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt289 | 288 | 39.8421 | -107.9120 | -924.2361 | 38.0949 | 2760.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 5.51369 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt290 | 289 | 40.0261 | -108.0292 | -931.6510 | 59.4903 | 1889.0 | 3.97 | 0.08 | 428.88 | 14.92 | 14.75367 | 0.01721 | 0.01319 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt291 | 290 | 40.2888 | -108.0213 | -927.4723 | 88.2473 | 2499.0 | 6.10 | 0.19 | 458.21 | 11.67 | 2.18066 | 0.01308 | 0.01529 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt292 | 291 | 40.4889 | -108.0498 | -927.1746 | 110.5056 | 1889.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 15.86175 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt293 | 292 | 36.8208 | -107.4434 | -923.0377 | -298.4912 | 1950.0 | 6.81 | 0.38 | 517.62 | 9.24 | 23.79800 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt294 | 293 | 36.9559 | -107.3527 | -913.3568 | -284.5568 | 2194.0 | 2.90 | 0.29 | 859.17 | 6.43 | 12.26737 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt295 | 294 | 38.8214 | -107.6900 | -918.7659 | -76.2193 | 1712.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.34386 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt296 | 295 | 38.9061 | -107.6527 | -914.4795 | -67.2949 | 2499.0 | 3.62 | 0.46 | 294.23 | 2.36 | 0.00000 | 0.00000 | 53.63171 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt297 | 296 | 39.4744 | -107.7275 | -913.4707 | -4.1407 | 1826.0 | 5.90 | 2.04 | 600.41 | 15.49 | 92.11067 | 0.27416 | 0.19254 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt298 | 297 | 39.5270 | -107.8105 | -919.8149 | 2.4717 | 1645.0 | 4.61 | 0.16 | 443.26 | 13.15 | 112.51988 | 0.13240 | 61.34159 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt299 | 298 | 40.0139 | -107.8729 | -918.6727 | 56.5598 | 2012.0 | 9.95 | 0.39 | 294.55 | 4.73 | 0.00000 | 0.00000 | 16.19297 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt300 | 299 | 40.1947 | -107.9173 | -920.0099 | 76.8593 | 2561.0 | 7.17 | 0.28 | 764.90 | 15.00 | 18.55937 | 1.37655 | 0.14760 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt301 | 300 | 40.9855 | -108.0684 | -922.0537 | 165.2198 | 1974.0 | 4.57 | 0.15 | 672.05 | 12.57 | 6.81364 | 0.00400 | 0.00307 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt302 | 301 | 36.8648 | -107.2229 | -903.0855 | -295.8694 | 2194.0 | 6.10 | 0.15 | 756.48 | 43.89 | 4.13034 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt303 | 302 | 37.0092 | -107.2226 | -901.2656 | -279.9962 | 2135.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 9.34583 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt304 | 303 | 37.2206 | -107.3425 | -909.1351 | -255.5637 | 2168.0 | 3.05 | 0.01 | 295.37 | 0.00 | 15.22853 | 1.00141 | 10.60942 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt305 | 304 | 38.3669 | -107.4874 | -907.2180 | -128.1691 | 2778.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.47053 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt306 | 305 | 38.6614 | -107.5289 | -907.0275 | -95.4084 | 2743.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.90960 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt307 | 306 | 38.9163 | -107.5444 | -905.0939 | -67.2590 | 2186.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 32.94599 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt308 | 307 | 39.3860 | -107.5996 | -903.7670 | -15.1267 | 2622.0 | 6.04 | 0.27 | 589.80 | 23.95 | 21.07985 | 0.02677 | 0.02096 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt309 | 308 | 39.4944 | -107.6738 | -908.6600 | -2.4830 | 1828.0 | 4.62 | 0.33 | 326.78 | 6.00 | 27.89294 | 0.07324 | 13.38652 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt310 | 309 | 39.5402 | -107.7007 | -910.3445 | 2.8154 | 1691.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 5.57879 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt311 | 310 | 40.5777 | -107.7818 | -903.6315 | 117.5568 | 2073.0 | 3.08 | 0.13 | 525.37 | 11.54 | 24.41930 | 2.44423 | 2.32975 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt312 | 311 | 40.8685 | -107.9171 | -911.0619 | 150.8452 | 2073.0 | 7.62 | 0.44 | 541.48 | 4.27 | 5.53413 | 0.00000 | 0.00675 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt313 | 312 | 41.6722 | -107.9809 | -905.6409 | 239.7678 | 2080.0 | 8.22 | 1.51 | 682.56 | 15.41 | 22.45517 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt314 | 313 | 38.9325 | -107.4694 | -898.4789 | -66.2239 | 2391.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 90.13543 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt315 | 314 | 39.3655 | -107.5236 | -897.5779 | -18.1313 | 2804.0 | 8.38 | 0.51 | 294.26 | 6.61 | 8.46691 | 0.00366 | 0.00280 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt316 | 315 | 40.4752 | -107.6115 | -890.7447 | 104.6171 | 1956.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 11.58083 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt317 | 316 | 37.1564 | -107.0558 | -884.8221 | -265.4512 | 2377.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.45209 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt318 | 317 | 37.3008 | -107.0761 | -884.8334 | -249.3771 | 2368.0 | 2.74 | 0.15 | 1009.26 | 5.73 | 0.00000 | 0.00000 | 0.00228 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt319 | 318 | 39.3906 | -107.2735 | -876.0253 | -17.8147 | 2072.0 | 7.46 | 0.27 | 706.05 | 44.67 | 20.32028 | 0.05152 | 0.00357 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt320 | 319 | 39.5470 | -107.3296 | -878.8270 | -0.0908 | 2438.0 | 4.88 | 0.51 | 560.93 | 11.46 | 0.01670 | 0.04454 | 0.00033 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt321 | 320 | 39.5708 | -107.4058 | -884.9811 | 3.2632 | 2299.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 6.00243 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt322 | 321 | 40.2001 | -107.4658 | -882.0651 | 72.9758 | 2438.0 | 2.04 | 0.08 | 894.26 | 81.38 | 26.85123 | 0.02112 | 0.40344 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt323 | 322 | 40.4886 | -107.5395 | -884.5567 | 105.3859 | 1951.0 | 3.15 | 0.02 | 321.21 | 5.85 | 23.65612 | 0.00818 | 57.71807 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt324 | 323 | 40.6172 | -107.5142 | -880.8008 | 119.2686 | 2010.0 | 2.97 | 0.14 | 630.43 | 41.95 | 36.47416 | 0.11179 | 0.25564 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt325 | 324 | 40.7221 | -107.5709 | -884.1827 | 131.3442 | 2012.0 | 4.94 | 0.26 | 667.73 | 20.25 | 20.01083 | 0.01470 | 1.77727 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt326 | 325 | 40.7522 | -107.5518 | -882.2066 | 134.4656 | 2368.0 | 4.88 | 0.15 | 831.48 | 5.76 | 8.87096 | 0.01121 | 0.00859 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt327 | 326 | 40.9225 | -107.6091 | -884.7813 | 153.7338 | 2012.0 | 3.05 | 0.08 | 418.85 | 21.80 | 5.43423 | 0.00656 | 0.00503 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt328 | 327 | 40.9647 | -107.6295 | -885.9300 | 158.5691 | 2018.0 | 3.49 | 0.52 | 568.45 | 18.53 | 21.01995 | 0.01601 | 0.01227 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

**Table D-1 CALPUFF Model Inputs: 2018 Non-Project Point Sources Less Than 100 TPY**

| Source_ID | Grid Cell Assignment | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_le_pt329 | 328 | 37.0346 | -106.8440 | -867.7161 | -280.8880 | 2377.0 | 6.03 | 0.10 | 295.41 | 1.80 | 0.00206 | 0.00014 | 22.64009 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt330 | 329 | 37.3182 | -106.9482 | -873.4368 | -248.7012 | 2504.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 19.18148 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt331 | 330 | 39.0353 | -107.1678 | -871.4364 | -57.8677 | 4023.0 | 3.05 | 0.01 | 295.37 | 0.00 | 10.82809 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt332 | 331 | 39.4013 | -107.2198 | -871.3329 | -17.1554 | 2011.0 | 16.49 | 1.31 | 294.26 | 10.67 | 0.00059 | 0.00439 | 0.00167 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt333 | 332 | 39.4458 | -107.2667 | -874.7599 | -11.8157 | 2133.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 37.99343 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt334 | 333 | 40.3633 | -107.2922 | -865.4573 | 89.2377 | 2256.0 | 15.33 | 0.82 | 294.26 | 10.16 | 0.00000 | 0.00000 | 29.18971 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt335 | 334 | 40.4625 | -107.3764 | -871.2569 | 100.9427 | 2073.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 21.73685 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt336 | 335 | 40.9819 | -107.3872 | -865.6073 | 158.1242 | 2256.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.13868 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt337 | 336 | 37.2148 | -106.7058 | -853.4558 | -262.3760 | 3535.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.91881 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt338 | 337 | 37.3408 | -106.8297 | -862.8036 | -247.3480 | 3052.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 11.18452 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt339 | 338 | 38.5582 | -106.9617 | -859.6151 | -112.2603 | 2387.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.57128 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt340 | 339 | 38.8680 | -107.0292 | -861.6435 | -77.5733 | 3029.0 | 12.50 | 0.27 | 294.26 | 15.81 | 0.00000 | 0.00000 | 0.09503 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt341 | 340 | 39.3861 | -107.0809 | -859.7254 | -20.1485 | 2438.0 | 3.70 | 0.19 | 296.22 | 0.19 | 0.00742 | 0.01979 | 18.88037 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt342 | 341 | 39.6736 | -107.0714 | -855.4027 | 11.3560 | 2573.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 29.07225 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt343 | 342 | 40.2897 | -107.1859 | -857.4668 | 80.1419 | 2499.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.38682 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt344 | 343 | 40.4913 | -107.2189 | -857.7312 | 102.6093 | 2012.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 9.18865 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt345 | 344 | 41.5319 | -107.3611 | -856.5183 | 218.3376 | 2524.0 | 3.05 | 0.01 | 295.37 | 0.00 | 17.82259 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt346 | 345 | 38.5412 | -106.8608 | -851.1461 | -115.0785 | 2560.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 4.21768 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt347 | 346 | 38.6111 | -106.8803 | -851.9840 | -107.2124 | 2654.0 | 17.07 | 0.36 | 533.15 | 10.29 | 0.71379 | 0.01167 | 0.46585 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt348 | 347 | 38.8421 | -106.8362 | -845.4370 | -82.2326 | 3352.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 17.94559 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt349 | 348 | 39.2505 | -106.8823 | -844.4830 | -36.9134 | 2577.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 38.97103 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt350 | 349 | 39.2680 | -106.8794 | -844.0262 | -35.0169 | 2629.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 10.85346 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt351 | 350 | 39.4393 | -106.8942 | -843.2275 | -16.0509 | 3535.0 | 6.10 | 2.43 | 294.75 | 1.99 | 0.00000 | 0.00000 | 17.42820 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt352 | 351 | 39.6496 | -106.9328 | -843.9676 | 7.4224 | 2073.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 25.89602 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt353 | 352 | 40.4387 | -107.1082 | -849.1238 | 95.7885 | 2438.0 | 0.61 | 0.06 | 523.71 | 5.67 | 1.95888 | 0.00080 | 0.00061 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt354 | 353 | 40.4707 | -107.0283 | -842.0496 | 98.5625 | 2110.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 49.49515 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt355 | 354 | 39.6522 | -106.8367 | -835.8032 | 6.8200 | 2215.0 | 3.13 | 0.02 | 318.78 | 0.23 | 1.06927 | 0.29493 | 57.45649 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt356 | 355 | 39.8772 | -106.8564 | -834.7774 | 31.7347 | 2179.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.05202 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt357 | 356 | 40.1567 | -106.9144 | -836.3049 | 62.9932 | 2621.0 | 7.62 | 0.63 | 394.26 | 16.11 | 0.71756 | 0.01938 | 0.00846 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt358 | 357 | 40.2754 | -106.9677 | -839.3460 | 76.5331 | 2541.0 | 5.20 | 0.43 | 665.65 | 13.76 | 7.19627 | 0.74779 | 0.15801 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt359 | 358 | 40.4941 | -106.9214 | -832.8274 | 100.1499 | 2106.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 39.23982 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt360 | 359 | 40.7083 | -106.9336 | -831.2628 | 123.8124 | 2493.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.73232 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt361 | 360 | 37.1546 | -106.3172 | -820.0891 | -272.5775 | 2987.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.44221 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt362 | 361 | 37.7003 | -106.3458 | -816.4008 | -212.2757 | 2438.0 | 3.13 | 0.05 | 296.75 | 1.50 | 0.59057 | 0.07723 | 21.04151 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt363 | 362 | 39.7261 | -106.6619 | -820.1402 | 13.3518 | 2537.0 | 8.27 | 0.30 | 295.11 | 2.60 | 0.00000 | 0.00000 | 16.11658 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt364 | 363 | 39.9736 | -106.7044 | -820.8171 | 40.9484 | 2865.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 27.34836 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt365 | 364 | 40.3959 | -106.8244 | -825.8887 | 88.4679 | 2499.0 | 6.02 | 0.23 | 295.19 | 3.46 | 0.16931 | 0.01099 | 46.30756 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt366 | 365 | 40.5019 | -106.8566 | -827.3159 | 100.4156 | 2219.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.14614 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt367 | 366 | 41.5359 | -106.9139 | -819.6516 | 214.6533 | 2072.0 | 13.96 | 0.82 | 396.92 | 12.13 | 26.37454 | 1.17570 | 70.37120 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt368 | 367 | 41.7061 | -106.9364 | -819.4489 | 233.5814 | 2073.0 | 5.30 | 0.28 | 308.65 | 6.59 | 2.48529 | 0.00000 | 60.66109 | 50.00723 | 0.91519 | 10.13208 | 0.17121 | 3.58336 | 35.20570 |
| nog_le_pt369 | 368 | 37.6941 | -106.3287 | -814.9826 | -213.1113 | 2433.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 4.16064 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt370 | 369 | 38.1354 | -106.3405 | -811.0025 | -164.4591 | 2743.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.67738 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt371 | 370 | 38.4036 | -106.2972 | -804.2273 | -135.3424 | 3304.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.82776 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt372 | 371 | 39.6447 | -106.5108 | -808.3018 | 3.0473 | 2852.0 | 6.64 | 0.14 | 294.81 | 1.80 | 0.00000 | 0.00000 | 2.30720 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt373 | 372 | 41.1791 | -106.7882 | -813.5439 | 174.2735 | 2451.0 | 18.29 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.21302 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt374 | 373 | 41.7179 | -106.8614 | -813.1466 | 234.2060 | 2067.0 | 11.72 | 2.43 | 1001.96 | 24.14 | 21.86710 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt375 | 374 | 37.0473 | -106.0081 | -794.1480 | -287.1335 | 2407.0 | 7.45 | 0.45 | 358.75 | 12.71 | 14.59448 | 0.07864 | 46.35578 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt376 | 375 | 37.3993 | -106.0964 | -798.0153 | -247.6127 | 2347.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.00896 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt377 | 376 | 37.5268 | -106.1251 | -799.1109 | -233.3283 | 2290.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.91051 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt378 | 377 | 37.5959 | -106.1317 | -798.9202 | -225.6658 | 2320.0 | 3.16 | 0.07 | 300.46 | 0.64 | 0.54513 | 1.10544 | 35.93917 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt379 | 378 | 37.7565 | -106.1967 | -802.7931 | -207.4207 | 2329.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 24.71846 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt380 | 379 | 38.0522 | -106.1289 | -793.6153 | -175.4804 | 2346.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 14.44524 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt381 | 380 | 39.1541 | -106.2901 | -795.1469 | -52.8554 | 3208.0 | 19.20 | 1.03 | 301.16 | 11.93 | 0.00000 | 0.00000 | 4.14760 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt382 | 381 | 39.2388 | -106.2896 | -794.1486 | -43.5435 | 3352.0 | 3.10 | 0.02 | 296.50 | 0.26 | 0.00000 | 0.00000 | 18.61696 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt383 | 382 | 39.5802 | -106.4184 | -801.2150 | -4.8642 | 3119.0 | 3.08 | 0.01 | 296.23 | 0.13 | 0.05453 | 0.00363 | 16.91488 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt384 | 383 | 39.6426 | -106.3837 | -797.5624 | 1.6934 | 2930.0 | 6.66 | 0.27 | 571.85 | 2.39 | 1.15153 | 0.42849 | 0.33138 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt385 | 384 | 40.0290 | -106.3869 | -793.4279 | 44.2210 | 2658.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.55473 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt386 | 385 | 40.1111 | -106.4650 | -799.0616 | 53.9355 | 2529.0 | 12.95 | 0.84 | 316.48 | 13.11 | 0.00000 | 0.00000 | 6.57365 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt387 | 386 | 40.4759 | -106.4526 | -793.8297 | 93.9527 | 2573.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 18.65990 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt388 | 387 | 37.6444 | -105.9495 | -782.5045 | -221.9134 | 2290.0 | 5.50 | 0.34 | 536.30 | 3.87 | 6.64092 | 0.01334 | 0.00123 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt389 | 388 | 38.1135 | -106.0197 | -783.4817 | -169.6829 | 2361.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 4.87662 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt390 | 389 | 38.2594 | -106.1355 | -791.8877 | -152.6257 | 3131.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 37.46725 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt391 | 390 | 38.7468 | -106.1293 | -785.9471 | -99.0577 | 2438.0 | 5.79 | 0.30 | 1223.71 | 2.44 | 0.13742 | 0.28950 | 0.22851 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt392 | 391 | 38.8326 | -106.1271 | -784.8071 | -89.6377 | 2753.0 | 7.01 | 0.41 | 383.81 | 11.21 | 43.39438 | 0.36716 | 38.84848 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt393 | 392 | 39.2272 | -106.2194 | -788.2979 | -45.4307 | 4027.0 | 9.14 | 0.34 | 291.48 | 25.39 | 0.00000 | 0.00000 | 10.02400 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt394 | 393 | 39.4847 | -106.1575 | -780.1590 | -17.6387 | 3413.0 | 8.23 | 0.67 | 1144.26 | 10.06 | 0.29057 | 0.18366 | 0.34463 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt395 | 394 | 40.0814 | -106.3728 | -791.6437 | 49.8618 | 2438.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.02884 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt396 | 395 | 37.4679 | -105.8829 | -778.6051 | -241.9137 | 2285.0 | 10.22 | 3.77 | 785.91 | 44.88 | 67.14244 | 16.04938 | 1.98852 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt397 | 396 | 37.5015 | -105.8210 | -772.8363 | -238.7431 | 2285.0 | 7.63 | 0.69 | 453.45 | 5.73 | 14.50696 | 0.39473 | 6.39071 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt398 | 397 | 37.7569 | -105.8633 | -773.7799 | -210.2687 | 2287.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.35741 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt399 | 398 | 38.0195 | -105.8771 | -772.1485 | -181.2480 | 2294.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.66361 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt400 | 399 | 38.4335 | -105.8924 | -769.0026 | -135.5566 | 2486.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 4.57672 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt401 | 400 | 38.5355 | -105.9979 | -776.9815 | -123.4352 | 2460.0 | 3.45 | 0.05 | 300.58 | 0.99 | 1.65031 | 0.00180 | 44.88231 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt402 | 401 | 38.8549 | -105.9952 | -773.2592 | -88.3149 | 3000.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 21.46675 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt403 | 402 | 39.2531 | -106.0402 | -772.7422 | -44.1205 | 3230.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 40.01020 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt404 | 403 | 39.5295 | -106.0407 | -769.7495 | -13.7059 | 2987.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 7.15052 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt405 | 404 | 39.5725 | -106.0836 | -772.9155 | -8.6108 | 2896.0 | 7.32 | 0.37 | 702.59 | 34.93 | 0.04640 | 0.12372 | 0.09155 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt406 | 405 | 39.6827 | -106.1033 | -773.3676 | 3.6810 | 2934.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 59.74594 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt407 | 406 | 39.8626 | -106.0898 | -770.2381 | 23.3593 | 3003.0 | 5.49 | 0.21 | 733.15 | 21.64 | 7.58178 | 0.07290 | 0.00335 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt408 | 407 | 40.0425 | -106.0913 | -768.3780 | 43.1661 | 2987.0 | 4.60 | 0.08 | 295.09 | 0.91 | 0.00000 | 0.00000 | 12.23984 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt409 | 408 | 37.1446 | -105.5989 | -757.1664 | -279.9119 | 2346.0 | 4.16 | 0.11 | 295.19 | 2.32 | 0.00000 | 0.00000 | 13.29542 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt410 | 409 | 38.4351 | -105.7932 | -760.4338 | -136.2153 | 2524.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 11.19802 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

**Table D-1 CALPUFF Model Inputs: 2018 Non-Project Point Sources Less Than 100 TPY**

| Source_ID | Grid Cell Assignment | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_le_pt411 | 410 | 39.1908 | -105.9719 | -767.6020 | -51.5539 | 3048.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 17.15354 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt412 | 411 | 39.2417 | -105.9742 | -767.2433 | -45.9340 | 3108.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 20.84909 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt413 | 412 | 39.5184 | -105.9528 | -762.4105 | -15.6682 | 3379.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 44.32122 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt414 | 413 | 39.6079 | -105.9949 | -765.0061 | -5.4665 | 3031.0 | 3.13 | 0.01 | 296.20 | 0.06 | 0.02889 | 0.00340 | 32.06373 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt415 | 414 | 40.6134 | -106.0968 | -762.5316 | 106.0350 | 2650.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 13.48963 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt416 | 415 | 37.1900 | -105.5600 | -753.2789 | -275.2350 | 2377.0 | 3.05 | 0.03 | 295.28 | 1.94 | 0.00000 | 0.00000 | 1.35910 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt417 | 416 | 38.3444 | -105.5955 | -744.3355 | -147.8354 | 2438.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 2.20507 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt418 | 417 | 38.3942 | -105.6302 | -746.8092 | -142.0688 | 2255.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 9.44109 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt419 | 418 | 39.0108 | -105.7038 | -746.6389 | -73.5958 | 2743.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 5.69765 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt420 | 419 | 39.7372 | -105.8481 | -751.1709 | 7.5373 | 3810.0 | 14.31 | 0.84 | 294.43 | 12.99 | 62.88848 | 2.47672 | 27.38395 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt421 | 420 | 39.9717 | -105.8625 | -749.8647 | 33.4638 | 2621.0 | 10.18 | 0.26 | 294.26 | 3.58 | 0.00000 | 0.00000 | 1.26166 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt422 | 421 | 40.0603 | -105.9280 | -754.4279 | 43.7566 | 2593.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.86499 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt423 | 422 | 40.1051 | -105.9115 | -752.5531 | 48.5501 | 2619.0 | 10.76 | 0.33 | 294.26 | 5.44 | 0.00000 | 0.00000 | 5.41475 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt424 | 423 | 40.2936 | -105.8536 | -745.6514 | 68.8194 | 3048.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 0.26696 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt425 | 424 | 37.4290 | -105.4575 | -741.8282 | -249.7556 | 2442.0 | 7.45 | 0.22 | 298.37 | 2.93 | 0.00000 | 0.00000 | 74.99327 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt426 | 425 | 38.1398 | -105.5258 | -740.4370 | -170.9292 | 2399.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 9.92920 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt427 | 426 | 38.6301 | -105.4896 | -732.2450 | -117.2442 | 2438.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 1.49738 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt428 | 427 | 39.7611 | -105.7022 | -738.5700 | 8.9719 | 2893.0 | 12.04 | 0.34 | 294.26 | 6.83 | 0.51560 | 0.00000 | 18.36310 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt429 | 428 | 37.9938 | -105.3483 | -726.5467 | -188.4378 | 2630.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 10.37367 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt430 | 429 | 38.0936 | -105.3813 | -728.3941 | -177.1838 | 2721.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 12.49782 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt431 | 430 | 38.4919 | -105.3865 | -724.7860 | -133.2861 | 1889.0 | 12.74 | 0.82 | 294.28 | 12.83 | 0.00000 | 0.00000 | 49.74457 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt432 | 431 | 38.8919 | -105.4963 | -730.1188 | -88.3695 | 2743.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 10.51784 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt433 | 432 | 39.7430 | -105.5251 | -723.7713 | 5.5545 | 2591.0 | 6.39 | 6.08 | 1039.72 | 0.09 | 0.22320 | 0.12411 | 0.07465 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| nog_le_pt434 | 433 | 40.8251 | -105.6144 | -720.0030 | 125.4059 | 2560.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.00000 | 0.00000 | 3.12053 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

**Table D-2 CALPUFF Model Inputs: 2018 Non-Project Point Sources Greater Than 100 TPY**

| Source ID | Plant Name | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2(TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_gr_pt1 | QUESTAR_ROCK SPRINGS COMPLEX | 41.5208 | -109.3149 | -1017.2877 | 237.2623 | 2012.0 | 5.82 | 1.49 | 731.35 | 15.94 | 101.5751 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt2 | Bonnett-Geothermal Power Plant | 38.3988 | -113.0100 | -1380.2451 | -55.1514 | 1558.0 | 13.33 | 0.68 | 416.94 | 9.07 | 0.5090 | 0.0332 | 101.4372 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt3 | EXXON MOBIL CORPORATION -PICEANCE CREEK | 39.8938 | -108.1944 | -947.3331 | 46.6775 | 2286.0 | 8.87 | 0.31 | 480.88 | 27.71 | 100.9692 | 0.2369 | 0.9107 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt4 | PacifiCorp Lakeside Plant | 40.3286 | -111.7533 | -1238.4078 | 137.0846 | 1455.0 | 45.72 | 5.49 | 354.70 | 14.59 | 94.5011 | 2.6000 | 5.2000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt5 | Rubber Hose Manufacturing Facility | 39.7251 | -111.8108 | -1254.0202 | 72.0169 | 2072.0 | 20.85 | 0.89 | 466.75 | 11.86 | 16.9995 | 19.7272 | 58.0050 | 8.8735 | 0.0887 | 1.7747 | 0.0444 | 1.4198 | 5.5458 |
| nog_gr_pt6 | Pump Mesa C.S. | 36.7649 | -107.7321 | -949.1660 | -301.6611 | 1937.0 | 6.10 | 0.30 | 650.37 | 45.72 | 104.3924 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt7 | COLORADO INTERSTATE GAS CO GREASEWOOD | 39.9017 | -108.1912 | -946.9564 | 47.5111 | 2258.0 | 8.05 | 0.89 | 708.44 | 10.36 | 104.3283 | 0.1984 | 0.2444 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt8 | ExxonMobile, McElmo Creek Plant | 37.2601 | -109.2054 | -1071.3942 | -230.9270 | 1524.0 | 3.05 | 0.01 | 295.37 | 0.00 | 10.0315 | 95.1592 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt9 | Rattlesnake Compressor Station | 36.8606 | -107.7371 | -948.3579 | -291.0931 | 1950.0 | 13.72 | 0.21 | 836.29 | 45.69 | 105.4328 | 0.0000 | 0.0000 | 0.0108 | 0.0000 | 0.0065 | 0.0001 | 0.0022 | 0.0021 |
| nog_gr_pt10 | AMERICAN SODA LLP - PARACHUTE FACILITY | 39.4806 | -108.0855 | -943.7229 | 0.1980 | 2072.0 | 17.67 | 0.69 | 331.13 | 9.18 | 31.6495 | 0.2269 | 73.9851 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt11 | Santaquin Pit | 40.0350 | -111.6226 | -1232.7338 | 103.2619 | 2464.0 | 13.38 | 0.68 | 417.59 | 9.12 | 9.8284 | 1.6528 | 94.6782 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt12 | MOUNTAIN COAL CO. LLC (WEST ELK MINE) | 38.9242 | -107.4461 | -896.5934 | -67.3657 | 2499.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 0.0000 | 107.2450 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt13 | Petroleum Products Refining | 40.8675 | -111.9111 | -1241.7988 | 198.0520 | 1519.0 | 10.48 | 0.33 | 467.84 | 12.28 | 110.9724 | 1.8978 | 0.0393 | 0.2154 | 0.0011 | 0.1229 | 0.0013 | 0.0415 | 0.0486 |
| nog_gr_pt14 | NORTH OPERATIONS CENTER | 40.7654 | -111.9232 | -1244.6438 | 187.0751 | 1379.0 | 4.67 | 0.14 | 424.02 | 9.39 | 113.8439 | 0.0460 | 0.0192 | 0.0133 | 0.0000 | 0.0080 | 0.0001 | 0.0027 | 0.0026 |
| nog_gr_pt15 | CHEVRON USA _ PAINTER RESERVOIR EAST | 41.3112 | -110.8650 | -1147.9218 | 232.7738 | 2320.0 | 17.96 | 0.44 | 573.35 | 17.66 | 118.7083 | 0.2004 | 0.0505 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt16 | 32-7 CDP Compressor Station | 36.8794 | -107.6363 | -939.2527 | -290.0741 | 1968.0 | 6.71 | 0.30 | 699.93 | 45.55 | 120.2920 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt17 | SENECA COAL COMPANY | 40.4197 | -107.1255 | -850.8047 | 93.8619 | 2448.0 | 3.24 | 0.03 | 295.77 | 0.25 | 0.0000 | 0.0000 | 120.4384 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt18 | Western Fiberglass - Salt Lake City Plan | 40.7514 | -111.9941 | -1250.7578 | 186.5209 | 1295.0 | 13.83 | 0.88 | 326.27 | 17.96 | 22.9467 | 11.7111 | 8.0881 | 77.8267 | 1.5566 | 26.1503 | 0.4281 | 0.4281 | 49.2654 |
| nog_gr_pt19 | EL PASO NATURAL GAS CO FLORIDA RIVER CS | 37.1321 | -107.7943 | -949.8268 | -260.6673 | 2022.0 | 12.26 | 1.01 | 785.63 | 56.46 | 119.7083 | 0.4438 | 0.4792 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt20 | Power Plant | 40.6548 | -111.8072 | -1237.0396 | 173.4208 | 2728.0 | 14.65 | 0.80 | 641.66 | 31.01 | 117.8217 | 2.5244 | 0.3621 | 1.4376 | 0.1204 | 0.1804 | 0.0010 | 0.7728 | 0.3630 |
| nog_gr_pt21 | WILLIAMS FIELD SVCS PLA 9 STA | 37.0030 | -107.9233 | -962.8362 | -273.4910 | 2087.0 | 5.99 | 0.28 | 600.90 | 32.10 | 121.7839 | 0.3194 | 0.2589 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt22 | San Arroyo Plant | 39.4000 | -109.1247 | -1032.8740 | 2.6601 | 2133.0 | 8.48 | 0.38 | 713.93 | 32.92 | 122.5818 | 0.0740 | 0.0000 | 0.3776 | 0.0102 | 0.1723 | 0.0014 | 0.0815 | 0.1121 |
| nog_gr_pt23 | Altamont Main Gas Processing Plant | 40.3578 | -110.3272 | -1119.1334 | 121.7771 | 1961.0 | 10.87 | 0.35 | 636.86 | 26.55 | 119.7360 | 0.0000 | 0.2217 | 3.6949 | 0.0000 | 3.6949 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt24 | Altamont South Compressor Station | 40.2719 | -110.4350 | -1129.5193 | 113.7136 | 1905.0 | 9.31 | 0.34 | 661.88 | 12.68 | 118.5888 | 0.0000 | 0.1324 | 6.2017 | 0.0000 | 6.2017 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt25 | Pipe Casting Plant | 40.1978 | -111.6319 | -1230.6249 | 121.1587 | 2743.0 | 29.83 | 0.93 | 461.47 | 21.80 | 49.9748 | 45.0063 | 29.9824 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt26 | Detergent Manufacturing | 40.7292 | -111.9750 | -1249.5818 | 183.8358 | 1296.0 | 13.38 | 0.68 | 417.59 | 9.12 | 22.9210 | 0.0988 | 105.7784 | 3.8454 | 0.0000 | 0.0255 | 0.0135 | 0.1275 | 3.6789 |
| nog_gr_pt27 | CANYON GAS RESOURCES-FOUNDATION CREEK | 39.6734 | -108.7921 | -1000.7904 | 28.9075 | 2732.0 | 4.63 | 1.31 | 431.40 | 3.40 | 133.9353 | 0.2175 | 0.1511 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt28 | Gobernador - Manzanares Compressor Stati | 36.7610 | -107.6465 | -941.6807 | -302.9802 | 2011.0 | 12.19 | 0.61 | 677.59 | 45.72 | 134.8927 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt29 | CATALYST MANUFACTURE FACILITY | 40.7362 | -111.9590 | -1248.1319 | 184.3797 | 1302.0 | 10.61 | 0.14 | 306.30 | 390.51 | 112.3226 | 9.1839 | 5.4558 | 9.5689 | 0.0805 | 1.2949 | 0.0281 | 0.9342 | 7.2311 |
| nog_gr_pt30 | Bountiful Sanitary Landfill | 40.9101 | -111.9233 | -1242.0353 | 202.8679 | 1329.0 | 12.60 | 0.63 | 408.35 | 8.43 | 9.5887 | 0.9589 | 104.8061 | 24.1966 | 0.0895 | 1.3187 | 0.0266 | 0.0097 | 22.7523 |
| nog_gr_pt31 | NUCLEAR FUEL SERVICE | 37.6870 | -110.7160 | -1195.9429 | -165.3399 | 1354.0 | 11.28 | 0.30 | 422.04 | 26.36 | 115.1174 | 19.5702 | 1.4965 | 3.5917 | 2.6618 | 0.8060 | 0.0057 | 0.1182 | 0.0000 |
| nog_gr_pt32 | Plant #12 (Geneva Slag Operations) | 40.3139 | -111.7467 | -1238.1213 | 135.3903 | 1451.0 | 3.05 | 0.01 | 295.37 | 0.00 | 45.5870 | 4.3745 | 40.5401 | 50.1575 | 1.3565 | 11.1562 | 0.2492 | 17.9392 | 19.4560 |
| nog_gr_pt33 | Salt Lake Operations | 40.6668 | -112.0804 | -1259.4364 | 178.4828 | 1464.0 | 16.63 | 0.56 | 671.16 | 7.66 | 102.1764 | 0.9323 | 35.9618 | 6.8451 | 0.1399 | 2.5401 | 0.0372 | 0.2864 | 3.8414 |
| nog_gr_pt34 | Bloomfield Compressor Station | 36.7280 | -107.9481 | -968.6686 | -303.4362 | 1767.0 | 15.24 | 1.22 | 755.37 | 8.14 | 147.5257 | 0.0000 | 0.0867 | 0.1373 | 0.0000 | 0.0824 | 0.0008 | 0.0275 | 0.0267 |
| nog_gr_pt35 | WEST TEXAS - PICEANCE CREEK GP | 39.8981 | -108.1920 | -947.0726 | 47.1244 | 2264.0 | 7.59 | 0.31 | 731.33 | 41.10 | 148.8353 | 0.0975 | 0.0322 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt36 | NATURAL SODA, INC. | 39.9433 | -108.3882 | -962.9642 | 54.1459 | 2021.0 | 21.15 | 1.19 | 428.75 | 4.32 | 66.6264 | 0.2935 | 83.0324 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt37 | Pump Canyon Compressor Station | 36.7947 | -107.7330 | -948.8567 | -298.3771 | 1893.0 | 16.15 | 0.61 | 677.59 | 45.72 | 150.2030 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt38 | COLORADO INTERSTATE GAS_LARAMIE COMP STN | 41.4341 | -105.9348 | -740.0838 | 195.0456 | 2226.0 | 13.15 | 0.96 | 684.62 | 19.48 | 153.4812 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt39 | Middle Mesa CDP | 36.7649 | -107.7321 | -949.1660 | -301.6611 | 1937.0 | 6.71 | 0.30 | 644.82 | 45.72 | 155.0869 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt40 | CLIMAX MINE / MILL | 39.3681 | -106.1834 | -783.6586 | -30.2427 | 4206.0 | 16.04 | 1.13 | 287.08 | 18.52 | 14.1050 | 0.0507 | 143.7881 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt41 | CANYON GAS RESOURCES - RIFLE C.S. | 39.5310 | -107.8298 | -921.3967 | 3.1064 | 1660.0 | 4.97 | 0.19 | 498.86 | 21.05 | 159.8956 | 0.0598 | 0.0494 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt42 | Thompson Compressor Station | 36.8312 | -107.9954 | -971.4549 | -291.5947 | 1798.0 | 10.40 | 0.35 | 643.22 | 35.21 | 163.0152 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt43 | Bluffview Power Plant | 36.7143 | -108.2144 | -992.2987 | -302.0679 | 1733.0 | 21.34 | 3.96 | 368.71 | 11.31 | 99.1012 | 11.2000 | 0.0000 | 56.9991 | 0.0000 | 34.2002 | 0.3135 | 11.4002 | 11.0866 |
| nog_gr_pt44 | Steel Manufacturing Facility | 40.2909 | -111.7049 | -1235.0523 | 132.3112 | 1470.0 | 28.90 | 2.86 | 438.91 | 14.68 | 72.5095 | 75.6516 | 11.8921 | 7.9719 | 0.0558 | 0.5420 | 0.0102 | 0.0632 | 7.3008 |
| nog_gr_pt45 | MOFFAT COUNTY ROAD DEPARTMENT | 40.6372 | -107.6292 | -890.1328 | 122.5863 | 2134.0 | 12.95 | 0.84 | 316.48 | 13.11 | 0.0000 | 0.0000 | 171.2288 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt46 | East Carbon Landfill | 39.5316 | -110.4594 | -1143.6357 | 33.0510 | 1898.0 | 5.22 | 0.15 | 321.03 | 1.91 | 124.2102 | 12.8183 | 24.6094 | 11.7984 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 11.7984 |
| nog_gr_pt47 | ARCH OF WY_MEDICINE BOW MINE | 41.7038 | -106.9229 | -818.3677 | 233.2067 | 2073.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 0.0000 | 112.9164 | 60.6630 | 0.8917 | 3.8278 | 0.1638 | 8.5290 | 47.2493 |
| nog_gr_pt48 | Main Campus | 40.2469 | -111.6469 | -1231.0041 | 126.7215 | 2621.0 | 41.95 | 2.50 | 470.59 | 3.22 | 73.8389 | 99.7577 | 0.1983 | 0.5628 | 0.1230 | 0.1636 | 0.0023 | 0.0763 | 0.1975 |
| nog_gr_pt49 | CLIMAX MOLYBDENUM AMAX HENDERSON MILL | 39.8457 | -106.0796 | -769.5631 | 21.4135 | 3048.0 | 5.68 | 0.22 | 294.36 | 6.92 | 56.7028 | 46.9755 | 74.0013 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt50 | QUESTAR GAS MANAGEMENT COMPANY | 40.9494 | -108.3138 | -942.8881 | 163.7744 | 2072.0 | 8.77 | 0.22 | 801.12 | 39.87 | 180.2587 | 0.0707 | 0.0932 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt51 | RADIOACTIVE MATERIAL DISPOSAL SITE | 40.6881 | -113.1137 | -1344.4398 | 195.6078 | 1407.0 | 3.05 | 0.01 | 295.37 | 0.00 | 130.8095 | 13.0428 | 35.2800 | 13.7176 | 5.7625 | 2.1647 | 0.0191 | 0.4069 | 5.3643 |
| nog_gr_pt52 | PacifiCorp Currant Creek Plant | 39.8195 | -111.8926 | -1259.1812 | 83.4473 | 1537.0 | 50.29 | 5.12 | 369.26 | 15.56 | 127.0018 | 7.3000 | 59.3019 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt53 | TWENTYMILE COAL CO.- FOIDEL CREEK | 40.3458 | -107.0750 | -847.4831 | 85.2674 | 2316.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 0.0000 | 193.9744 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt54 | El Cedro Gas Plant | 36.7379 | -107.6233 | -939.9361 | -305.7591 | 2072.0 | 7.83 | 1.45 | 731.98 | 26.88 | 195.3046 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt55 | Gadsby Power Plant | 40.7670 | -111.9288 | -1245.0777 | 187.3265 | 1377.0 | 70.44 | 3.11 | 434.21 | 23.79 | 173.9098 | 2.4996 | 17.5823 | 1.3201 | 0.0222 | 0.7808 | 0.0071 | 0.2590 | 0.2509 |
| nog_gr_pt56 | TRI-STATE GENERATION & TRANS.-RIFLE STAT | 39.5184 | -107.7191 | -912.1862 | 0.6062 | 1752.0 | 15.94 | 3.23 | 358.85 | 21.54 | 189.5187 | 0.8442 | 8.5773 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt57 | Main Base | 41.1170 | -111.9769 | -1242.7007 | 226.1812 | 1507.0 | 13.23 | 0.70 | 414.21 | 8.85 | 143.1693 | 2.6422 | 36.2522 | 18.3977 | 1.1753 | 1.7318 | 0.0272 | 4.6003 | 10.8631 |
| nog_gr_pt58 | OLDCASTLE SW GROUP DBA UNITED CO OF MESA | 38.9307 | -108.2699 | -966.8621 | -58.2059 | 2236.0 | 4.50 | 0.19 | 307.64 | 1.00 | 9.6743 | 10.2021 | 183.7948 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt59 | AE STALEY MFG CO | 37.5839 | -106.0944 | -795.8004 | -227.3137 | 2311.0 | 6.70 | 0.36 | 305.98 | 18.98 | 36.1233 | 126.7156 | 47.8595 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt60 | UMETCO MINERALS CORP | 38.6595 | -108.6331 | -1001.6820 | -84.0209 | 2750.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 0.0000 | 212.1614 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt61 | COLORADO INTERSTATE GAS_RAWLINS COMP | 41.7542 | -107.0551 | -828.6104 | 239.9496 | 2011.0 | 9.56 | 0.72 | 655.62 | 33.44 | 215.8242 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt62 | La Jara Compressor Station | 36.7066 | -107.9786 | -971.6395 | -305.4616 | 1707.0 | 6.91 | 0.75 | 691.02 | 49.31 | 218.3753 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt63 | AMERICAN GYPSUM COMPANY | 39.6506 | -106.9357 | -844.2010 | 7.5592 | 2092.0 | 13.94 | 0.72 | 501.50 | 12.04 | 148.4941 | 0.4082 | 69.9832 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt64 | Grantsville Plant | 40.7000 | -112.5750 | -1299.7178 | 189.0671 | 1281.0 | 16.74 | 1.35 | 439.44 | 5.36 | 87.1885 | 6.2775 | 98.3092 | 33.5972 | 0.3925 | 1.6846 | 0.0721 | 3.7916 | 27.6567 |
| nog_gr_pt65 | Geneva Nitrogen Plant | 40.3183 | -111.7350 | -1237.0690 | 135.7112 | 1496.0 | 21.13 | 2.23 | 420.07 | 13.60 | 173.6273 | 0.0115 | 27.2946 | 25.6603 | 0.0282 | 0.2204 | 18.3667 | 0.0416 | 7.0030 |
| nog_gr_pt66 | Delta Mill | 39.5000 | -112.4160 | -1308.9814 | 56.0045 | 1471.0 | 12.59 | 1.01 | 478.44 | 2.86 | 39.4967 | 166.1962 | 14.0231 | 9.3067 | 0.3552 | 0.4196 | 0.0221 | 1.8349 | 6.6748 |
| nog_gr_pt67 | SENECA COAL CO | 40.3886 | -107.1920 | -856.7540 | 91.0686 | 2377.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 0.0000 | 232.6156 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt68 | Riverbend Field | 40.1008 | -109.7070 | -1071.3624 | 86.1717 | 1463.0 | 3.05 | 0.01 | 295.37 | 0.00 | 55.6264 | 0.2697 | 29.2635 | 148.0836 | 0.0000 | 148.0836 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt69 | Moab Compressor Station | 38.3264 | -109.4266 | -1074.6154 | -111.4665 | 2023.0 | 11.36 | 0.52 | 704.36 | 3.60 | 236.2033 | 0.0000 | 0.0186 | 0.0927 | 0.0000 | 0.0556 | 0.0005 | 0.0185 | 0.0180 |
| nog_gr_pt70 | Brick Manufacturing Plant | 40.5943 | -112.0298 | -1256.5694 | 169.8730 | 1411.0 | 21.09 | 1.77 | 369.94 | 10.92 | 32.0769 | 79.0940 | 119.3620 | 9.7969 | 0.0308 | 0.4440 | 0.0098 | 0.0189 | 9.2936 |
| nog_gr_pt71 | Desert Power Plant | 40.9133 | -112.7344 | -1308.8222 | 214.6005 | 1280.0 | 12.19 | 3.73 | 779.26 | 7.92 | 240.3598 | 1.1588 | 0.0683 | 0.0864 | 0.0000 | 0.0519 | 0.0005 | 0.0173 | 0.0168 |
| nog_gr_pt72 | SENECA COAL CO SENECA II W | 40.3841 | -107.2425 | -861.0372 | 91.0513 | 2432.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 0.0000 | 251.0324 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt73 | Point of the Mountain Facility | 40.5008 | -111.9077 | -1248.1422 | 157.9888 | 1447.0 | 9.48 | 0.74 | 412.17 | 7.53 | 74.6563 | 70.3699 | 81.4168 | 27.0485 | 0.1277 | 0.6836 | 0.0230 | 1.3559 | 24.8585 |
| nog_gr_pt74 | BP AMERICA PRODUCTION CO. [MISC. ENGINES | 37.0147 | -107.8103 | -952.7695 | -273.3967 | 2161.0 | 10.94 | 0.68 | 294.26 | 15.11 | 270.0599 | 0.2161 | 0.1657 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt75 | Hazardous Waste Storage/Incineration | 40.7344 | -112.9680 | -1331.5141 | 198.5045 | 1915.0 | 13.38 | 0.68 | 417.59 | 9.12 | 212.2137 | 63.8720 | 4.4096 | 1.9628 | 0.0637 | 0.1819 | 0.0058 | 0.1897 | 1.5217 |
| nog_gr_pt76 | COLORADO LIME COMPANY DBA CALCO | 38.5368 | -105.9874 | -776.0636 | -123.3819 | 2635.0 | 8.58 | 1.27 | 435.34 | 9.79 | 91.6477 | 120.5529 | 83.2927 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt77 | WILLIAMS PROD. RMT CORP. - PARACHUTE | 39.4856 | -108.1088 | -945.6292 | 0.9890 | 2255.0 | 3.20 | 0.03 | 306.03 | 0.67 | 293.4218 | 0.7647 | 2.5132 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt78 | EL PASO NATURAL GAS CO BONDAD COMP STA | 37.0849 | -107.8218 | -952.8555 | -265.5644 | 2237.0 | 10.00 | 1.46 | 693.40 | 3.52 | 299.8110 | 0.6911 | 0.7462 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt79 | Payson City Power | 40.0439 | -111.7377 | -1242.1934 | 105.8006 | 1420.0 | 11.58 | 0.67 | 649.03 | 12.45 | 296.7873 | 5.1056 | 0.1731 | 2.8557 | 0.2482 | 0.3070 | 0.0014 | 1.5717 | 0.7273 |
| nog_gr_pt80 | AMERICAN SODA LLP - PICEANCE FACILITY | 39.9522 | -108.2969 | -955.1620 | 54.1589 | 1986.0 | 30.31 | 1.78 | 364.04 | 20.23 | 116.3083 | 1.8210 | 196.9203 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt81 | Milagro Gas Plant | 36.7066 | -107.9786 | -971.6395 | -305.4616 | 1707.0 | 21.47 | 2.61 | 451.69 | 20.02 | 303.2506 | 0.0000 | 1.5296 | 22.0032 | 0.0000 | 20.9997 | 0.0138 | 0.5017 | 0.4879 |
| nog_gr_pt82 | Shale Processing | 40.7558 | -111.4027 | -1201.7707 | 179.0210 | 2072.0 | 13.38 | 0.68 | 417.59 | 9.12 | 182.4562 | 121.8644 | 19.3572 | 14.1428 | 0.0786 | 1.5729 | 0.0393 | 1.2929 | 11.1590 |
| nog_gr_pt83 | BOWIE RESOURCES, LLC - BOWIE NO 2 MINE | 38.9316 | -107.5474 | -905.1544 | -65.5488 | 2276.0 | 16.41 | 0.57 | 294.39 | 8.40 | 0.0000 | 0.0000 | 352.1651 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt84 | Salt Lake Valley Landfill & Transfer Sta | 40.7403 | -112.0319 | -1254.0843 | 185.8307 | 1290.0 | 13.38 | 0.68 | 417.59 | 9.12 | 0.5483 | 0.0360 | 270.0287 | 89.4968 | 0.3348 | 4.8170 | 0.0971 | 0.0424 | 84.2049 |
| nog_gr_pt85 | NORTHWEST PIPELINE CORP RANGELY STA | 40.0489 | -108.7731 | -993.8228 | 69.8726 | 1828.0 | 4.33 | 0.59 | 672.04 | 11.15 | 405.9424 | 0.9500 | 0.0777 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt86 | Kastler/Marushack Compressor Station | 40.9958 | -109.2110 | -1016.5390 | 178.5372 | 2256.0 | 13.93 | 0.62 | 672.36 | 34.78 | 484.6239 | 0.0000 | 0.0000 | 0.1678 | 0.0000 | 0.1007 | 0.0009 | 0.0336 | 0.0326 |
| nog_gr_pt87 | County Landfill & Energy Recovery Facili | 41.0824 | -111.9812 | -1243.6824 | 222.4639 | 1419.0 | 36.87 | 1.18 | 483.55 | 22.71 | 408.7430 | 45.0505 | 24.7416 | 11.6990 | 0.1300 | 6.6009 | 0.0113 | 0.1169 | 10.8398 |
| nog_gr_pt88 | Flying J Refinery (Big West Oil Co.) | 40.8647 | -111.9066 | -1241.4780 | 197.6849 | 1553.0 | 20.50 | 0.76 | 760.60 | 14.32 | 316.7364 | 261.4133 | 0.3288 | 4.0960 | 0.0226 | 8.8019 | 0.0090 | 1.6061 | 1.6564 |
| nog_gr_pt89 | ChevronTexaco, Aneth Natural Gas Process | 37.2577 | -109.3273 | -1082.0651 | -229.7458 | 1402.0 | 3.05 | 0.01 | 295.37 | 0.00 | 324.4780 | 260.5001 | 0.0875 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt90 | TRAPPER MINING INC | 40.4215 | -107.5823 | -888.9948 | 98.4324 | 2316.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 0.0000 | 597.7207 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt91 | BP AMERICA _ ANSCHUTZ RANCH EAST | 41.0736 | -111.0403 | -1166.3659 | 209.0263 | 2240.0 | 15.31 | 3.32 | 552.93 | 18.41 | 654.1501 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt92 | San Juan Refinery (Bloomfield) | 36.6997 | -107.9741 | -971.3351 | -306.2677 | 1723.0 | 29.33 | 1.23 | 648.29 | 6.23 | 233.5747 | 475.9683 | 0.1616 | 1.0607 | 0.0011 | 0.1374 | 0.0052 | 0.4695 | 0.4476 |
| nog_gr_pt93 | UNION PAC_BRADY | 41.3854 | -108.7437 | -972.3033 | 216.1567 | 2316.0 | 17.30 | 0.56 | 743.17 | 19.27 | 537.9226 | 181.1999 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt94 | ENCANA OIL & GAS (USA), INC-DRAGON TRAIL | 39.8300 | -108.8089 | -999.9644 | 46.2628 | 1950.0 | 7.12 | 0.33 | 658.49 | 22.08 | 718.9993 | 0.4631 | 0.2854 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt95 | U.S. Army-Dugway Proving Ground | 40.1769 | -112.9377 | -1339.7718 | 137.3471 | 1331.0 | 13.38 | 0.68 | 417.59 | 9.12 | 16.2163 | 27.6292 | 715.9273 | 114.2392 | 0.2220 | 1.4730 | 0.0251 | 2.2225 | 110.2972 |

**Table D-2 CALPUFF Model Inputs: 2018 Non-Project Point Sources Greater Than 100 TPY**

| Source ID | Plant Name | Latitude | Longitude | LCC_X | LCC_Y | Base Elev (m) | Stk Ht (m) | Stk Dm (m) | Stk Tmp (K) | Stk Vel (m/s) | NOX (TPY) | SO2(TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog_gr_pt96 | Chevron USA - Whitney Canyon/Carter Cree | 41.2890 | -110.5580 | -1123.0606 | 226.5094 | 2266.0 | 3.05 | 0.01 | 295.37 | 0.00 | 0.0000 | 876.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt97 | Phillips Refinery | 40.8860 | -111.9000 | -1240.5487 | 199.9194 | 1516.0 | 24.48 | 1.10 | 671.68 | 20.06 | 304.2130 | 566.9973 | 2.0375 | 3.9107 | 0.0000 | 2.0761 | 0.0215 | 0.9236 | 0.8895 |
| nog_gr_pt98 | Valverde Gas Plant | 36.7317 | -107.9563 | -969.3414 | -302.9423 | 1767.0 | 18.56 | 1.09 | 643.11 | 6.53 | 835.8156 | 0.0000 | 49.2303 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt99 | Rowley Plant | 40.9141 | -112.7318 | -1308.5929 | 214.6503 | 1280.0 | 44.66 | 1.85 | 341.82 | 11.64 | 540.5286 | 37.2827 | 364.0036 | 0.3470 | 0.0000 | 0.2082 | 0.0019 | 0.0694 | 0.0675 |
| nog_gr_pt100 | Kutz Gas Plant | 36.7066 | -107.9786 | -971.6395 | -305.4616 | 1707.0 | 7.97 | 0.70 | 662.11 | 32.39 | 969.7685 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt101 | San Juan Plant Gas Plant | 36.7314 | -107.9596 | -969.6359 | -302.9401 | 1767.0 | 13.12 | 2.39 | 602.39 | 16.59 | 1005.4961 | 38.2566 | 0.2948 | 0.5452 | 0.0000 | 0.3271 | 0.0030 | 0.1090 | 0.1060 |
| nog_gr_pt102 | San Juan River Gas Plant | 36.7591 | -108.3652 | -1004.9546 | -295.4914 | 1645.0 | 47.40 | 0.73 | 719.67 | 11.77 | 370.5377 | 734.7961 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt103 | WILLIAMS FIELD SERVICES IGNACIO B PLT | 37.1422 | -107.7851 | -948.8888 | -259.6539 | 2013.0 | 10.53 | 1.20 | 698.06 | 25.22 | 1172.8311 | 1.2958 | 1.9576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt104 | Sunnyside Cogeneration Facility | 39.5472 | -110.3916 | -1137.6634 | 33.9061 | 2452.0 | 73.89 | 2.52 | 421.89 | 27.06 | 442.4847 | 715.2940 | 31.0459 | 31.4343 | 0.9149 | 1.6685 | 0.0673 | 4.7550 | 24.0288 |
| nog_gr_pt105 | COLOWYO COAL CO | 40.2656 | -107.8083 | -909.9377 | 83.5467 | 2195.0 | 8.44 | 0.15 | 295.14 | 1.95 | 0.0000 | 0.0000 | 1288.3802 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt106 | Salt Lake City Refinery | 40.7915 | -111.9028 | -1242.4863 | 189.6443 | 1767.0 | 51.90 | 1.89 | 529.79 | 11.75 | 550.7843 | 717.7626 | 55.4321 | 10.1863 | 0.4632 | 2.5106 | 0.0284 | 4.4173 | 2.7668 |
| nog_gr_pt107 | SOLVAY MINERALS, INC. | 41.5093 | -109.6086 | -1041.5711 | 239.3285 | 2026.0 | 52.06 | 2.36 | 619.65 | 17.07 | 1110.7947 | 23.8234 | 229.9132 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt108 | Blanco Compressor Station - A,C,D Plants | 36.7315 | -107.9608 | -969.7402 | -302.9163 | 1767.0 | 12.83 | 1.48 | 536.74 | 26.63 | 1381.9612 | 1.4778 | 0.6970 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt109 | Future Coal EGU (NEVCO Energy Co.) | 38.7590 | -111.7870 | -1269.3277 | -33.7216 | 2474.0 | 3.05 | 0.01 | 295.37 | 0.00 | 1005.2100 | 226.1358 | 154.8038 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt110 | P4 PRODUCTION_ROCK SPRINGS FACILITY | 41.5498 | -109.2249 | -1009.4678 | 239.4389 | 2073.0 | 37.60 | 0.95 | 1202.15 | 7.32 | 303.8370 | 1007.5460 | 81.8668 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt111 | Salt Lake Refinery | 40.8434 | -111.9184 | -1242.8370 | 195.5216 | 1706.0 | 46.20 | 1.14 | 602.26 | 6.03 | 695.7515 | 1267.7080 | 70.8107 | 4.7976 | 0.6944 | 1.1289 | 0.0077 | 1.4776 | 1.4891 |
| nog_gr_pt112 | Devil's Slide Plant | 41.0511 | -111.5338 | -1207.4146 | 213.0130 | 1951.0 | 76.62 | 2.93 | 508.39 | 8.69 | 1746.0140 | 83.0010 | 359.6855 | 60.9178 | 1.8438 | 2.5868 | 0.2955 | 18.9875 | 37.2041 |
| nog_gr_pt113 | Smelter & Refinery | 40.7172 | -112.1996 | -1268.3706 | 185.6382 | 1608.0 | 300.71 | 6.03 | 340.28 | 10.45 | 263.8168 | 1690.1071 | 73.1245 | 291.8308 | 0.8234 | 8.3373 | 0.2723 | 9.0426 | 273.3551 |
| nog_gr_pt114 | Lisbon Natural Gas Processing Plant | 37.1500 | -109.0500 | -1059.4440 | -244.8207 | 1494.0 | 57.99 | 1.64 | 728.35 | 0.60 | 269.3469 | 2118.6060 | 6.1720 | 0.8449 | 0.0000 | 0.7751 | 0.0010 | 0.0349 | 0.0339 |
| nog_gr_pt115 | Chaco Gas Plant | 36.7066 | -107.9786 | -971.6395 | -305.4616 | 1707.0 | 16.44 | 1.63 | 672.38 | 35.39 | 2505.4674 | 3.7563 | 0.1119 | 0.2456 | 0.0000 | 0.1894 | 0.0008 | 0.0281 | 0.0273 |
| nog_gr_pt116 | Leamington Cement Plant | 39.5625 | -112.1972 | -1289.4274 | 59.6894 | 1746.0 | 28.70 | 4.57 | 380.42 | 10.15 | 2345.5821 | 2.9287 | 29.9552 | 196.1980 | 1.6821 | 16.5628 | 0.5644 | 18.6365 | 158.7532 |
| nog_gr_pt117 | Simplot Phosphates | 41.5378 | -109.1282 | -1001.7072 | 237.0528 | 2014.0 | 58.79 | 0.52 | 323.30 | 6.65 | 175.6384 | 2370.3865 | 78.9787 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt118 | Cricket Mountain Plant | 38.9439 | -112.8252 | -1354.0327 | 1.4187 | 1453.0 | 45.32 | 1.88 | 446.91 | 16.95 | 1880.9957 | 460.5816 | 124.1804 | 272.3829 | 3.6708 | 15.7566 | 0.6742 | 35.2339 | 217.0502 |
| nog_gr_pt119 | Mine & Copperton Concentrator | 40.5333 | -112.1500 | -1267.6454 | 164.8882 | 2077.0 | 13.44 | 0.68 | 417.31 | 9.12 | 3.1004 | 5.0000 | 2498.2702 | 510.3927 | 1.2791 | 39.4447 | 0.3815 | 31.3415 | 437.9437 |
| nog_gr_pt120 | TRI STATE GENERATION NUCLA | 38.2418 | -108.5088 | -996.8702 | -131.2010 | 1831.0 | 64.22 | 3.57 | 413.69 | 22.10 | 1759.8051 | 1359.8093 | 108.8756 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt121 | BLACK BUTTE COAL CO- BLACK BUTTE MINE | 41.5730 | -108.6950 | -965.6293 | 236.2260 | 2073.0 | 15.85 | 1.52 | 370.93 | 37.49 | 0.0000 | 0.0000 | 2517.5510 | 1049.5575 | 15.4286 | 66.2256 | 2.8338 | 147.5659 | 817.4905 |
| nog_gr_pt122 | Power Plt/ Lab/ Tailings Impoundment | 40.7000 | -112.1166 | -1261.8237 | 182.6066 | 1329.0 | 44.73 | 3.62 | 419.60 | 5.43 | 2054.2367 | 1958.7973 | 147.6053 | 88.9765 | 0.9297 | 9.7717 | 0.2556 | 8.0565 | 69.9629 |
| nog_gr_pt123 | Carbon Power Plant | 39.7269 | -110.8641 | -1174.4778 | 59.5640 | 2499.0 | 52.34 | 3.80 | 435.55 | 23.43 | 3367.4171 | 6978.8154 | 134.5813 | 86.1894 | 0.8720 | 16.4152 | 0.4131 | 13.3942 | 55.0946 |
| nog_gr_pt124 | PUBLIC SERVICE CO HAYDEN PLT | 40.4880 | -107.1996 | -856.1589 | 102.0646 | 2012.0 | 140.37 | 5.55 | 419.53 | 20.51 | 7313.2421 | 2969.8540 | 309.8479 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt125 | BONANZA POWER PLANT | 40.0908 | -109.2902 | -1036.5881 | 80.2422 | 1585.0 | 182.88 | 7.92 | 420.94 | 15.24 | 8407.6210 | 1649.5514 | 326.1056 | 562.7920 | 5.6352 | 112.5373 | 2.8136 | 90.0620 | 351.7307 |
| nog_gr_pt126 | Huntington Power Plant | 39.3802 | -111.0767 | -1198.2591 | 24.4563 | 2377.0 | 180.55 | 7.22 | 399.81 | 19.32 | 8574.1388 | 4048.6464 | 249.0823 | 405.2185 | 4.1196 | 77.9403 | 1.9621 | 63.2962 | 257.9014 |
| nog_gr_pt127 | TRI STATE GENERATION CRAIG | 40.4974 | -107.6264 | -891.7033 | 107.2019 | 1951.0 | 182.45 | 7.61 | 419.23 | 22.20 | 16821.1502 | 4036.7800 | 445.9507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| nog_gr_pt128 | NAVAJO GENERATING STATION | 36.9050 | -111.3892 | -1267.8017 | -241.6894 | 1402.0 | 142.65 | 5.58 | 420.93 | 20.93 | 10610.6230 | 8565.9660 | 0.0000 | 2929.0155 | 29.2902 | 585.7995 | 14.6449 | 468.6418 | 1830.6210 |
| nog_gr_pt129 | Hunter Power Plant | 39.1436 | -111.0277 | -1198.1434 | -2.0382 | 1768.0 | 181.74 | 7.27 | 417.23 | 19.96 | 16503.4019 | 6493.4834 | 553.2928 | 495.5327 | 5.1323 | 94.3790 | 2.3937 | 78.2897 | 315.3345 |
| nog_gr_pt130 | San Juan Generating Station | 36.8318 | -108.4608 | -1012.3514 | -286.4490 | 1655.0 | 120.47 | 7.53 | 418.19 | 28.75 | 19822.6464 | 11102.3522 | 326.1247 | 396.9375 | 3.9694 | 79.3871 | 1.9847 | 63.5093 | 248.0832 |
| nog_gr_pt131 | Intermountain Generation Station | 39.4391 | -112.6557 | -1330.2886 | 52.8496 | 1412.0 | 179.28 | 7.02 | 398.92 | 21.57 | 28210.8669 | 6923.8351 | 713.1262 | 205.9197 | 2.1957 | 40.8102 | 1.0351 | 32.6791 | 129.2015 |
| nog_gr_pt132 | Four Corners Power Plant | 36.7006 | -108.4746 | -1015.3921 | -300.6979 | 1645.0 | 115.32 | 8.64 | 417.04 | 24.26 | 17513.1544 | 18386.4505 | 1689.6215 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

**Table D-3 CALPUFF Model Inputs: 2018 Non-Project Area Sources (State, Motor Vehicle and Nonroad Sources)**

| name | Grid Cell | X1 (km) | X2 (km) | X3 (km) | X4 (km) | Y1 (km) | Y2 (km) | Y3 (km) | Y4 (km) | Base Elevation (m) | Grid Cell Area (km2) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog-mg-n-area1 | 0 | -1392.0 | -1392.0 | -1320.0 | -1320.0 | -312.0 | -240.0 | -240.0 | -312.0 | 1592.0 | 5184.0 | 53.6912 | 3.1472 | 100.7607 | 16.7476 | 1.6561 | 3.2455 | 0.0000 | 0.0260 | 0.4889 |
| nog-mg-n-area2 | 2 | -1392.0 | -1392.0 | -1356.0 | -1356.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1451.0 | 1296.0 | 86.3398 | 16.4091 | 266.3005 | 61.6619 | 0.8325 | 1.0120 | 0.0000 | 0.0482 | 0.8738 |
| nog-mg-n-area3 | 3 | -1392.0 | -1392.0 | -1356.0 | -1356.0 | -204.0 | -168.0 | -168.0 | -204.0 | 1867.0 | 1296.0 | 43.5360 | 13.4430 | 67.5546 | 10.5229 | 0.3161 | 0.3689 | 0.0000 | 0.0270 | 0.4972 |
| nog-mg-n-area4 | 4 | -1392.0 | -1392.0 | -1356.0 | -1356.0 | -168.0 | -132.0 | -132.0 | -168.0 | 1963.0 | 1296.0 | 47.7887 | 41.9768 | 46.8299 | 9.5490 | 0.4474 | 0.6987 | 0.0000 | 0.0172 | 0.3047 |
| nog-mg-n-area5 | 5 | -1392.0 | -1392.0 | -1356.0 | -1356.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2998.0 | 1296.0 | 296.8084 | 59.1060 | 464.7435 | 90.4180 | 2.6019 | 2.6233 | 0.0000 | 0.1749 | 2.9019 |
| nog-mg-n-area6 | 6 | -1392.0 | -1392.0 | -1320.0 | -1320.0 | -96.0 | -24.0 | -24.0 | -96.0 | 1948.0 | 5184.0 | 603.5845 | 171.8530 | 986.2444 | 202.9564 | 10.5910 | 16.5222 | 0.0000 | 0.2934 | 4.9102 |
| nog-mg-n-area7 | 8 | -1392.0 | -1392.0 | -1320.0 | -1320.0 | -24.0 | 48.0 | 48.0 | -24.0 | 1828.0 | 5184.0 | 239.9586 | 66.4851 | 1360.2873 | 265.0579 | 3.1878 | 2.4572 | 0.0000 | 0.1034 | 1.7600 |
| nog-mg-n-area8 | 10 | -1392.0 | -1392.0 | -1320.0 | -1320.0 | 48.0 | 120.0 | 120.0 | 48.0 | 1933.0 | 5184.0 | 40.3245 | 44.6220 | 355.2201 | 62.3078 | 0.6109 | 0.5473 | 0.0000 | 0.0037 | 0.0500 |
| nog-mg-n-area9 | 12 | -1392.0 | -1392.0 | -1320.0 | -1320.0 | 120.0 | 192.0 | 192.0 | 120.0 | 1299.0 | 5184.0 | 25.3344 | 29.2512 | 81.9419 | 9.0906 | 0.1357 | 0.1951 | 0.0000 | 0.0066 | 0.0896 |
| nog-mg-n-area10 | 14 | -1392.0 | -1392.0 | -1320.0 | -1320.0 | 192.0 | 240.0 | 240.0 | 192.0 | 1283.0 | 3456.0 | 322.8090 | 6.8658 | 112.9576 | 24.1154 | 2.8002 | 3.3889 | 0.0000 | 0.2125 | 3.5853 |
| nog-mg-n-area11 | 18 | -1356.0 | -1356.0 | -1320.0 | -1320.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1901.0 | 1296.0 | 38.8370 | 5.0936 | 55.6451 | 9.9641 | 0.4597 | 0.7006 | 0.0000 | 0.0253 | 0.4782 |
| nog-mg-n-area12 | 19 | -1356.0 | -1356.0 | -1320.0 | -1320.0 | -204.0 | -168.0 | -168.0 | -204.0 | 1768.0 | 1296.0 | 8.2848 | 8.6842 | 41.1112 | 6.1417 | 0.1093 | 0.1313 | 0.0000 | 0.0010 | 0.0139 |
| nog-mg-n-area13 | 20 | -1356.0 | -1356.0 | -1320.0 | -1320.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2116.0 | 1296.0 | 62.5814 | 16.1269 | 49.6715 | 9.3407 | 1.0618 | 1.8239 | 0.0000 | 0.0351 | 0.6796 |
| nog-mg-n-area14 | 21 | -1356.0 | -1356.0 | -1320.0 | -1320.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2560.0 | 1296.0 | 86.2591 | 24.3525 | 129.6861 | 23.8216 | 1.3385 | 2.0387 | 0.0000 | 0.0467 | 0.8993 |
| nog-mg-n-area15 | 32 | -1320.0 | -1320.0 | -1248.0 | -1248.0 | -312.0 | -240.0 | -240.0 | -312.0 | 1552.0 | 5184.0 | 269.4213 | 10.1921 | 729.2426 | 146.9919 | 3.5502 | 5.2224 | 0.0000 | 0.1647 | 2.9401 |
| nog-mg-n-area16 | 34 | -1320.0 | -1320.0 | -1284.0 | -1284.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1984.0 | 1296.0 | 31.7584 | 4.8288 | 39.6063 | 6.7189 | 0.3600 | 0.5570 | 0.0000 | 0.0207 | 0.3879 |
| nog-mg-n-area17 | 35 | -1320.0 | -1320.0 | -1284.0 | -1284.0 | -204.0 | -168.0 | -168.0 | -204.0 | 1673.0 | 1296.0 | 8.7926 | 6.9561 | 13.9760 | 1.5522 | 0.0894 | 0.1420 | 0.0000 | 0.0031 | 0.0580 |
| nog-mg-n-area18 | 36 | -1320.0 | -1320.0 | -1284.0 | -1284.0 | -168.0 | -132.0 | -132.0 | -168.0 | 1885.0 | 1296.0 | 17.4615 | 8.9591 | 56.0440 | 9.4360 | 0.9728 | 1.8857 | 0.0000 | 0.0025 | 0.0468 |
| nog-mg-n-area19 | 37 | -1320.0 | -1320.0 | -1284.0 | -1284.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2397.0 | 1296.0 | 22.3613 | 12.0793 | 69.2486 | 12.4657 | 1.5531 | 3.0725 | 0.0000 | 0.0009 | 0.0138 |
| nog-mg-n-area20 | 38 | -1320.0 | -1320.0 | -1284.0 | -1284.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2189.0 | 1296.0 | 173.9483 | 21.9406 | 182.6608 | 52.9537 | 18.1085 | 38.6951 | 0.0000 | 0.0163 | 0.2986 |
| nog-mg-n-area21 | 39 | -1320.0 | -1320.0 | -1284.0 | -1284.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2142.0 | 1296.0 | 322.0667 | 226.5219 | 661.7166 | 133.2579 | 4.3647 | 6.5292 | 0.0000 | 0.1138 | 1.8114 |
| nog-mg-n-area22 | 40 | -1320.0 | -1320.0 | -1248.0 | -1248.0 | -24.0 | 48.0 | 48.0 | -24.0 | 2341.0 | 5184.0 | 682.9392 | 278.2939 | 1766.1389 | 353.1477 | 6.8655 | 7.0890 | 0.0000 | 0.3208 | 5.5100 |
| nog-mg-n-area23 | 42 | -1320.0 | -1320.0 | -1248.0 | -1248.0 | 48.0 | 120.0 | 120.0 | 48.0 | 1464.0 | 5184.0 | 573.3788 | 157.9060 | 1713.5582 | 340.1046 | 5.2976 | 4.6892 | 0.0000 | 0.3267 | 5.6209 |
| nog-mg-n-area24 | 44 | -1320.0 | -1320.0 | -1248.0 | -1248.0 | 120.0 | 192.0 | 192.0 | 120.0 | 1856.0 | 5184.0 | 5963.1564 | 277.7346 | 4367.1014 | 979.0101 | 127.6603 | 78.7171 | 0.0000 | 1.8361 | 28.5227 |
| nog-mg-n-area25 | 46 | -1320.0 | -1320.0 | -1248.0 | -1248.0 | 192.0 | 240.0 | 240.0 | 192.0 | 1291.0 | 3456.0 | 424.4498 | 16.0463 | 1144.2150 | 228.8974 | 7.1625 | 9.4903 | 0.0000 | 0.1415 | 2.0591 |
| nog-mg-n-area26 | 50 | -1284.0 | -1284.0 | -1248.0 | -1248.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1341.0 | 1296.0 | 96.2462 | 10.3325 | 226.7514 | 57.3539 | 2.5949 | 5.7471 | 0.0000 | 0.0420 | 0.6788 |
| nog-mg-n-area27 | 51 | -1284.0 | -1284.0 | -1248.0 | -1248.0 | -204.0 | -168.0 | -168.0 | -204.0 | 1524.0 | 1296.0 | 5.4644 | 6.5393 | 12.1527 | 1.1615 | 0.1329 | 0.2590 | 0.0000 | 0.0003 | 0.0035 |
| nog-mg-n-area28 | 52 | -1284.0 | -1284.0 | -1248.0 | -1248.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2194.0 | 1296.0 | 16.9056 | 5.5135 | 85.3649 | 14.9779 | 1.0827 | 2.0400 | 0.0000 | 0.0025 | 0.0464 |
| nog-mg-n-area29 | 53 | -1284.0 | -1284.0 | -1248.0 | -1248.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2316.0 | 1296.0 | 13.2409 | 8.7861 | 42.5357 | 8.6178 | 0.8027 | 1.5971 | 0.0000 | 0.0012 | 0.0195 |
| nog-mg-n-area30 | 54 | -1284.0 | -1284.0 | -1248.0 | -1248.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2723.0 | 1296.0 | 63.3063 | 43.2711 | 338.0005 | 65.7337 | 2.0124 | 3.4494 | 0.0000 | 0.0165 | 0.2955 |
| nog-mg-n-area31 | 55 | -1284.0 | -1284.0 | -1248.0 | -1248.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2131.0 | 1296.0 | 71.6371 | 19.0625 | 77.6766 | 15.0678 | 1.1843 | 1.9232 | 0.0000 | 0.0370 | 0.6278 |
| nog-mg-n-area32 | 64 | -1248.0 | -1248.0 | -1176.0 | -1176.0 | -312.0 | -240.0 | -240.0 | -312.0 | 1764.0 | 5184.0 | 287.9578 | 4.6653 | 1455.3243 | 285.6240 | 2.6554 | 3.2783 | 0.0000 | 0.1978 | 3.5657 |
| nog-mg-n-area33 | 66 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1463.0 | 1296.0 | 7.9585 | 3.7915 | 17.2289 | 2.2236 | 0.2925 | 0.5654 | 0.0000 | 0.0010 | 0.0133 |
| nog-mg-n-area34 | 67 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | -204.0 | -168.0 | -168.0 | -204.0 | 1706.0 | 1296.0 | 6.5624 | 5.8140 | 16.2717 | 2.0180 | 0.2923 | 0.5845 | 0.0000 | 0.0002 | 0.0032 |
| nog-mg-n-area35 | 68 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | -168.0 | -132.0 | -132.0 | -168.0 | 1751.0 | 1296.0 | 8.6063 | 2.4222 | 11.3304 | 1.2155 | 0.8917 | 1.9054 | 0.0000 | 0.0001 | 0.0017 |
| nog-mg-n-area36 | 69 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2011.0 | 1296.0 | 17.6092 | 12.1933 | 73.8480 | 13.3021 | 0.7209 | 1.3457 | 0.0000 | 0.0035 | 0.0654 |
| nog-mg-n-area37 | 70 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2316.0 | 1296.0 | 26.7639 | 28.8225 | 67.0875 | 11.6896 | 0.2229 | 0.2590 | 0.0000 | 0.0074 | 0.1357 |
| nog-mg-n-area38 | 71 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2560.0 | 1296.0 | 131.4305 | 35.7106 | 116.1808 | 24.3100 | 1.2597 | 1.5776 | 0.0000 | 0.0749 | 1.2955 |
| nog-mg-n-area39 | 72 | -1248.0 | -1248.0 | -1176.0 | -1176.0 | -24.0 | 48.0 | 48.0 | -24.0 | 2467.0 | 5184.0 | 444.5292 | 397.4797 | 1200.2119 | 230.7264 | 4.0440 | 4.2547 | 0.0000 | 0.1172 | 2.0197 |
| nog-mg-n-area40 | 74 | -1248.0 | -1248.0 | -1176.0 | -1176.0 | 48.0 | 120.0 | 120.0 | 48.0 | 2207.0 | 5184.0 | 1314.3080 | 147.2378 | 2561.6641 | 519.9328 | 13.8789 | 17.4725 | 0.0000 | 1.0397 | 17.1695 |
| nog-mg-n-area41 | 76 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | 120.0 | 156.0 | 156.0 | 120.0 | 1367.0 | 1296.0 | 2224.4152 | 156.1927 | 3339.2244 | 646.2734 | 22.9468 | 26.2947 | 0.0000 | 1.5252 | 23.5904 |
| nog-mg-n-area42 | 77 | -1248.0 | -1248.0 | -1212.0 | -1212.0 | 156.0 | 192.0 | 192.0 | 156.0 | 1804.0 | 1296.0 | 9215.9936 | 211.7524 | 3195.6298 | 876.8852 | 138.9689 | 93.9347 | 0.0000 | 4.5664 | 70.6107 |
| nog-mg-n-area43 | 78 | -1248.0 | -1248.0 | -1176.0 | -1176.0 | 192.0 | 240.0 | 240.0 | 192.0 | 1323.0 | 3456.0 | 4396.5572 | 102.8561 | 3874.9262 | 844.4722 | 42.0532 | 53.1283 | 0.0000 | 2.8142 | 45.0814 |
| nog-mg-n-area44 | 82 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1920.0 | 1296.0 | 5.5966 | 2.5315 | 13.2108 | 0.6804 | 0.1557 | 0.2760 | 0.0000 | 0.0013 | 0.0175 |
| nog-mg-n-area45 | 83 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | -204.0 | -168.0 | -168.0 | -204.0 | 1463.0 | 1296.0 | 11.9117 | 4.0931 | 46.5921 | 9.3102 | 0.6204 | 1.2212 | 0.0000 | 0.0011 | 0.0204 |
| nog-mg-n-area46 | 84 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | -168.0 | -132.0 | -132.0 | -168.0 | 1584.0 | 1296.0 | 10.7975 | 2.4554 | 14.9425 | 1.9164 | 0.9140 | 1.9317 | 0.0000 | 0.0016 | 0.0315 |
| nog-mg-n-area47 | 85 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2024.0 | 1296.0 | 15.1917 | 14.2353 | 15.1487 | 2.0403 | 0.4971 | 1.0289 | 0.0000 | 0.0032 | 0.0622 |
| nog-mg-n-area48 | 86 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1785.0 | 1296.0 | 21.1797 | 20.9214 | 49.9800 | 8.6851 | 0.1523 | 0.1695 | 0.0000 | 0.0068 | 0.1299 |
| nog-mg-n-area49 | 87 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1950.0 | 1296.0 | 68.9913 | 12.7510 | 25.2619 | 4.3201 | 0.4593 | 0.4569 | 0.0000 | 0.0442 | 0.7837 |
| nog-mg-n-area50 | 92 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2316.0 | 1296.0 | 170.0898 | 8.2268 | 369.3683 | 73.3934 | 3.2209 | 5.0172 | 0.0000 | 0.0606 | 1.1043 |
| nog-mg-n-area51 | 93 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | 156.0 | 192.0 | 192.0 | 156.0 | 1767.0 | 1296.0 | 421.1255 | 12.6400 | 458.8524 | 91.9847 | 4.1918 | 4.5651 | 0.0000 | 0.2198 | 3.8083 |
| nog-mg-n-area52 | 96 | -1176.0 | -1176.0 | -1104.0 | -1104.0 | -312.0 | -240.0 | -240.0 | -312.0 | 2255.0 | 5184.0 | 437.6795 | 11.4724 | 874.6312 | 189.6971 | 3.2692 | 3.8645 | 0.0000 | 0.3131 | 5.6059 |
| nog-mg-n-area53 | 98 | -1176.0 | -1176.0 | -1104.0 | -1104.0 | -240.0 | -168.0 | -168.0 | -240.0 | 1645.0 | 5184.0 | 79.5918 | 15.4582 | 123.4878 | 18.4715 | 0.6598 | 0.7573 | 0.0000 | 0.0515 | 0.9776 |
| nog-mg-n-area54 | 100 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | -168.0 | -132.0 | -132.0 | -168.0 | 1448.0 | 1296.0 | 14.5274 | 3.1856 | 21.6579 | 2.9445 | 0.6187 | 1.2360 | 0.0000 | 0.0050 | 0.0965 |
| nog-mg-n-area55 | 101 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | -132.0 | -96.0 | -96.0 | -132.0 | 1512.0 | 1296.0 | 12.1815 | 17.7730 | 11.8032 | 1.3770 | 0.3453 | 0.7265 | 0.0000 | 0.0003 | 0.0041 |
| nog-mg-n-area56 | 102 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1465.0 | 1296.0 | 14.8436 | 17.6264 | 17.3020 | 2.0973 | 0.0723 | 0.0872 | 0.0000 | 0.0041 | 0.0758 |
| nog-mg-n-area57 | 103 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1638.0 | 1296.0 | 82.9654 | 11.7101 | 34.5490 | 6.3413 | 0.5482 | 0.5641 | 0.0000 | 0.0556 | 0.9956 |
| nog-mg-n-area58 | 104 | -1176.0 | -1176.0 | -1104.0 | -1104.0 | -24.0 | 48.0 | 48.0 | -24.0 | 1828.0 | 5184.0 | 345.2742 | 161.0422 | 416.4887 | 78.8726 | 2.3475 | 2.6990 | 0.0000 | 0.1787 | 2.8896 |
| nog-mg-n-area59 | 106 | -1176.0 | -1176.0 | -1104.0 | -1104.0 | 48.0 | 120.0 | 120.0 | 48.0 | 1829.0 | 5184.0 | 411.3845 | 101.0610 | 594.2503 | 113.8444 | 4.5803 | 6.1858 | 0.0000 | 0.2347 | 4.2608 |
| nog-mg-n-area60 | 108 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2316.0 | 1296.0 | 21.9457 | 3.0835 | 112.8686 | 20.5057 | 1.0236 | 1.7830 | 0.0000 | 0.0041 | 0.0714 |
| nog-mg-n-area61 | 109 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2696.0 | 1296.0 | 45.8941 | 1.2623 | 41.5250 | 9.1947 | 0.9113 | 1.5533 | 0.0000 | 0.0274 | 0.5289 |
| nog-mg-n-area62 | 110 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2377.0 | 1296.0 | 225.4663 | 38.0812 | 489.2602 | 128.4632 | 2.2303 | 2.8285 | 0.0000 | 0.0856 | 1.4278 |
| nog-mg-n-area63 | 111 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2126.0 | 432.0 | 259.7353 | 67.5818 | 411.3879 | 111.0613 | 2.3121 | 3.9213 | 0.0000 | 0.0871 | 1.3301 |
| nog-mg-n-area64 | 116 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2230.0 | 1296.0 | 3.6254 | 3.6605 | 9.9774 | 0.2112 | 0.0700 | 0.1275 | 0.0000 | 0.0003 | 0.0042 |
| nog-mg-n-area65 | 117 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | -132.0 | -96.0 | -96.0 | -132.0 | 1706.0 | 1296.0 | 9.9848 | 14.2785 | 11.4482 | 3.0465 | 0.1669 | 0.3251 | 0.0000 | 0.0004 | 0.0051 |
| nog-mg-n-area66 | 118 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1815.0 | 1296.0 | 7.2471 | 8.6449 | 12.6057 | 2.0630 | 0.1018 | 0.1691 | 0.0000 | 0.0009 | 0.0131 |
| nog-mg-n-area67 | 119 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1456.0 | 1296.0 | 102.8700 | 5.5271 | 61.3352 | 12.3430 | 0.8568 | 1.0279 | 0.0000 | 0.0695 | 1.1988 |
| nog-mg-n-area68 | 124 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2195.0 | 1296.0 | 31.1928 | 4.7219 | 362.8184 | 67.8666 | 1.1056 | 1.2298 | 0.0000 | 0.0047 | 0.0638 |
| nog-mg-n-area69 | 125 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 156.0 | 192.0 | 192.0 | 156.0 | 3475.0 | 1296.0 | 10.1280 | 0.4573 | 29.3961 | 4.2968 | 0.6416 | 1.2048 | 0.0000 | 0.0008 | 0.0109 |
| nog-mg-n-area70 | 126 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 192.0 | 228.0 | 228.0 | 192.0 | 3109.0 | 1296.0 | 153.9704 | 50.0138 | 295.9181 | 92.7949 | 1.4977 | 1.7116 | 0.0000 | 0.0234 | 0.3976 |
| nog-mg-n-area71 | 127 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2312.0 | 432.0 | 98.6874 | 7.3664 | 77.5961 | 21.7687 | 0.7602 | 1.1192 | 0.0000 | 0.0456 | 0.8483 |
| nog-mg-n-area72 | 128 | -1104.0 | -1104.0 | -1032.0 | -1032.0 | -312.0 | -240.0 | -240.0 | -312.0 | 1704.0 | 5184.0 | 359.9281 | 10.6217 | 1058.6976 | 239.4090 | 3.2443 | 4.3767 | 0.0000 | 0.2495 | 4.3814 |
| nog-mg-n-area73 | 130 | -1104.0 | -1104.0 | -1032.0 | -1032.0 | -240.0 | -168.0 | -168.0 | -240.0 | 1468.0 | 5184.0 | 169.5630 | 22.6167 | 704.2779 | 195.6282 | 3.1209 | 4.2141 | 0.0000 | 0.0831 | 1.4679 |
| nog-mg-n-area74 | 132 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2133.0 | 1296.0 | 43.3937 | 7.5364 | 203.1948 | 43.2517 | 0.5556 | 0.4917 | 0.0000 | 0.0235 | 0.4225 |
| nog-mg-n-area75 | 133 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -132.0 | -96.0 | -96.0 | -132.0 | 1828.0 | 1296.0 | 33.5935 | 7.8075 | 154.8993 | 33.3162 | 0.3876 | 0.2952 | 0.0000 | 0.0183 | 0.3514 |
| nog-mg-n-area76 | 134 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1524.0 | 1296.0 | 89.1143 | 5.6240 | 113.1917 | 21.6007 | 0.9625 | 1.3110 | 0.0000 | 0.0414 | 0.7269 |
| nog-mg-n-area77 | 135 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1463.0 | 1296.0 | 108.9186 | 1.8905 | 30.7047 | 7.0436 | 0.8388 | 0.9032 | 0.0000 | 0.0749 | 1.2637 |

**Table D-3 CALPUFF Model Inputs: 2018 Non-Project Area Sources (State, Motor Vehicle and Nonroad Sources)**

| name | Grid Cell | X1 (km) | X2 (km) | X3 (km) | X4 (km) | Y1 (km) | Y2 (km) | Y3 (km) | Y4 (km) | Base Elevation (m) | Grid Cell Area (km2) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog-mg-n-area78 | 136 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -24.0 | 12.0 | 12.0 | -24.0 | 2194.0 | 1296.0 | 2.7047 | 0.4963 | 11.6192 | 1.6070 | 0.1124 | 0.2108 | 0.0000 | 0.0010 | 0.0132 |
| nog-mg-n-area79 | 137 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2570.0 | 1296.0 | 4.6480 | 0.4988 | 10.4395 | 0.6319 | 0.2136 | 0.4220 | 0.0000 | 0.0003 | 0.0046 |
| nog-mg-n-area80 | 138 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1828.0 | 1296.0 | 12.8519 | 6.5239 | 31.0291 | 4.3146 | 0.3286 | 0.5806 | 0.0000 | 0.0015 | 0.0206 |
| nog-mg-n-area81 | 139 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1656.0 | 1296.0 | 139.1647 | 45.3123 | 722.1735 | 139.0166 | 1.9616 | 1.5427 | 0.0000 | 0.0382 | 0.6512 |
| nog-mg-n-area82 | 140 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 120.0 | 156.0 | 156.0 | 120.0 | 1770.0 | 1296.0 | 45.3750 | 5.6272 | 429.3416 | 79.8529 | 1.0836 | 1.0236 | 0.0000 | 0.0150 | 0.2421 |
| nog-mg-n-area83 | 141 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 156.0 | 192.0 | 192.0 | 156.0 | 3414.0 | 1296.0 | 15.7733 | 1.1177 | 69.2861 | 13.6738 | 0.5810 | 0.8519 | 0.0000 | 0.0035 | 0.0562 |
| nog-mg-n-area84 | 142 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2562.0 | 1296.0 | 63.6730 | 5.5019 | 265.1549 | 74.9483 | 0.9933 | 1.1417 | 0.0000 | 0.0217 | 0.3689 |
| nog-mg-n-area85 | 143 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2018.0 | 432.0 | 90.2239 | 4.3103 | 173.0270 | 48.9627 | 0.6677 | 0.7346 | 0.0000 | 0.0420 | 0.7530 |
| nog-mg-n-area86 | 148 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2072.0 | 1296.0 | 25.6010 | 5.5805 | 50.1210 | 18.0899 | 0.5181 | 0.8879 | 0.0000 | 0.0122 | 0.2207 |
| nog-mg-n-area87 | 149 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -132.0 | -96.0 | -96.0 | -132.0 | 1844.0 | 1296.0 | 33.4172 | 6.1893 | 592.7892 | 135.6681 | 0.8884 | 0.3768 | 0.0000 | 0.0078 | 0.1492 |
| nog-mg-n-area88 | 150 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2290.0 | 1296.0 | 16.4994 | 0.8712 | 71.0684 | 13.9209 | 0.2257 | 0.2857 | 0.0000 | 0.0093 | 0.1450 |
| nog-mg-n-area89 | 151 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1610.0 | 1296.0 | 70.1919 | 1.3977 | 36.6910 | 7.3840 | 0.5836 | 0.6700 | 0.0000 | 0.0478 | 0.8096 |
| nog-mg-n-area90 | 152 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -24.0 | 12.0 | 12.0 | -24.0 | 1916.0 | 1296.0 | 22.6985 | 0.7719 | 19.2127 | 3.1925 | 0.2533 | 0.3443 | 0.0000 | 0.0148 | 0.2453 |
| nog-mg-n-area91 | 153 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2248.0 | 1296.0 | 5.0757 | 0.3711 | 10.6979 | 0.5536 | 0.2294 | 0.4532 | 0.0000 | 0.0004 | 0.0053 |
| nog-mg-n-area92 | 154 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1920.0 | 1296.0 | 6.2482 | 0.3842 | 16.0269 | 1.5632 | 0.2483 | 0.4704 | 0.0000 | 0.0011 | 0.0191 |
| nog-mg-n-area93 | 155 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1463.0 | 1296.0 | 102.3388 | 10.6071 | 368.7939 | 67.7618 | 1.2251 | 1.1592 | 0.0000 | 0.0541 | 0.9693 |
| nog-mg-n-area94 | 156 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 120.0 | 156.0 | 156.0 | 120.0 | 1714.0 | 1296.0 | 193.0639 | 20.9513 | 321.5268 | 65.8020 | 1.8665 | 2.1419 | 0.0000 | 0.1064 | 1.5871 |
| nog-mg-n-area95 | 157 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 156.0 | 192.0 | 192.0 | 156.0 | 3086.0 | 1296.0 | 37.7906 | 2.1058 | 134.4584 | 24.8683 | 0.5265 | 0.7006 | 0.0000 | 0.0203 | 0.3814 |
| nog-mg-n-area96 | 158 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2035.0 | 1296.0 | 14.3312 | 0.5268 | 149.9263 | 31.9828 | 0.1585 | 0.2003 | 0.0000 | 0.0069 | 0.1134 |
| nog-mg-n-area97 | 159 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 228.0 | 240.0 | 240.0 | 228.0 | 1981.0 | 432.0 | 26.2281 | 9.4420 | 109.9917 | 22.3794 | 0.1197 | 0.1240 | 0.0000 | 0.0055 | 0.0827 |
| nog-mg-n-area98 | 160 | -1032.0 | -1032.0 | -996.0 | -996.0 | -312.0 | -276.0 | -276.0 | -312.0 | 1615.0 | 1296.0 | 255.7874 | 19.6452 | 2189.4537 | 498.0949 | 2.0276 | 1.6334 | 0.0000 | 0.1465 | 2.1609 |
| nog-mg-n-area99 | 161 | -1032.0 | -1032.0 | -996.0 | -996.0 | -276.0 | -240.0 | -240.0 | -276.0 | 1610.0 | 1296.0 | 41.6949 | 2.3093 | 63.3107 | 23.5168 | 0.4562 | 0.6636 | 0.0000 | 0.0235 | 0.4262 |
| nog-mg-n-area100 | 162 | -1032.0 | -1032.0 | -996.0 | -996.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1844.0 | 1296.0 | 304.8186 | 21.4446 | 646.5467 | 322.6316 | 3.0103 | 2.9754 | 0.0000 | 0.1897 | 3.0280 |
| nog-mg-n-area101 | 163 | -1032.0 | -1032.0 | -996.0 | -996.0 | -204.0 | -168.0 | -168.0 | -204.0 | 2103.0 | 1296.0 | 60.7503 | 1.9170 | 537.1581 | 145.1848 | 2.9847 | 5.1074 | 0.0000 | 0.0156 | 0.2783 |
| nog-mg-n-area102 | 164 | -1032.0 | -1032.0 | -960.0 | -960.0 | -168.0 | -96.0 | -96.0 | -168.0 | 2438.0 | 5184.0 | 108.4224 | 12.5343 | 556.7470 | 185.7261 | 2.6695 | 4.2161 | 0.0000 | 0.0460 | 0.8307 |
| nog-mg-n-area103 | 166 | -1032.0 | -1032.0 | -996.0 | -996.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1988.0 | 1296.0 | 17.2548 | 0.9016 | 96.3485 | 30.1847 | 0.1553 | 0.2288 | 0.0000 | 0.0106 | 0.2158 |
| nog-mg-n-area104 | 167 | -1032.0 | -1032.0 | -996.0 | -996.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2449.0 | 1296.0 | 171.1607 | 10.9206 | 1043.1170 | 251.4044 | 1.3807 | 1.3636 | 0.0000 | 0.0974 | 1.5572 |
| nog-mg-n-area105 | 168 | -1032.0 | -1032.0 | -996.0 | -996.0 | -24.0 | 12.0 | 12.0 | -24.0 | 1645.0 | 1296.0 | 144.9689 | 11.3587 | 484.2404 | 155.3537 | 1.2878 | 1.2176 | 0.0000 | 0.0857 | 1.5733 |
| nog-mg-n-area106 | 169 | -1032.0 | -1032.0 | -996.0 | -996.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2499.0 | 1296.0 | 19.6166 | 1.6010 | 17.2903 | 4.4851 | 0.2949 | 0.5043 | 0.0000 | 0.0099 | 0.1967 |
| nog-mg-n-area107 | 170 | -1032.0 | -1032.0 | -996.0 | -996.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1946.0 | 1296.0 | 23.6600 | 1.6768 | 31.6660 | 10.9840 | 0.3714 | 0.5999 | 0.0000 | 0.0117 | 0.2185 |
| nog-mg-n-area108 | 171 | -1032.0 | -1032.0 | -996.0 | -996.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1646.0 | 1296.0 | 42.5072 | 1.6762 | 38.7134 | 7.7297 | 0.4454 | 0.6234 | 0.0000 | 0.0280 | 0.5220 |
| nog-mg-n-area109 | 172 | -1032.0 | -1032.0 | -996.0 | -996.0 | 120.0 | 156.0 | 156.0 | 120.0 | 1900.0 | 1296.0 | 9.8062 | 1.8958 | 19.8690 | 3.4199 | 0.2296 | 0.3732 | 0.0000 | 0.0022 | 0.0292 |
| nog-mg-n-area110 | 173 | -1032.0 | -1032.0 | -996.0 | -996.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2488.0 | 1296.0 | 33.7552 | 1.1284 | 54.1542 | 9.5827 | 0.2859 | 0.3672 | 0.0000 | 0.0172 | 0.3165 |
| nog-mg-n-area111 | 174 | -1032.0 | -1032.0 | -996.0 | -996.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2316.0 | 1296.0 | 53.6938 | 0.6171 | 40.5228 | 8.0999 | 0.3359 | 0.4036 | 0.0000 | 0.0292 | 0.5435 |
| nog-mg-n-area112 | 175 | -1032.0 | -1032.0 | -996.0 | -996.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2138.0 | 432.0 | 392.1177 | 108.1583 | 967.2406 | 227.1339 | 1.0788 | 1.0591 | 0.0000 | 0.0768 | 1.1842 |
| nog-mg-n-area113 | 176 | -996.0 | -996.0 | -960.0 | -960.0 | -312.0 | -276.0 | -276.0 | -312.0 | 1833.0 | 1296.0 | 1210.3068 | 220.8063 | 7246.6732 | 1802.8577 | 6.5442 | 6.5116 | 0.0000 | 0.3357 | 4.9797 |
| nog-mg-n-area114 | 177 | -996.0 | -996.0 | -960.0 | -960.0 | -276.0 | -240.0 | -240.0 | -276.0 | 1950.0 | 1296.0 | 91.0559 | 9.8540 | 228.2103 | 91.0575 | 1.0180 | 0.9726 | 0.0000 | 0.0437 | 0.8043 |
| nog-mg-n-area115 | 178 | -996.0 | -996.0 | -960.0 | -960.0 | -240.0 | -204.0 | -204.0 | -240.0 | 2234.0 | 1296.0 | 88.4458 | 6.7156 | 115.3081 | 62.1833 | 0.8988 | 1.0422 | 0.0000 | 0.0525 | 0.9763 |
| nog-mg-n-area116 | 179 | -996.0 | -996.0 | -960.0 | -960.0 | -204.0 | -168.0 | -168.0 | -204.0 | 2582.0 | 1296.0 | 38.1031 | 2.8174 | 187.0703 | 64.2863 | 2.3966 | 4.7613 | 0.0000 | 0.0055 | 0.0950 |
| nog-mg-n-area117 | 182 | -996.0 | -996.0 | -960.0 | -960.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2743.0 | 1296.0 | 123.4740 | 7.3676 | 97.0078 | 36.9277 | 0.8858 | 1.0703 | 0.0000 | 0.0868 | 1.7088 |
| nog-mg-n-area118 | 183 | -996.0 | -996.0 | -960.0 | -960.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2331.0 | 1296.0 | 941.6403 | 147.2324 | 3970.9989 | 1051.2497 | 8.7182 | 10.9548 | 0.0000 | 0.4869 | 7.2744 |
| nog-mg-n-area119 | 184 | -996.0 | -996.0 | -924.0 | -924.0 | -24.0 | 48.0 | 48.0 | -24.0 | 1493.0 | 5184.0 | 255.2699 | 17.1268 | 488.6448 | 204.2676 | 2.3839 | 2.8765 | 0.0000 | 0.1389 | 2.5644 |
| nog-mg-n-area120 | 186 | -996.0 | -996.0 | -960.0 | -960.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1907.0 | 1296.0 | 30.5140 | 2.3779 | 39.6327 | 22.6665 | 0.5637 | 1.1373 | 0.0000 | 0.0134 | 0.2340 |
| nog-mg-n-area121 | 187 | -996.0 | -996.0 | -960.0 | -960.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2007.0 | 1296.0 | 23.2896 | 0.6004 | 22.2751 | 5.8128 | 0.2563 | 0.3479 | 0.0000 | 0.0149 | 0.2681 |
| nog-mg-n-area122 | 188 | -996.0 | -996.0 | -960.0 | -960.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2194.0 | 1296.0 | 8.0494 | 0.2334 | 23.5435 | 5.5284 | 0.1280 | 0.2149 | 0.0000 | 0.0043 | 0.0787 |
| nog-mg-n-area123 | 189 | -996.0 | -996.0 | -960.0 | -960.0 | 156.0 | 192.0 | 192.0 | 156.0 | 1871.0 | 1296.0 | 5.3889 | 0.1285 | 29.1254 | 5.7497 | 0.0984 | 0.1747 | 0.0000 | 0.0025 | 0.0429 |
| nog-mg-n-area124 | 190 | -996.0 | -996.0 | -924.0 | -924.0 | 192.0 | 240.0 | 240.0 | 192.0 | 2499.0 | 3456.0 | 48.8214 | 4.6197 | 2826.7887 | 529.4087 | 0.3649 | 0.5418 | 0.0000 | 0.0205 | 0.3745 |
| nog-mg-n-area125 | 192 | -960.0 | -960.0 | -924.0 | -924.0 | -312.0 | -276.0 | -276.0 | -312.0 | 1893.0 | 1296.0 | 150.9105 | 17.8236 | 629.7104 | 143.9250 | 1.6849 | 2.8512 | 0.0000 | 0.0649 | 1.1540 |
| nog-mg-n-area126 | 193 | -960.0 | -960.0 | -924.0 | -924.0 | -276.0 | -240.0 | -240.0 | -276.0 | 2072.0 | 1296.0 | 378.2430 | 54.3051 | 568.1321 | 244.4516 | 5.2133 | 6.1965 | 0.0000 | 0.2136 | 3.4543 |
| nog-mg-n-area127 | 194 | -960.0 | -960.0 | -924.0 | -924.0 | -240.0 | -204.0 | -204.0 | -240.0 | 2468.0 | 1296.0 | 138.3473 | 11.9028 | 203.0348 | 92.0431 | 1.8521 | 2.6750 | 0.0000 | 0.0952 | 1.4215 |
| nog-mg-n-area128 | 195 | -960.0 | -960.0 | -924.0 | -924.0 | -204.0 | -168.0 | -168.0 | -204.0 | 3246.0 | 1296.0 | 207.8958 | 9.3323 | 254.5408 | 104.9976 | 10.8120 | 22.5741 | 0.0000 | 0.0703 | 1.3228 |
| nog-mg-n-area129 | 196 | -960.0 | -960.0 | -924.0 | -924.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2929.0 | 1296.0 | 108.2195 | 7.2809 | 168.9649 | 83.8660 | 3.0582 | 5.6491 | 0.0000 | 0.0535 | 0.9764 |
| nog-mg-n-area130 | 197 | -960.0 | -960.0 | -924.0 | -924.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2926.0 | 1296.0 | 310.6660 | 50.1233 | 1515.8701 | 460.6137 | 3.1782 | 3.3308 | 0.0000 | 0.1743 | 2.6854 |
| nog-mg-n-area131 | 198 | -960.0 | -960.0 | -924.0 | -924.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1754.0 | 1296.0 | 217.0726 | 26.5005 | 703.7216 | 359.0878 | 2.1657 | 2.0102 | 0.0000 | 0.1023 | 1.9040 |
| nog-mg-n-area132 | 199 | -960.0 | -960.0 | -924.0 | -924.0 | -60.0 | -24.0 | -24.0 | -60.0 | 3086.0 | 1296.0 | 53.7589 | 9.2409 | 588.8935 | 193.6545 | 0.7503 | 0.6639 | 0.0000 | 0.0240 | 0.4665 |
| nog-mg-n-area133 | 202 | -960.0 | -960.0 | -924.0 | -924.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2011.0 | 1296.0 | 25.6319 | 1.7763 | 44.5904 | 18.0879 | 0.4622 | 0.5979 | 0.0000 | 0.0100 | 0.1788 |
| nog-mg-n-area134 | 203 | -960.0 | -960.0 | -924.0 | -924.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1889.0 | 1296.0 | 24.8369 | 0.4962 | 28.5295 | 7.6955 | 0.2637 | 0.3359 | 0.0000 | 0.0163 | 0.2933 |
| nog-mg-n-area135 | 204 | -960.0 | -960.0 | -924.0 | -924.0 | 120.0 | 156.0 | 156.0 | 120.0 | 1889.0 | 1296.0 | 5.6187 | 0.2015 | 20.8972 | 5.4135 | 0.1109 | 0.1969 | 0.0000 | 0.0024 | 0.0431 |
| nog-mg-n-area136 | 205 | -960.0 | -960.0 | -924.0 | -924.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2458.0 | 1296.0 | 6.1664 | 1.5803 | 28.0579 | 5.4324 | 0.0822 | 0.1537 | 0.0000 | 0.0005 | 0.0074 |
| nog-mg-n-area137 | 208 | -924.0 | -924.0 | -888.0 | -888.0 | -312.0 | -276.0 | -276.0 | -312.0 | 2042.0 | 1296.0 | 34.9248 | 1.4014 | 25.7185 | 7.7503 | 0.5238 | 0.8520 | 0.0000 | 0.0207 | 0.3904 |
| nog-mg-n-area138 | 209 | -924.0 | -924.0 | -888.0 | -888.0 | -276.0 | -240.0 | -240.0 | -276.0 | 1903.0 | 1296.0 | 94.9361 | 4.9066 | 114.7405 | 78.6517 | 1.1650 | 1.7217 | 0.0000 | 0.0598 | 1.1338 |
| nog-mg-n-area139 | 210 | -924.0 | -924.0 | -888.0 | -888.0 | -240.0 | -204.0 | -204.0 | -240.0 | 2685.0 | 1296.0 | 64.3217 | 2.7010 | 57.9382 | 37.7596 | 5.5264 | 11.7598 | 0.0000 | 0.0035 | 0.0474 |
| nog-mg-n-area140 | 211 | -924.0 | -924.0 | -888.0 | -888.0 | -204.0 | -168.0 | -168.0 | -204.0 | 4084.0 | 1296.0 | 99.3007 | 2.1785 | 20.4698 | 18.5890 | 9.4133 | 20.3566 | 0.0000 | 0.0037 | 0.0582 |
| nog-mg-n-area141 | 212 | -924.0 | -924.0 | -888.0 | -888.0 | -168.0 | -132.0 | -132.0 | -168.0 | 3962.0 | 1296.0 | 41.8708 | 1.6223 | 50.6394 | 24.1966 | 3.0764 | 6.5564 | 0.0000 | 0.0076 | 0.1295 |
| nog-mg-n-area142 | 213 | -924.0 | -924.0 | -888.0 | -888.0 | -132.0 | -96.0 | -96.0 | -132.0 | 3471.0 | 1296.0 | 98.0392 | 5.7566 | 212.8566 | 65.5763 | 0.8337 | 0.9545 | 0.0000 | 0.0656 | 1.2548 |
| nog-mg-n-area143 | 214 | -924.0 | -924.0 | -888.0 | -888.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2327.0 | 1296.0 | 74.2860 | 16.8774 | 218.1168 | 141.0050 | 0.8574 | 0.8926 | 0.0000 | 0.0329 | 0.5938 |
| nog-mg-n-area144 | 215 | -924.0 | -924.0 | -888.0 | -888.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2608.0 | 1296.0 | 17.2653 | 8.2142 | 49.8051 | 38.9288 | 0.2420 | 0.3707 | 0.0000 | 0.0042 | 0.0647 |
| nog-mg-n-area145 | 216 | -924.0 | -924.0 | -888.0 | -888.0 | -24.0 | 12.0 | 12.0 | -24.0 | 2438.0 | 1296.0 | 270.3672 | 13.0662 | 457.6057 | 322.8973 | 2.2891 | 2.5390 | 0.0000 | 0.1529 | 2.7643 |
| nog-mg-n-area146 | 217 | -924.0 | -924.0 | -888.0 | -888.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2111.0 | 1296.0 | 27.9440 | 5.6775 | 107.7491 | 85.0673 | 0.4417 | 0.6488 | 0.0000 | 0.0060 | 0.0974 |
| nog-mg-n-area147 | 218 | -924.0 | -924.0 | -888.0 | -888.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2560.0 | 1296.0 | 31.1826 | 1.8557 | 87.8019 | 30.3166 | 0.8529 | 1.1511 | 0.0000 | 0.0083 | 0.1367 |
| nog-mg-n-area148 | 219 | -924.0 | -924.0 | -888.0 | -888.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2378.0 | 1296.0 | 54.5846 | 5.8340 | 185.2055 | 75.6205 | 0.7139 | 0.5188 | 0.0000 | 0.0244 | 0.4137 |
| nog-mg-n-area149 | 220 | -924.0 | -924.0 | -852.0 | -852.0 | 120.0 | 192.0 | 192.0 | 120.0 | 2051.0 | 5184.0 | 61.7326 | 16.8627 | 236.7850 | 65.2585 | 1.2923 | 1.6019 | 0.0000 | 0.0131 | 0.2180 |
| nog-mg-n-area150 | 222 | -924.0 | -924.0 | -852.0 | -852.0 | 192.0 | 240.0 | 240.0 | 192.0 | 2073.0 | 3456.0 | 77.9924 | 22.8815 | 185.8735 | 37.0998 | 0.7439 | 1.1428 | 0.0000 | 0.0234 | 0.4152 |
| nog-mg-n-area151 | 224 | -888.0 | -888.0 | -852.0 | -852.0 | -312.0 | -276.0 | -276.0 | -312.0 | 2316.0 | 1296.0 | 113.1318 | 3.6681 | 190.5490 | 69.3159 | 1.1182 | 1.2467 | 0.0000 | 0.0749 | 1.2683 |
| nog-mg-n-area152 | 225 | -888.0 | -888.0 | -852.0 | -852.0 | -276.0 | -240.0 | -240.0 | -276.0 | 2207.0 | 1296.0 | 75.3943 | 4.7635 | 96.7465 | 71.0970 | 1.4124 | 2.5315 | 0.0000 | 0.0388 | 0.7356 |
| nog-mg-n-area153 | 226 | -888.0 | -888.0 | -852.0 | -852.0 | -240.0 | -204.0 | -204.0 | -240.0 | 2722.0 | 1296.0 | 114.9693 | 1.8071 | 27.3669 | 18.6638 | 8.3456 | 17.8045 | 0.0000 | 0.0261 | 0.4855 |
| nog-mg-n-area154 | 227 | -888.0 | -888.0 | -852.0 | -852.0 | -204.0 | -168.0 | -168.0 | -204.0 | 3543.0 | 1296.0 | 76.1719 | 1.2495 | 26.2566 | 15.6360 | 6.6886 | 14.3879 | 0.0000 | 0.0080 | 0.1366 |

**Table D-3 CALPUFF Model Inputs: 2018 Non-Project Area Sources (State, Motor Vehicle and Nonroad Sources)**

| name | Grid Cell | X1 (km) | X2 (km) | X3 (km) | X4 (km) | Y1 (km) | Y2 (km) | Y3 (km) | Y4 (km) | Base Elevation (m) | Grid Cell Area (km2) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nog-mg-n-area155 | 228 | -888.0 | -888.0 | -852.0 | -852.0 | -168.0 | -132.0 | -132.0 | -168.0 | 3367.0 | 1296.0 | 24.8064 | 0.5507 | 26.4654 | 9.3885 | 1.5813 | 3.2536 | 0.0000 | 0.0065 | 0.1246 |
| nog-mg-n-area156 | 229 | -888.0 | -888.0 | -852.0 | -852.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2621.0 | 1296.0 | 101.0094 | 4.9405 | 237.3122 | 107.8748 | 1.8699 | 2.2229 | 0.0000 | 0.0428 | 0.8037 |
| nog-mg-n-area157 | 230 | -888.0 | -888.0 | -852.0 | -852.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2976.0 | 1296.0 | 37.0703 | 2.4558 | 190.6412 | 83.9727 | 0.5663 | 0.6153 | 0.0000 | 0.0179 | 0.2616 |
| nog-mg-n-area158 | 231 | -888.0 | -888.0 | -852.0 | -852.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2431.0 | 1296.0 | 100.8777 | 8.5937 | 86.3071 | 35.2026 | 1.3975 | 1.8043 | 0.0000 | 0.0579 | 1.1017 |
| nog-mg-n-area159 | 232 | -888.0 | -888.0 | -852.0 | -852.0 | -24.0 | 12.0 | 12.0 | -24.0 | 2967.0 | 1296.0 | 398.2062 | 35.5162 | 952.9673 | 446.8761 | 3.9732 | 4.4131 | 0.0000 | 0.2128 | 3.7304 |
| nog-mg-n-area160 | 233 | -888.0 | -888.0 | -852.0 | -852.0 | 12.0 | 48.0 | 48.0 | 12.0 | 3147.0 | 1296.0 | 18.3015 | 3.6547 | 76.2831 | 32.6487 | 0.3303 | 0.4831 | 0.0000 | 0.0023 | 0.0311 |
| nog-mg-n-area161 | 234 | -888.0 | -888.0 | -852.0 | -852.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2965.0 | 1296.0 | 10.7012 | 1.9633 | 40.6607 | 14.3545 | 0.2802 | 0.4638 | 0.0000 | 0.0012 | 0.0157 |
| nog-mg-n-area162 | 235 | -888.0 | -888.0 | -852.0 | -852.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2377.0 | 1296.0 | 166.5571 | 15.3940 | 605.9250 | 206.4502 | 2.4259 | 1.9886 | 0.0000 | 0.0731 | 1.1702 |
| nog-mg-n-area163 | 240 | -852.0 | -852.0 | -780.0 | -780.0 | -312.0 | -240.0 | -240.0 | -312.0 | 2286.0 | 5184.0 | 296.8142 | 14.4310 | 1268.8132 | 417.0559 | 5.1606 | 5.0245 | 0.0000 | 0.1504 | 2.7495 |
| nog-mg-n-area164 | 242 | -852.0 | -852.0 | -816.0 | -816.0 | -240.0 | -204.0 | -204.0 | -240.0 | 3718.0 | 1296.0 | 95.5454 | 4.0653 | 194.0400 | 106.5662 | 1.8453 | 2.9070 | 0.0000 | 0.0507 | 0.9371 |
| nog-mg-n-area165 | 243 | -852.0 | -852.0 | -816.0 | -816.0 | -204.0 | -168.0 | -168.0 | -204.0 | 2900.0 | 1296.0 | 13.8703 | 1.1000 | 32.9378 | 15.4690 | 0.9445 | 1.9465 | 0.0000 | 0.0017 | 0.0229 |
| nog-mg-n-area166 | 244 | -852.0 | -852.0 | -816.0 | -816.0 | -168.0 | -132.0 | -132.0 | -168.0 | 3230.0 | 1296.0 | 21.2922 | 0.5576 | 44.9877 | 11.1095 | 0.4459 | 0.7167 | 0.0000 | 0.0127 | 0.2349 |
| nog-mg-n-area167 | 245 | -852.0 | -852.0 | -816.0 | -816.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2826.0 | 1296.0 | 63.4139 | 2.7387 | 64.6892 | 40.3070 | 0.7282 | 0.7935 | 0.0000 | 0.0414 | 0.7877 |
| nog-mg-n-area168 | 246 | -852.0 | -852.0 | -816.0 | -816.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2745.0 | 1296.0 | 27.9705 | 6.2995 | 92.6419 | 46.0197 | 0.6391 | 0.8951 | 0.0000 | 0.0078 | 0.1218 |
| nog-mg-n-area169 | 247 | -852.0 | -852.0 | -816.0 | -816.0 | -60.0 | -24.0 | -24.0 | -60.0 | 4084.0 | 1296.0 | 227.2889 | 34.0973 | 201.9275 | 84.6373 | 5.2551 | 6.1389 | 0.0000 | 0.0881 | 1.6712 |
| nog-mg-n-area170 | 248 | -852.0 | -852.0 | -816.0 | -816.0 | -24.0 | 12.0 | 12.0 | -24.0 | 2743.0 | 1296.0 | 355.4428 | 21.0968 | 755.6553 | 329.9139 | 4.1329 | 4.7720 | 0.0000 | 0.1849 | 3.5142 |
| nog-mg-n-area171 | 249 | -852.0 | -852.0 | -816.0 | -816.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2499.0 | 1296.0 | 77.6993 | 7.9968 | 131.3160 | 63.6124 | 0.7886 | 0.9661 | 0.0000 | 0.0476 | 0.9582 |
| nog-mg-n-area172 | 250 | -852.0 | -852.0 | -816.0 | -816.0 | 48.0 | 84.0 | 84.0 | 48.0 | 3632.0 | 1296.0 | 52.5188 | 7.2062 | 238.2614 | 80.1891 | 0.7750 | 0.8218 | 0.0000 | 0.0273 | 0.4806 |
| nog-mg-n-area173 | 251 | -852.0 | -852.0 | -816.0 | -816.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2256.0 | 1296.0 | 191.9253 | 22.7866 | 640.5166 | 206.7061 | 2.6901 | 2.6013 | 0.0000 | 0.1041 | 1.6474 |
| nog-mg-n-area174 | 252 | -852.0 | -852.0 | -816.0 | -816.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2621.0 | 1296.0 | 13.1048 | 5.1683 | 50.1706 | 19.9924 | 0.3990 | 0.6515 | 0.0000 | 0.0016 | 0.0221 |
| nog-mg-n-area175 | 253 | -852.0 | -852.0 | -816.0 | -816.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2363.0 | 1296.0 | 37.0716 | 14.5590 | 140.5635 | 38.1179 | 0.4422 | 0.5716 | 0.0000 | 0.0048 | 0.0777 |
| nog-mg-n-area176 | 254 | -852.0 | -852.0 | -780.0 | -780.0 | 192.0 | 240.0 | 240.0 | 192.0 | 2462.0 | 3456.0 | 313.1013 | 99.5531 | 458.3147 | 123.5557 | 2.5376 | 2.5263 | 0.0000 | 0.0744 | 1.3183 |
| nog-mg-n-area177 | 258 | -816.0 | -816.0 | -780.0 | -780.0 | -240.0 | -204.0 | -204.0 | -240.0 | 3352.0 | 1296.0 | 227.8378 | 13.5710 | 1691.1199 | 498.4379 | 4.3690 | 2.9098 | 0.0000 | 0.0899 | 1.6542 |
| nog-mg-n-area178 | 259 | -816.0 | -816.0 | -780.0 | -780.0 | -204.0 | -168.0 | -168.0 | -204.0 | 2620.0 | 1296.0 | 63.4910 | 1.5314 | 426.8008 | 119.2031 | 1.4032 | 1.0901 | 0.0000 | 0.0284 | 0.4925 |
| nog-mg-n-area179 | 260 | -816.0 | -816.0 | -780.0 | -780.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2759.0 | 1296.0 | 27.9988 | 0.7001 | 55.5637 | 15.9989 | 0.5039 | 0.7759 | 0.0000 | 0.0170 | 0.3086 |
| nog-mg-n-area180 | 261 | -816.0 | -816.0 | -780.0 | -780.0 | -132.0 | -96.0 | -96.0 | -132.0 | 2691.0 | 1296.0 | 145.2139 | 5.3534 | 203.3867 | 97.6370 | 1.4801 | 2.0237 | 0.0000 | 0.0985 | 1.8785 |
| nog-mg-n-area181 | 262 | -816.0 | -816.0 | -780.0 | -780.0 | -96.0 | -60.0 | -60.0 | -96.0 | 3612.0 | 1296.0 | 91.1175 | 8.6870 | 250.0524 | 134.3373 | 1.2282 | 1.8270 | 0.0000 | 0.0494 | 0.8828 |
| nog-mg-n-area182 | 263 | -816.0 | -816.0 | -780.0 | -780.0 | -60.0 | -24.0 | -24.0 | -60.0 | 3595.0 | 1296.0 | 125.1618 | 9.1935 | 249.6245 | 136.2633 | 2.2012 | 3.9948 | 0.0000 | 0.0597 | 1.0806 |
| nog-mg-n-area183 | 264 | -816.0 | -816.0 | -780.0 | -780.0 | -24.0 | 12.0 | 12.0 | -24.0 | 3925.0 | 1296.0 | 450.5951 | 46.8444 | 1278.3956 | 354.9800 | 4.0233 | 4.1085 | 0.0000 | 0.2310 | 4.4520 |
| nog-mg-n-area184 | 265 | -816.0 | -816.0 | -780.0 | -780.0 | 12.0 | 48.0 | 48.0 | 12.0 | 3227.0 | 1296.0 | 80.8856 | 10.6373 | 171.2389 | 86.9930 | 1.0487 | 1.3221 | 0.0000 | 0.0353 | 0.6640 |
| nog-mg-n-area185 | 266 | -816.0 | -816.0 | -780.0 | -780.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2806.0 | 1296.0 | 64.8571 | 3.0848 | 35.6458 | 34.2457 | 0.9325 | 1.2872 | 0.0000 | 0.0411 | 0.8219 |
| nog-mg-n-area186 | 267 | -816.0 | -816.0 | -780.0 | -780.0 | 84.0 | 120.0 | 120.0 | 84.0 | 3004.0 | 1296.0 | 71.3073 | 4.3146 | 92.8764 | 32.3368 | 2.2793 | 3.4614 | 0.0000 | 0.0270 | 0.5245 |
| nog-mg-n-area187 | 268 | -816.0 | -816.0 | -780.0 | -780.0 | 120.0 | 156.0 | 156.0 | 120.0 | 3444.0 | 1296.0 | 28.5947 | 3.0446 | 23.3582 | 13.2754 | 1.5774 | 2.8267 | 0.0000 | 0.0040 | 0.0718 |
| nog-mg-n-area188 | 269 | -816.0 | -816.0 | -780.0 | -780.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2756.0 | 1296.0 | 57.1809 | 15.4552 | 113.0207 | 38.3999 | 1.1332 | 0.7690 | 0.0000 | 0.0068 | 0.1127 |
| nog-mg-n-area189 | 272 | -780.0 | -780.0 | -720.0 | -720.0 | -312.0 | -240.0 | -240.0 | -312.0 | 2352.0 | 4320.0 | 324.2217 | 20.2463 | 780.0171 | 253.9994 | 5.5248 | 8.3263 | 0.0000 | 0.1652 | 2.8426 |
| nog-mg-n-area190 | 274 | -780.0 | -780.0 | -744.0 | -744.0 | -240.0 | -204.0 | -204.0 | -240.0 | 2285.0 | 1296.0 | 47.0385 | 2.0037 | 400.2123 | 107.3450 | 1.0706 | 1.1956 | 0.0000 | 0.0215 | 0.3937 |
| nog-mg-n-area191 | 275 | -780.0 | -780.0 | -744.0 | -744.0 | -204.0 | -168.0 | -168.0 | -204.0 | 2293.0 | 1296.0 | 22.9259 | 1.0013 | 155.9506 | 55.4102 | 0.8166 | 1.2745 | 0.0000 | 0.0075 | 0.1305 |
| nog-mg-n-area192 | 276 | -780.0 | -780.0 | -720.0 | -720.0 | -168.0 | -96.0 | -96.0 | -168.0 | 2350.0 | 4320.0 | 275.1644 | 13.3308 | 501.3112 | 197.2874 | 3.4079 | 4.9583 | 0.0000 | 0.1704 | 3.2494 |
| nog-mg-n-area193 | 278 | -780.0 | -780.0 | -720.0 | -720.0 | -96.0 | -24.0 | -24.0 | -96.0 | 2926.0 | 4320.0 | 260.6035 | 12.7843 | 483.6947 | 233.0341 | 2.9024 | 4.0950 | 0.0000 | 0.1651 | 3.1363 |
| nog-mg-n-area194 | 280 | -780.0 | -780.0 | -744.0 | -744.0 | -24.0 | 12.0 | 12.0 | -24.0 | 4155.0 | 1296.0 | 652.8784 | 48.2660 | 1160.9031 | 477.6275 | 5.0588 | 5.2246 | 0.0000 | 0.3323 | 6.4001 |
| nog-mg-n-area195 | 281 | -780.0 | -780.0 | -744.0 | -744.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2926.0 | 1296.0 | 114.5677 | 8.9664 | 228.1029 | 94.9410 | 1.3116 | 1.6664 | 0.0000 | 0.0666 | 1.2474 |
| nog-mg-n-area196 | 282 | -780.0 | -780.0 | -744.0 | -744.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2409.0 | 1296.0 | 88.1010 | 6.9452 | 130.4241 | 66.1180 | 1.1505 | 1.7708 | 0.0000 | 0.0558 | 1.0924 |
| nog-mg-n-area197 | 283 | -780.0 | -780.0 | -744.0 | -744.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2981.0 | 1296.0 | 39.1985 | 1.0149 | 30.4918 | 13.1750 | 2.0652 | 3.1911 | 0.0000 | 0.0079 | 0.1525 |
| nog-mg-n-area198 | 284 | -780.0 | -780.0 | -744.0 | -744.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2469.0 | 1296.0 | 34.4357 | 4.0354 | 94.8968 | 34.8204 | 1.1742 | 1.8529 | 0.0000 | 0.0108 | 0.1828 |
| nog-mg-n-area199 | 285 | -780.0 | -780.0 | -744.0 | -744.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2682.0 | 1296.0 | 32.8164 | 15.1410 | 49.5466 | 26.8156 | 0.4547 | 0.5422 | 0.0000 | 0.0086 | 0.1461 |
| nog-mg-n-area200 | 286 | -780.0 | -780.0 | -720.0 | -720.0 | 192.0 | 240.0 | 240.0 | 192.0 | 3220.0 | 2880.0 | 238.9908 | 50.2756 | 153.1635 | 45.6112 | 1.8664 | 1.9622 | 0.0000 | 0.0921 | 1.7049 |
| nog-mg-n-area201 | 290 | -744.0 | -744.0 | -720.0 | -720.0 | -240.0 | -204.0 | -204.0 | -240.0 | 2773.0 | 864.0 | 33.7755 | 1.1149 | 26.1045 | 21.4004 | 0.6383 | 1.0815 | 0.0000 | 0.0194 | 0.3436 |
| nog-mg-n-area202 | 291 | -744.0 | -744.0 | -720.0 | -720.0 | -204.0 | -168.0 | -168.0 | -204.0 | 3794.0 | 864.0 | 38.2290 | 1.6779 | 130.3198 | 50.3018 | 1.8005 | 3.3765 | 0.0000 | 0.0107 | 0.1920 |
| nog-mg-n-area203 | 296 | -744.0 | -744.0 | -720.0 | -720.0 | -24.0 | 12.0 | 12.0 | -24.0 | 3057.0 | 864.0 | 246.7371 | 10.5346 | 255.3179 | 149.8489 | 2.4140 | 3.3080 | 0.0000 | 0.1440 | 2.7057 |
| nog-mg-n-area204 | 297 | -744.0 | -744.0 | -720.0 | -720.0 | 12.0 | 48.0 | 48.0 | 12.0 | 3779.0 | 864.0 | 92.8655 | 12.5348 | 187.2973 | 120.0085 | 2.2818 | 3.9858 | 0.0000 | 0.0377 | 0.6490 |
| nog-mg-n-area205 | 298 | -744.0 | -744.0 | -720.0 | -720.0 | 48.0 | 84.0 | 84.0 | 48.0 | 3045.0 | 864.0 | 142.1577 | 13.8704 | 205.9670 | 73.5857 | 1.2643 | 1.6428 | 0.0000 | 0.0906 | 1.7499 |
| nog-mg-n-area206 | 299 | -744.0 | -744.0 | -720.0 | -720.0 | 84.0 | 120.0 | 120.0 | 84.0 | 3465.0 | 864.0 | 45.2913 | 7.3110 | 108.2288 | 33.0344 | 0.4795 | 0.7016 | 0.0000 | 0.0288 | 0.5893 |
| nog-mg-n-area207 | 300 | -744.0 | -744.0 | -720.0 | -720.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2826.0 | 864.0 | 9.1128 | 3.4178 | 112.9730 | 34.7038 | 0.2584 | 0.3081 | 0.0000 | 0.0011 | 0.0151 |
| nog-mg-n-area208 | 301 | -744.0 | -744.0 | -720.0 | -720.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2318.0 | 864.0 | 124.3926 | 89.8413 | 221.0003 | 66.9968 | 1.5123 | 1.2350 | 0.0000 | 0.0208 | 0.3617 |

**Table D-4 CALPUFF Model Inputs: 2018 Non-Project Area Sources (Uinta Basin Oil and Gas Sources)**

| name | Grid Cell | X1 (km) | X2 (km) | X3 (km) | X4 (km) | Y1 (km) | Y2 (km) | Y3 (km) | Y4 (km) | Base Elevation (m) | Grid Cell Area (km2) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| unita-og-area1 | 72 | -1248.0 | -1248.0 | -1176.0 | -1176.0 | -24.0 | 48.0 | 48.0 | -24.0 | 2467.0 | 5184.0 | 965.0450 | 2.1086 | 0.0000 | 51.3677 | 0.0000 | 2.1575 | 0.1438 | 12.0716 | 36.9955 |
| unita-og-area2 | 74 | -1248.0 | -1248.0 | -1176.0 | -1176.0 | 48.0 | 120.0 | 120.0 | 48.0 | 2207.0 | 5184.0 | 75.9741 | 0.2534 | 0.0000 | 4.3549 | 0.0000 | 0.1829 | 0.0122 | 1.0234 | 3.1364 |
| unita-og-area3 | 104 | -1176.0 | -1176.0 | -1104.0 | -1104.0 | -24.0 | 48.0 | 48.0 | -24.0 | 1828.0 | 5184.0 | 243.4241 | 0.9284 | 0.0000 | 16.1389 | 0.0000 | 0.6778 | 0.0452 | 3.7926 | 11.6231 |
| unita-og-area4 | 106 | -1176.0 | -1176.0 | -1104.0 | -1104.0 | 48.0 | 120.0 | 120.0 | 48.0 | 1829.0 | 5184.0 | 2805.2885 | 9.4687 | 0.0000 | 196.3510 | 0.0000 | 8.2468 | 0.5498 | 46.1431 | 141.4127 |
| unita-og-area5 | 118 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1815.0 | 1296.0 | 2.9799 | 0.0020 | 0.0000 | 0.1240 | 0.0000 | 0.0052 | 0.0003 | 0.0291 | 0.0893 |
| unita-og-area6 | 119 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1456.0 | 1296.0 | 7.5061 | 0.0332 | 0.0000 | 0.1709 | 0.0000 | 0.0072 | 0.0005 | 0.0402 | 0.1231 |
| unita-og-area7 | 124 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2195.0 | 1296.0 | 73.1067 | 0.0770 | 0.0000 | 6.1882 | 0.0000 | 0.2599 | 0.0173 | 1.4543 | 4.4568 |
| unita-og-area8 | 134 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -96.0 | -60.0 | -60.0 | -96.0 | 1524.0 | 1296.0 | 18.6994 | 0.0121 | 0.0000 | 0.7799 | 0.0000 | 0.0328 | 0.0022 | 0.1833 | 0.5617 |
| unita-og-area9 | 135 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1463.0 | 1296.0 | 20.7270 | 0.0977 | 0.0000 | 0.7572 | 0.0000 | 0.0318 | 0.0021 | 0.1779 | 0.5453 |
| unita-og-area10 | 136 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -24.0 | 12.0 | 12.0 | -24.0 | 2194.0 | 1296.0 | 3.4230 | 0.0116 | 0.0000 | 0.1306 | 0.0000 | 0.0055 | 0.0004 | 0.0307 | 0.0941 |
| unita-og-area11 | 137 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2570.0 | 1296.0 | 155.1693 | 0.3881 | 0.0000 | 6.8622 | 0.0000 | 0.2882 | 0.0192 | 1.6126 | 4.9422 |
| unita-og-area12 | 138 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1828.0 | 1296.0 | 1366.0236 | 4.8147 | 0.0000 | 72.2440 | 0.0000 | 3.0343 | 0.2023 | 16.9775 | 52.0300 |
| unita-og-area13 | 139 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1656.0 | 1296.0 | 723.1322 | 1.2577 | 0.0000 | 44.5957 | 0.0000 | 1.8730 | 0.1249 | 10.4801 | 32.1178 |
| unita-og-area14 | 140 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 120.0 | 156.0 | 156.0 | 120.0 | 1770.0 | 1296.0 | 386.3598 | 0.9887 | 0.0000 | 29.9764 | 0.0000 | 1.2590 | 0.0839 | 7.0444 | 21.5890 |
| unita-og-area15 | 150 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -96.0 | -60.0 | -60.0 | -96.0 | 2290.0 | 1296.0 | 1.6850 | 0.0101 | 0.0000 | 0.0248 | 0.0000 | 0.0010 | 0.0001 | 0.0058 | 0.0179 |
| unita-og-area16 | 151 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -60.0 | -24.0 | -24.0 | -60.0 | 1610.0 | 1296.0 | 31.1359 | 0.1713 | 0.0000 | 0.9179 | 0.0000 | 0.0386 | 0.0026 | 0.2157 | 0.6611 |
| unita-og-area17 | 152 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -24.0 | 12.0 | 12.0 | -24.0 | 1916.0 | 1296.0 | 85.3554 | 0.3540 | 0.0000 | 3.1836 | 0.0000 | 0.1337 | 0.0089 | 0.7481 | 2.2928 |
| unita-og-area18 | 153 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2248.0 | 1296.0 | 64.3397 | 0.3300 | 0.0000 | 3.0314 | 0.0000 | 0.1273 | 0.0085 | 0.7124 | 2.1833 |
| unita-og-area19 | 154 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1920.0 | 1296.0 | 3309.2287 | 12.7069 | 0.0000 | 156.2433 | 0.0000 | 6.5623 | 0.4375 | 36.7175 | 112.5277 |
| unita-og-area20 | 155 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1463.0 | 1296.0 | 709.4476 | 2.0786 | 0.0000 | 39.4412 | 0.0000 | 1.6565 | 0.1104 | 9.2688 | 28.4057 |
| unita-og-area21 | 168 | -1032.0 | -1032.0 | -996.0 | -996.0 | -24.0 | 12.0 | 12.0 | -24.0 | 1645.0 | 1296.0 | 42.2451 | 0.1571 | 0.0000 | 1.4288 | 0.0000 | 0.0600 | 0.0040 | 0.3358 | 1.0290 |
| unita-og-area22 | 169 | -1032.0 | -1032.0 | -996.0 | -996.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2499.0 | 1296.0 | 5.8896 | 0.0296 | 0.0000 | 0.2920 | 0.0000 | 0.0123 | 0.0008 | 0.0686 | 0.2103 |
| unita-og-area23 | 170 | -1032.0 | -1032.0 | -996.0 | -996.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1946.0 | 1296.0 | 39.7029 | 0.1976 | 0.0000 | 1.6797 | 0.0000 | 0.0705 | 0.0047 | 0.3947 | 1.2097 |
| unita-og-area24 | 171 | -1032.0 | -1032.0 | -996.0 | -996.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1646.0 | 1296.0 | 31.1659 | 0.0886 | 0.0000 | 1.6768 | 0.0000 | 0.0704 | 0.0047 | 0.3941 | 1.2076 |

**Table D-5 CALPUFF Model Inputs: 2018 Non-Project Area Sources (Piceance Basin Oil and Gas Sources)**

| name | Grid Cell | X1 (km) | X2 (km) | X3 (km) | X4 (km) | Y1 (km) | Y2 (km) | Y3 (km) | Y4 (km) | Base Elevation (m) | Grid Cell Area (km2) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| piceance-og-area1 | 168 | -1032.0 | -1032.0 | -996.0 | -996.0 | -24.0 | 12.0 | 12.0 | -24.0 | 1645.0 | 1296.0 | 50.9261 | 0.2366 | 0.0000 | 3.2411 | 0.0000 | 0.1361 | 0.0091 | 0.7617 | 2.3342 |
| piceance-og-area2 | 169 | -1032.0 | -1032.0 | -996.0 | -996.0 | 12.0 | 48.0 | 48.0 | 12.0 | 2499.0 | 1296.0 | 118.1598 | 0.5294 | 0.0000 | 8.5180 | 0.0000 | 0.3578 | 0.0239 | 2.0017 | 6.1346 |
| piceance-og-area3 | 170 | -1032.0 | -1032.0 | -996.0 | -996.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1946.0 | 1296.0 | 207.3610 | 0.7633 | 0.0000 | 13.6868 | 0.0000 | 0.5748 | 0.0383 | 3.2163 | 9.8571 |
| piceance-og-area4 | 171 | -1032.0 | -1032.0 | -996.0 | -996.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1646.0 | 1296.0 | 0.0763 | 0.0000 | 0.0000 | 0.0009 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0007 |
| piceance-og-area5 | 183 | -996.0 | -996.0 | -960.0 | -960.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2331.0 | 1296.0 | 2.2151 | 0.0108 | 0.0000 | 0.1409 | 0.0000 | 0.0059 | 0.0004 | 0.0331 | 0.1015 |
| piceance-og-area6 | 184 | -996.0 | -996.0 | -924.0 | -924.0 | -24.0 | 48.0 | 48.0 | -24.0 | 1493.0 | 5184.0 | 1936.7687 | 5.6018 | 0.0000 | 140.4199 | 0.0000 | 5.8977 | 0.3932 | 32.9987 | 101.1303 |
| piceance-og-area7 | 186 | -996.0 | -996.0 | -960.0 | -960.0 | 48.0 | 84.0 | 84.0 | 48.0 | 1907.0 | 1296.0 | 55.1343 | 0.1897 | 0.0000 | 3.9148 | 0.0000 | 0.1644 | 0.0110 | 0.9200 | 2.8194 |
| piceance-og-area8 | 187 | -996.0 | -996.0 | -960.0 | -960.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2007.0 | 1296.0 | 0.9206 | 0.0034 | 0.0000 | 0.0465 | 0.0000 | 0.0020 | 0.0001 | 0.0109 | 0.0335 |
| piceance-og-area9 | 189 | -996.0 | -996.0 | -960.0 | -960.0 | 156.0 | 192.0 | 192.0 | 156.0 | 1871.0 | 1296.0 | 62.2051 | 0.2193 | 0.0000 | 4.3960 | 0.0000 | 0.1846 | 0.0123 | 1.0331 | 3.1660 |
| piceance-og-area10 | 199 | -960.0 | -960.0 | -924.0 | -924.0 | -60.0 | -24.0 | -24.0 | -60.0 | 3086.0 | 1296.0 | 163.1865 | 0.3328 | 0.0000 | 9.9240 | 0.0000 | 0.4168 | 0.0278 | 2.3322 | 7.1473 |
| piceance-og-area11 | 202 | -960.0 | -960.0 | -924.0 | -924.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2011.0 | 1296.0 | 76.8506 | 0.2418 | 0.0000 | 5.5075 | 0.0000 | 0.2313 | 0.0154 | 1.2942 | 3.9665 |
| piceance-og-area12 | 203 | -960.0 | -960.0 | -924.0 | -924.0 | 84.0 | 120.0 | 120.0 | 84.0 | 1889.0 | 1296.0 | 0.8387 | 0.0000 | 0.0000 | 0.0092 | 0.0000 | 0.0004 | 0.0000 | 0.0022 | 0.0066 |
| piceance-og-area13 | 204 | -960.0 | -960.0 | -924.0 | -924.0 | 120.0 | 156.0 | 156.0 | 120.0 | 1889.0 | 1296.0 | 2.1079 | 0.0011 | 0.0000 | 0.1964 | 0.0000 | 0.0083 | 0.0006 | 0.0462 | 0.1415 |
| piceance-og-area14 | 205 | -960.0 | -960.0 | -924.0 | -924.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2458.0 | 1296.0 | 35.7211 | 0.1230 | 0.0000 | 2.0590 | 0.0000 | 0.0865 | 0.0058 | 0.4839 | 1.4829 |
| piceance-og-area15 | 215 | -924.0 | -924.0 | -888.0 | -888.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2608.0 | 1296.0 | 68.3730 | 0.1074 | 0.0000 | 5.1009 | 0.0000 | 0.2142 | 0.0143 | 1.1987 | 3.6736 |
| piceance-og-area16 | 216 | -924.0 | -924.0 | -888.0 | -888.0 | -24.0 | 12.0 | 12.0 | -24.0 | 2438.0 | 1296.0 | 884.8818 | 2.7346 | 0.0000 | 50.5297 | 0.0000 | 2.1222 | 0.1415 | 11.8746 | 36.3914 |
| piceance-og-area17 | 218 | -924.0 | -924.0 | -888.0 | -888.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2560.0 | 1296.0 | 1.8538 | 0.0038 | 0.0000 | 0.0590 | 0.0000 | 0.0025 | 0.0002 | 0.0139 | 0.0425 |
| piceance-og-area18 | 219 | -924.0 | -924.0 | -888.0 | -888.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2378.0 | 1296.0 | 14.8010 | 0.0133 | 0.0000 | 1.2757 | 0.0000 | 0.0536 | 0.0036 | 0.2998 | 0.9188 |
| piceance-og-area19 | 220 | -924.0 | -924.0 | -852.0 | -852.0 | 120.0 | 192.0 | 192.0 | 120.0 | 2051.0 | 5184.0 | 51.4987 | 0.1838 | 0.0000 | 3.6616 | 0.0000 | 0.1538 | 0.0103 | 0.8605 | 2.6370 |
| piceance-og-area20 | 234 | -888.0 | -888.0 | -852.0 | -852.0 | 48.0 | 84.0 | 84.0 | 48.0 | 2965.0 | 1296.0 | 0.1145 | 0.0000 | 0.0000 | 0.0014 | 0.0000 | 0.0001 | 0.0000 | 0.0003 | 0.0010 |
| piceance-og-area21 | 235 | -888.0 | -888.0 | -852.0 | -852.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2377.0 | 1296.0 | 8.0234 | 0.0361 | 0.0000 | 0.4740 | 0.0000 | 0.0199 | 0.0013 | 0.1114 | 0.3414 |
| piceance-og-area22 | 251 | -852.0 | -852.0 | -816.0 | -816.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2256.0 | 1296.0 | 2.5006 | 0.0140 | 0.0000 | 0.1836 | 0.0000 | 0.0077 | 0.0005 | 0.0431 | 0.1322 |

**Table D-6 CALPUFF Model Inputs: 2018 Non-Project Area Sources (Other State Non-Project Oil and Gas Sources)**

| name | Grid Cell | X1 (km) | X2 (km) | X3 (km) | X4 (km) | Y1 (km) | Y2 (km) | Y3 (km) | Y4 (km) | Base Elevation (m) | Grid Cell Area (km2) | NOX (TPY) | SO2 (TPY) | PMC (TPY) | PM2_5 (TPY) | PEC (TPY) | POA (TPY) | PNO3 (TPY) | PSO4 (TPY) | PMFINE (TPY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| other-og-area1 | 36 | -1320.0 | -1320.0 | -1284.0 | -1284.0 | -168.0 | -132.0 | -132.0 | -168.0 | 1885.0 | 1296.0 | 0.4300 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area2 | 78 | -1248.0 | -1248.0 | -1176.0 | -1176.0 | 192.0 | 240.0 | 240.0 | 192.0 | 1323.0 | 3456.0 | 11.9516 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area3 | 93 | -1212.0 | -1212.0 | -1176.0 | -1176.0 | 156.0 | 192.0 | 192.0 | 156.0 | 1767.0 | 1296.0 | 0.2730 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area4 | 98 | -1176.0 | -1176.0 | -1104.0 | -1104.0 | -240.0 | -168.0 | -168.0 | -240.0 | 1645.0 | 5184.0 | 0.1170 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area5 | 110 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2377.0 | 1296.0 | 100.3257 | 0.0793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area6 | 111 | -1176.0 | -1176.0 | -1140.0 | -1140.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2126.0 | 432.0 | 268.3407 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area7 | 125 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 156.0 | 192.0 | 192.0 | 156.0 | 3475.0 | 1296.0 | 3.0834 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area8 | 126 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 192.0 | 228.0 | 228.0 | 192.0 | 3109.0 | 1296.0 | 34.8651 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area9 | 127 | -1140.0 | -1140.0 | -1104.0 | -1104.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2312.0 | 432.0 | 169.3783 | 0.1196 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area10 | 128 | -1104.0 | -1104.0 | -1032.0 | -1032.0 | -312.0 | -240.0 | -240.0 | -312.0 | 1704.0 | 5184.0 | 56.0053 | 0.0094 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area11 | 130 | -1104.0 | -1104.0 | -1032.0 | -1032.0 | -240.0 | -168.0 | -168.0 | -240.0 | 1468.0 | 5184.0 | 98.9291 | 0.7614 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area12 | 133 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | -132.0 | -96.0 | -96.0 | -132.0 | 1828.0 | 1296.0 | 0.0310 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area13 | 142 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2562.0 | 1296.0 | 12.8771 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area14 | 143 | -1104.0 | -1104.0 | -1068.0 | -1068.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2018.0 | 432.0 | 14.4904 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area15 | 148 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -168.0 | -132.0 | -132.0 | -168.0 | 2072.0 | 1296.0 | 9.2192 | 0.3150 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area16 | 149 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | -132.0 | -96.0 | -96.0 | -132.0 | 1844.0 | 1296.0 | 5.9600 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area17 | 158 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2035.0 | 1296.0 | 10.6927 | 0.0025 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area18 | 159 | -1068.0 | -1068.0 | -1032.0 | -1032.0 | 228.0 | 240.0 | 240.0 | 228.0 | 1981.0 | 432.0 | 10.6927 | 0.0025 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area19 | 160 | -1032.0 | -1032.0 | -996.0 | -996.0 | -312.0 | -276.0 | -276.0 | -312.0 | 1615.0 | 1296.0 | 2095.4506 | 0.4429 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area20 | 161 | -1032.0 | -1032.0 | -996.0 | -996.0 | -276.0 | -240.0 | -240.0 | -276.0 | 1610.0 | 1296.0 | 961.0450 | 0.1261 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area21 | 162 | -1032.0 | -1032.0 | -996.0 | -996.0 | -240.0 | -204.0 | -204.0 | -240.0 | 1844.0 | 1296.0 | 0.4528 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area22 | 164 | -1032.0 | -1032.0 | -960.0 | -960.0 | -168.0 | -96.0 | -96.0 | -168.0 | 2438.0 | 5184.0 | 61.7106 | 2.2050 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area23 | 173 | -1032.0 | -1032.0 | -996.0 | -996.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2488.0 | 1296.0 | 17.3949 | 0.0015 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area24 | 174 | -1032.0 | -1032.0 | -996.0 | -996.0 | 192.0 | 228.0 | 228.0 | 192.0 | 2316.0 | 1296.0 | 0.0388 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area25 | 175 | -1032.0 | -1032.0 | -996.0 | -996.0 | 228.0 | 240.0 | 240.0 | 228.0 | 2138.0 | 432.0 | 0.0375 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area26 | 176 | -996.0 | -996.0 | -960.0 | -960.0 | -312.0 | -276.0 | -276.0 | -312.0 | 1833.0 | 1296.0 | 7956.9124 | 1.6301 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area27 | 177 | -996.0 | -996.0 | -960.0 | -960.0 | -276.0 | -240.0 | -240.0 | -276.0 | 1950.0 | 1296.0 | 7228.2454 | 0.5240 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area28 | 189 | -996.0 | -996.0 | -960.0 | -960.0 | 156.0 | 192.0 | 192.0 | 156.0 | 1871.0 | 1296.0 | 23.0573 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area29 | 190 | -996.0 | -996.0 | -924.0 | -924.0 | 192.0 | 240.0 | 240.0 | 192.0 | 2499.0 | 3456.0 | 904.6063 | 0.0987 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area30 | 192 | -960.0 | -960.0 | -924.0 | -924.0 | -312.0 | -276.0 | -276.0 | -312.0 | 1893.0 | 1296.0 | 9808.7691 | 2.1141 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area31 | 193 | -960.0 | -960.0 | -924.0 | -924.0 | -276.0 | -240.0 | -240.0 | -276.0 | 2072.0 | 1296.0 | 607.0235 | 2.2041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area32 | 205 | -960.0 | -960.0 | -924.0 | -924.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2458.0 | 1296.0 | 21.9461 | 0.0049 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area33 | 208 | -924.0 | -924.0 | -888.0 | -888.0 | -312.0 | -276.0 | -276.0 | -312.0 | 2042.0 | 1296.0 | 314.2251 | 0.1453 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area34 | 209 | -924.0 | -924.0 | -888.0 | -888.0 | -276.0 | -240.0 | -240.0 | -276.0 | 1903.0 | 1296.0 | 2.3299 | 0.0234 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area35 | 215 | -924.0 | -924.0 | -888.0 | -888.0 | -60.0 | -24.0 | -24.0 | -60.0 | 2608.0 | 1296.0 | 2.6127 | 0.0062 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area36 | 220 | -924.0 | -924.0 | -852.0 | -852.0 | 120.0 | 192.0 | 192.0 | 120.0 | 2051.0 | 5184.0 | 233.3897 | 0.0283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area37 | 222 | -924.0 | -924.0 | -852.0 | -852.0 | 192.0 | 240.0 | 240.0 | 192.0 | 2073.0 | 3456.0 | 3141.1988 | 0.3893 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area38 | 224 | -888.0 | -888.0 | -852.0 | -852.0 | -312.0 | -276.0 | -276.0 | -312.0 | 2316.0 | 1296.0 | 93.5897 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area39 | 254 | -852.0 | -852.0 | -780.0 | -780.0 | 192.0 | 240.0 | 240.0 | 192.0 | 2462.0 | 3456.0 | 1.1613 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area40 | 267 | -816.0 | -816.0 | -780.0 | -780.0 | 84.0 | 120.0 | 120.0 | 84.0 | 3004.0 | 1296.0 | 0.0135 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area41 | 268 | -816.0 | -816.0 | -780.0 | -780.0 | 120.0 | 156.0 | 156.0 | 120.0 | 3444.0 | 1296.0 | 0.1216 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area42 | 283 | -780.0 | -780.0 | -744.0 | -744.0 | 84.0 | 120.0 | 120.0 | 84.0 | 2981.0 | 1296.0 | 0.0045 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area43 | 284 | -780.0 | -780.0 | -744.0 | -744.0 | 120.0 | 156.0 | 156.0 | 120.0 | 2469.0 | 1296.0 | 1.7589 | 0.0431 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area44 | 285 | -780.0 | -780.0 | -744.0 | -744.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2682.0 | 1296.0 | 1.3134 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area45 | 286 | -780.0 | -780.0 | -720.0 | -720.0 | 192.0 | 240.0 | 240.0 | 192.0 | 3220.0 | 2880.0 | 111.3240 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| other-og-area46 | 301 | -744.0 | -744.0 | -720.0 | -720.0 | 156.0 | 192.0 | 192.0 | 156.0 | 2318.0 | 864.0 | 0.0828 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

# Appendix E

# Project Alternatives Compression Inventories

**Table E-1 Summary of Compression Emissions (Proposed Action)**

| Station | Location | Elevation | Additional Engines Proposed Action | | | Proposed Action Over Baseline (tpy) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1340 hp | 2370 hp | 1265 hp | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| Antelope Flats | 39-59-44.53 N / 109-28-05.92 W | 5022' | 3 | | | 58.2 | 6.6 | 0.4 | 1.2 | 10.9 |
| Archie Bench | 39-57-22.16 N / 109-24-41.48 W | 5174' | 4 | | | 77.6 | 8.8 | 0.5 | 1.6 | 14.5 |
| Bitter Creek | 39-56-03.49 N / 109-29-07.13 W | 5271' | 1 | | | 19.4 | 2.2 | 0.1 | 0.4 | 3.6 |
| Blue Feather | 40-02-16.65 N / 109-31-1.97 W | | 2 | | | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Bonanza Central | 39-58-37.60 N / 109-20-42.88 W | 5274' | | | | | | | | |
| Bonanza East | 39-58-12.69 N / 109-17-20.56 W | 5453' | 2 | | | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Bonanza West | 39-57-57.73 N / 109-22-14.71 W | 5298' | 3 | | | 58.2 | 6.6 | 0.4 | 1.2 | 10.9 |
| Bridge | 40-02-24.78 N / 109-27-22.37 W | 4743' | 2 | | | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Cottonwood/West 3 | 40-00-33.77 N / 109-32-35.24 W | 4952' | 1 | 1 | | 35.4 | 6.1 | 0.4 | 1.1 | 10.0 |
| Diablo | 39-58-19.40 N / 109-17-33.25 W | | | 4 | | 64.1 | 16.0 | 1.0 | 2.9 | 38.0 |
| East | 39-58-10.59 N / 109-23-34.13 W | 5123' | 1 | | | 19.4 | 2.2 | 0.1 | 0.4 | 3.6 |
| East Bench | 39-54-27.42 N / 109-27-58.21 W | 5511' | | | | | | | | |
| East Jr. | 39-59-26.27 N / 109-23-06.69 W | 4963' | | | | | | | | |
| L16 | 40-01-29.14 N / 109-39-15.26 W | 4871' | | | | | | | | |
| Love | 39-54-0.61 N/109-34-49.05 W | | 2 | | | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Morgan State | 39-59-46.13 N / 109-30-17.69 W | 5004' | | | | | | | | |
| North | 40-02-08.01 N / 109-39-9.81 W | 4816' | | | | | | | | |
| Northeast | 40-03-06.44 N / 109-32-28.69 W | 4716' | | | | | | | | |
| North Ouray | 40-03-54.59 N/109-30-0.63 W | | 2 | | | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Ouray | 40-04-15.34 N /109-29-30.54 W | 4704' | 3 | 1 | | 74.2 | 10.5 | 0.7 | 2.0 | 17.3 |
| Rimer Canyon | 39-55-11.44 N /109-24-25.6 W | | 6 | | | 116.5 | 13.2 | 0.8 | 2.5 | 21.7 |
| Sage Grouse | 39-54-13.57 N / 109-28-14.81 W | 5493' | 2 | | | 38.8 | 4.4 | 0.3 | 0.8 | 7.2 |
| Sand Wash | 39-59-45.97 N / 10927-56.05 W | 4986' | 1 | | | 19.4 | 2.2 | 0.1 | 0.4 | 3.6 |
| South | 39-56-56.77 N / 109-33-11.00 W | 5176' | | | 1 | 18.3 | 2.1 | 0.1 | 0.4 | 3.4 |
| South Central | 39-59-44.53 N / 109-28-05.92 W | 5022' | | | | | | | | |
| Southeast | 39-58-23.86 N / 109-26-39.72 W | 5161' | | | | | | | | |
| White River | 39-58-12.27 N / 109-23-08.43 W | 5160' | 3 | 2 | | 90.3 | 14.3 | 0.9 | 2.7 | 23.7 |
| Willow Creek | 39-59-57.41 N / 109-34-38.90 W | 4963' | 3 | 5 | | 74.2 | 10.5 | 0.7 | 2.0 | 17.3 |
| **Total** | | | | | | **958.3** | **127.3** | **8.0** | **23.7** | **222.0** |

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 3 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Maximum Design Heat Input | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 13.29 | 58.23 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.50 | 6.58 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.09 | 0.41 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.28 | 1.23 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 2.48 | 10.87 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 4 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 17.73 | 77.64 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.00 | 8.77 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.13 | 0.55 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.37 | 1.64 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 3.31 | 14.49 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 1 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 4.43 | 19.41 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 0.50 | 2.19 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.03 | 0.14 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.09 | 0.41 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 0.83 | 3.62 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 2 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 8.86 | 38.82 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.00 | 4.38 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.06 | 0.27 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.19 | 0.82 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 1.65 | 7.25 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 2 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 8.86 | 38.82 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.00 | 4.38 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.06 | 0.27 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.19 | 0.82 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 1.65 | 7.25 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 3 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 13.29 | 58.23 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.50 | 6.58 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.09 | 0.41 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.28 | 1.23 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 2.48 | 10.87 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 2 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 8.86 | 38.82 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.00 | 4.38 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.06 | 0.27 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.19 | 0.82 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 1.65 | 7.25 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | 1 | @ | 1340 | (bhp) | 9.38 | (MMBtu/hr) |
| | 1 | @ | 2370 | (bhp) | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 4.43 | 19.41 | 0.70 | g/hp-hr | 3.66 | 16.02 | 3.66 | 16.02 | 8.09 | 35.43 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 0.50 | 2.19 | 2.50 | g/hp-hr | 0.89 | 3.88 | 0.89 | 3.88 | 1.39 | 6.07 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.03 | 0.14 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.06 | 0.24 | 0.09 | 0.38 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.09 | 0.41 | 9.99E-03 | lb/MMBtu | 0.17 | 0.73 | 0.17 | 0.73 | 0.26 | 1.14 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 0.83 | 3.62 | 0.83 | g/hp-hr | 1.46 | 6.41 | 1.46 | 6.41 | 2.29 | 10.03 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 4 | |
| Rated Engine Capacity | 2370 | (bhp) |
| Fuel Usage | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 0.70 | g/hp-hr | | 3.66 | 16.02 | 14.63 | 64.08 | 1 |
| CO | 2.50 | g/hp-hr | 93% | 0.91 | 4.00 | 3.66 | 16.02 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.06 | 0.24 | 0.22 | 0.97 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.17 | 0.73 | 0.66 | 2.90 | 4 |
| NMHC | 0.83 | g/hp-hr | 50% | 2.17 | 9.50 | 8.67 | 37.99 | 1,2 |

[1] Manufacturer Specification, CAT G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 1 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 4.43 | 19.41 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 0.50 | 2.19 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.03 | 0.14 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.09 | 0.41 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 0.83 | 3.62 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 2 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 8.86 | 38.82 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.00 | 4.38 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.06 | 0.27 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.19 | 0.82 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 1.65 | 7.25 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 2 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 8.86 | 38.82 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.00 | 4.38 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.06 | 0.27 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.19 | 0.82 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 1.65 | 7.25 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | | @ | | (bhp) | 9.38 | (MMBtu/hr) |
| | | @ | | (bhp) | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 13.29 | 58.23 | 0.70 | g/hp-hr | 3.66 | 16.02 | 3.66 | 16.02 | 16.95 | 74.25 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.50 | 6.58 | 2.50 | g/hp-hr | 0.89 | 3.88 | 0.89 | 3.88 | 2.39 | 10.45 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.09 | 0.41 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.06 | 0.24 | 0.15 | 0.66 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.28 | 1.23 | 9.99E-03 | lb/MMBtu | 0.17 | 0.73 | 0.17 | 0.73 | 0.45 | 1.96 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 2.48 | 10.87 | 0.83 | g/hp-hr | 1.46 | 6.41 | 1.46 | 6.41 | 3.94 | 17.28 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 6 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Maximum Design Heat Input | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 26.59 | 116.45 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 3.00 | 13.15 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.19 | 0.82 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.56 | 2.46 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.96 | 21.74 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 2 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 8.86 | 38.82 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.00 | 4.38 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.06 | 0.27 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.19 | 0.82 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 1.65 | 7.25 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 1 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | (per engine) (tpy) | (per station) (lb/hr) | (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 4.43 | 19.41 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 0.50 | 2.19 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.03 | 0.14 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.09 | 0.41 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 0.83 | 3.62 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Proposed Action Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 1 | |
| Rated Engine Capacity | 1265 | (bhp) |
| Fuel Usage | 8.855 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | (per engine) (tpy) | (per station) (lb/hr) | (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.18 | 18.32 | 4.18 | 18.32 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.47 | 2.07 | 0.47 | 2.07 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.13 | 0.03 | 0.13 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.39 | 0.09 | 0.39 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.78 | 3.42 | 0.78 | 3.42 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

## Proposed Action Over Baseline

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | | @ | | (bhp) | 9.38 | (MMBtu/hr) |
| | | @ | | (bhp) | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 13.29 | 58.23 | 0.70 | g/hp-hr | 3.66 | 16.02 | 7.31 | 32.04 | 20.61 | 90.27 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.50 | 6.58 | 2.50 | g/hp-hr | 0.89 | 3.88 | 1.77 | 7.75 | 3.27 | 14.33 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.09 | 0.41 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.11 | 0.49 | 0.21 | 0.90 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.28 | 1.23 | 9.99E-03 | lb/MMBtu | 0.17 | 0.73 | 0.33 | 1.45 | 0.61 | 2.68 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 2.48 | 10.87 | 0.83 | g/hp-hr | 1.46 | 6.41 | 2.93 | 12.82 | 5.41 | 23.68 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

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**Proposed Action Over Baseline**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | | @ | | (bhp) | 9.38 | (MMBtu/hr) |
| | | @ | | (bhp) | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 13.29 | 58.23 | 0.70 | g/hp-hr | 3.66 | 16.02 | 3.66 | 16.02 | 16.95 | 74.25 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.50 | 6.58 | 2.50 | g/hp-hr | 0.89 | 3.88 | 0.89 | 3.88 | 2.39 | 10.45 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.09 | 0.41 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.06 | 0.24 | 0.15 | 0.66 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.28 | 1.23 | 9.99E-03 | lb/MMBtu | 0.17 | 0.73 | 0.17 | 0.73 | 0.45 | 1.96 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 2.48 | 10.87 | 0.83 | g/hp-hr | 1.46 | 6.41 | 1.46 | 6.41 | 3.94 | 17.28 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Table E-2 Summary of Compression Emissions (Optimal Recovery)**

| Station | Location | Elevation | Additional Engines Optimal Recovery | | | Optimal Recovery Over Baseline (tpy) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1340 hp | 2370 hp | 1265 hp | $NO_x$ | CO | $SO_2$ | $PM_{10}$ | VOC |
| Antelope Flats | 39-59-44.53 N / 109-28-05.92 W | 5022' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Archie Bench | 39-57-22.16 N / 109-24-41.48 W | 5174' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bitter Creek | 39-56-03.49 N / 109-29-07.13 W | 5271' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Blue Feather | 40-02-16.65 N / 109-31-1.97 W | | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bonanza Central | 39-58-37.60 N / 109-20-42.88 W | 5274' | | | | | | | | |
| Bonanza East | 39-58-12.69 N / 109-17-20.56 W | 5453' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bonanza West | 39-57-57.73 N / 109-22-14.71 W | 5298' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Bridge | 40-02-24.78 N / 109-27-22.37 W | 4743' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Cottonwood/West 3 | 40-00-33.77 N / 109-32-35.24 W | 4952' | 2 | 5 | | 118.9 | 23.8 | 1.5 | 4.4 | 39.3 |
| Diablo | 39-58-19.40 N / 109-17-33.25 W | | | 8 | | 128.2 | 32.0 | 1.9 | 5.8 | 76.0 |
| East | 39-58-10.59 N / 109-23-34.13 W | 5123' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| East Bench | 39-54-27.42 N / 109-27-58.21 W | 5511' | | | | | | | | |
| East Jr. | 39-59-26.27 N / 109-23-06.69 W | 4963' | | | | | | | | |
| L16 | 40-01-29.14 N / 109-39-15.26 W | 4871' | | | | | | | | |
| Love | 39-54-0.61 N/109-34-49.05 W | | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Morgan State | 39-59-46.13 N / 109-30-17.69 W | 5004' | | | | | | | | |
| North | 40-02-08.01 N / 109-39-9.81 W | 4816' | | | | | | | | |
| Northeast | 40-03-06.44 N / 109-32-28.69 W | 4716' | | | | | | | | |
| North Ouray | 40-03-54.59 N/109-30-0.63 W | | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Ouray | 40-04-15.34 N /109-29-30.54 W | 4704' | 4 | 5 | | 157.7 | 28.2 | 1.8 | 5.3 | 46.5 |
| Rimer Canyon | 39-55-11.44 N /109-24-25.6 W | | 6 | | | 116.5 | 13.2 | 0.8 | 2.5 | 21.7 |
| Sage Grouse | 39-54-13.57 N / 109-28-14.81 W | 5493' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| Sand Wash | 39-59-45.97 N / 10927-56.05 W | 4986' | 5 | | | 97.0 | 11.0 | 0.7 | 2.1 | 18.1 |
| South | 39-56-56.77 N / 109-33-11.00 W | 5176' | | | 2 | 36.6 | 4.1 | 0.3 | 0.8 | 6.8 |
| South Central | 39-59-44.53 N / 109-28-05.92 W | 5022' | | | | | | | | |
| Southeast | 39-58-23.86 N / 109-26-39.72 W | 5161' | | | | | | | | |
| White River | 39-58-12.27 N / 109-23-08.43 W | 5160' | 3 | 6 | | 154.3 | 29.8 | 1.9 | 5.6 | 49.3 |
| Willow Creek | 39-59-57.41 N / 109-34-38.90 W | 4963' | 3 | 5 | | 138.3 | 26.0 | 1.6 | 4.9 | 42.9 |
| **Total** | | | | | | **2015.1** | **288.6** | **18.0** | **53.8** | **500.0** |

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Maximum Design Heat Input | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}/PM_{2.5}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

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**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

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**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

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Cottonwood-West Complex

**Optimal Recovery Over Baseline**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | | @ | | (bhp) | | (MMBtu/hr) |
| | | @ | | (bhp) | | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 8.86 | 38.82 | 0.70 | g/hp-hr | 3.66 | 16.02 | 18.29 | 80.10 | 27.15 | 118.92 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.00 | 4.38 | 2.50 | g/hp-hr | 0.89 | 3.88 | 4.43 | 19.38 | 5.43 | 23.77 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.06 | 0.27 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.28 | 1.22 | 0.34 | 1.49 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.19 | 0.82 | 9.99E-03 | lb/MMBtu | 0.17 | 0.73 | 0.83 | 3.63 | 1.02 | 4.45 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 1.65 | 7.25 | 0.83 | g/hp-hr | 1.46 | 6.41 | 7.31 | 32.04 | 8.97 | 39.29 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

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**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 8 | |
| Rated Engine Capacity | 2370 | (bhp) |
| Fuel Usage | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 0.70 | g/hp-hr | | 3.66 | 16.02 | 29.26 | 128.16 | 1 |
| CO | 2.50 | g/hp-hr | 93% | 0.91 | 4.00 | 7.31 | 32.04 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.06 | 0.24 | 0.44 | 1.94 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.17 | 0.73 | 1.33 | 5.81 | 4 |
| NMHC | 0.83 | g/hp-hr | 50% | 2.17 | 9.50 | 17.35 | 75.98 | 1,2 |

[1] Manufacturer Specification, CAT G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

Ouray

**Optimal Recovery Over Baseline**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | 4 | @ | 1340 | (bhp) | 9.38 | (MMBtu/hr) |
| | 5 | @ | 2370 | (bhp) | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 17.73 | 77.64 | 0.70 | g/hp-hr | 3.66 | 16.02 | 18.29 | 80.10 | 36.01 | 157.73 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.00 | 8.77 | 2.50 | g/hp-hr | 0.89 | 3.88 | 4.43 | 19.38 | 6.43 | 28.15 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.13 | 0.55 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.28 | 1.22 | 0.40 | 1.76 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.37 | 1.64 | 9.99E-03 | lb/MMB | 0.17 | 0.73 | 0.83 | 3.63 | 1.20 | 5.27 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 3.31 | 14.49 | 0.83 | g/hp-hr | 1.46 | 6.41 | 7.31 | 32.04 | 10.62 | 46.53 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 6 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Maximum Design Heat Input | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 26.59 | 116.45 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 3.00 | 13.15 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.19 | 0.82 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.56 | 2.46 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.96 | 21.74 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 5 | |
| Rated Engine Capacity | 1340 | (bhp) |
| Fuel Usage | 9.38 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 22.16 | 97.05 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 2.50 | 10.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.16 | 0.69 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.47 | 2.05 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 4.14 | 18.12 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

**Optimal Recovery Over Baseline**

| | | |
|---|---|---|
| Operating Time | 8760 | (hrs/year) |
| Fuel Sulfur Content | 0.012 | (gr/scf) |
| Natural Gas Heating Value | 950 | (Btu/scf) |
| Conversion | 454 | (g/lb) |
| Conversion | 7,000 | (gr/lb) |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) |
| Proposed Number of Engines | 2 | |
| Rated Engine Capacity | 1265 | (bhp) |
| Fuel Usage | 8.855 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff (%) | Emission Rate (per engine) (lb/hr) | Emission Rate (per engine) (tpy) | Emission Rate (per station) (lb/hr) | Emission Rate (per station) (tpy) | Notes |
|---|---|---|---|---|---|---|---|---|
| $NO_x$ | 1.50 | g/hp-hr | | 4.18 | 18.32 | 8.37 | 36.65 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.47 | 2.07 | 0.94 | 4.14 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.13 | 0.06 | 0.26 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.39 | 0.18 | 0.77 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.78 | 3.42 | 1.56 | 6.84 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

White River

**Optimal Recovery Over Baseline**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | 3 | @ | 1340 | (bhp) | 9.38 | (MMBtu/hr) |
| | 6 | @ | 2370 | (bhp) | 16.59 | (MMBtu/hr) |

| Pollutant | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 13.29 | 58.23 | 0.70 | g/hp-hr | 3.66 | 16.02 | 21.94 | 96.12 | 35.24 | 154.35 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.50 | 6.58 | 2.50 | g/hp-hr | 0.89 | 3.88 | 5.31 | 23.26 | 6.81 | 29.84 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.09 | 0.41 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.33 | 1.46 | 0.43 | 1.87 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.28 | 1.23 | 9.99E-03 | lb/MMBtu | 0.17 | 0.73 | 0.99 | 4.35 | 1.28 | 5.59 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 2.48 | 10.87 | 0.83 | g/hp-hr | 1.46 | 6.41 | 8.78 | 38.45 | 11.26 | 49.32 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

Willow Creek

**Optimal Recovery Over Baseline**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Time | 8760 | (hrs/year) | | | | |
| Fuel Sulfur Content | 0.012 | (gr/scf) | | | | |
| Natural Gas Heating Value | 950 | (Btu/scf) | | | | |
| Conversion | 454 | (g/lb) | | | | |
| Conversion | 7,000 | (gr/lb) | | | | |
| Brake Specific Fuel Consumption | 7,000 | (Btu/bhp-hr) | | | | |
| Proposed Number of Engines | 3 | @ | 1340 | (bhp) | 9.38 | (MMBtu/hr) |
| | 5 | @ | 2370 | (bhp) | 16.59 | (MMBtu/hr) |

| Pollutan | Emission Factor | | Control Eff | 3516 Engine | | | | 3608 Engine | | | | | | Total | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Emission Rate | | | | Emission Factor | | Emission Rate | | | | | | |
| | | | | (per engine) | | (per station) | | | | (per engine) | | (per station) | | (lb/hr) | (tpy) | |
| | | | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | (lb/hr) | (tpy) | (lb/hr) | (tpy) | | | |
| $NO_x$ | 1.50 | g/hp-hr | | 4.43 | 19.41 | 13.29 | 58.23 | 0.70 | g/hp-hr | 3.66 | 16.02 | 18.29 | 80.10 | 31.58 | 138.33 | 1 |
| CO | 2.42 | g/hp-hr | 93% | 0.50 | 2.19 | 1.50 | 6.58 | 2.50 | g/hp-hr | 0.89 | 3.88 | 4.43 | 19.38 | 5.93 | 25.96 | 1, 2 |
| $SO_2$ | 2.34E-05 | lb/hp-hr | | 0.03 | 0.14 | 0.09 | 0.41 | 2.34E-05 | lb/hp-hr | 0.06 | 0.24 | 0.28 | 1.22 | 0.37 | 1.63 | 3 |
| $PM_{10}$ | 9.99E-03 | lb/MMBtu | | 0.09 | 0.41 | 0.28 | 1.23 | 9.99E-03 | lb/MMBtu | 0.17 | 0.73 | 0.83 | 3.63 | 1.11 | 4.86 | 4 |
| NMHC | 0.56 | g/hp-hr | 50% | 0.83 | 3.62 | 2.48 | 10.87 | 0.83 | g/hp-hr | 1.46 | 6.41 | 7.31 | 32.04 | 9.80 | 42.91 | 1,2 |

[1] Manufacturer Specification, CAT G3516 LE and G3608 Engine

[2] 93% CO Control Efficiency for oxidation catalyst; 50% VOC control efficiency

[3] EF (lb/hp-hr) = BSFC (Btu/bhp-hr) / Heating Value (Btu/scf) x Fuel Sulfur Content (gr/scf) / 7000 (gr/lb) x MW ($SO_2$)/MW ($H_2S$)

[4] AP-42 Chapter 3.2

# Appendix F

# SANGEA Output for Analysis of Greenhouse Gases

| Primary Production & Performance | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Emissions | tonne | 1,761,016 | 435,608 | 437,269 | 442,549 | 445,590 | 150,090 | 136,048 | 149,470 | 144,210 | 148,850 | 144,210 | 148,850 | 148,850 | 144,850 | 150,090 | 145,410 | 150,090 |
| Total BOE | bbl | 33,766,667 | 8,326,027 | 8,418,539 | 8,511,050 | 8,511,050 | 2,867,854 | 2,590,320 | 2,867,854 | 2,775,342 | 2,867,854 | 2,775,342 | 2,867,854 | 2,867,854 | 2,775,342 | 2,867,854 | 2,775,342 | 2,867,854 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emissions for E&P | tonne | 304,583 | 76,461 | 74,153 | 75,464 | 78,505 | 26,405 | 24,271 | 25,785 | 24,494 | 25,165 | 24,494 | 25,165 | 25,165 | 25,134 | 26,405 | 25,694 | 26,405 |
| BOE for E&P | bbl | 16,883,333 | 4,163,014 | 4,209,269 | 4,255,525 | 4,255,525 | 1,433,927 | 1,295,160 | 1,433,927 | 1,387,671 | 1,433,927 | 1,387,671 | 1,433,927 | 1,433,927 | 1,387,671 | 1,433,927 | 1,387,671 | 1,433,927 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission for E&P | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission for E&P | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy for E&P | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy for E&P | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emissions for Midstream | tonne | 1,456,433 | 359,147 | 363,116 | 367,085 | 367,085 | 123,685 | 111,778 | 123,685 | 119,716 | 123,685 | 119,716 | 123,685 | 123,685 | 119,716 | 123,685 | 119,716 | 123,685 |
| BOE for Midstream | bbl | 16,883,333 | 4,163,014 | 4,209,269 | 4,255,525 | 4,255,525 | 1,433,927 | 1,295,160 | 1,433,927 | 1,387,671 | 1,433,927 | 1,387,671 | 1,433,927 | 1,433,927 | 1,387,671 | 1,433,927 | 1,387,671 | 1,433,927 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission for Midstream | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission for Midstream | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy for Midstream | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy for Midstream | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

| Secondary Production Measures | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Forecast Emissions | Units | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| BOE | bbl | 33,766,667 | | | | |
| Forecast Emissions (Excl Flaring | tonne | 1,760,770 | | | | |
| Flaring Emissions | tonne | 246 | | | | |
| Total Forecast Emissions | tonne | **1,761,016** | **0** | **0** | **0** | **0** |

| Report by Location | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | Total $CO_2e$ | Energy (10^3 Btu (LHV)) |
|---|---|---|---|---|---|---|---|
| E&P | 209,440 | 4,351 | 12.2 | 91,374 | 3,769 | 304,583 | 3,106,833,911 |
| Midstream | 1,351,304 | 4,672 | 22.6 | 98,121 | 7,007 | 1,456,433 | 16,299,920,120 |
| Total (tonne) | **1,560,744** | **9,024** | **34.8** | **189,496** | **10,777** | **1,761,016** | **19,406,754,031** |

| Report by Module | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | $CO_2e$ | Energy (10^3 Btu (LHV)) |
|---|---|---|---|---|---|---|---|
| Combustion | 569,774 | 24 | 19.0 | 508 | 5,884 | 576,166 | 9,141,718,895 |
| Flare | 239 | 0 | 0.0 | 5 | 1 | 246 | n/a |
| Flashing | 0 | 1,463 | 0.0 | 30,730 | 0 | 30,730 | n/a |
| Fugitive | n/a | 6,056 | n/a | 127,182 | n/a | 127,182 | n/a |
| Indirect Emission | 990,719 | 7 | 15.8 | 144 | 4,891 | 995,754 | 10,265,035,136 |
| Miscellaneous | 0 | 0 | 0.0 | 0 | 0 | 0 | n/a |
| Venting | 12 | 1,473 | n/a | 30,926 | n/a | 30,938 | n/a |
| Total (tonne) | **1,560,744** | **9,024** | **34.8** | **189,496** | **10,777** | **1,761,016** | **19,406,754,031** |

| Key Input Data | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diesel / Distillate (No. 2 | 10^3 gal | 10,087 | 2,609 | 2,338 | 2,421 | 2,719 | 915 | 841 | 854 | 772 | 793 | 772 | 793 | 793 | 835 | 915 | 890 | 915 |
| Gasoline | 10^3 gal | 467 | 115 | 117 | 118 | 118 | 40 | 36 | 40 | 38 | 40 | 38 | 40 | 40 | 38 | 40 | 38 | 40 |
| Unitah Fuel Gas | 10^6 Btu (HHV) | 1,992,900 | 491,400 | 496,860 | 502,320 | 502,320 | 169,260 | 152,880 | 169,260 | 163,800 | 169,260 | 163,800 | 169,260 | 169,260 | 163,800 | 169,260 | 163,800 | 169,260 |
| GNB Fuel Gas | 10^6 Btu (HHV) | 6,643,365 | 1,638,090 | 1,656,291 | 1,674,492 | 1,674,492 | 564,231 | 509,628 | 564,231 | 546,030 | 564,231 | 546,030 | 564,231 | 564,231 | 546,030 | 564,231 | 546,030 | 564,231 |
| Electricity | GWh | 1,039 | 256 | 259 | 262 | 262 | 88 | 80 | 88 | 85 | 88 | 85 | 88 | 88 | 85 | 88 | 85 | 88 |

| $CO_2$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 209,427 | 0 | 0 | n/a | 0 | 0 | 12 | **209,440** |
| Midstream | 360,346 | 239 | 0 | n/a | 990,719 | 0 | 0 | **1,351,304** |
| Total (tonne) | **569,774** | **239** | **0** | **0** | **990,719** | **0** | **12** | **1,560,744** |

| $CH_4$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 17 | 0 | 129 | 2,732 | 0 | 0 | 1,473 | **4,351** |
| Midstream | 7 | 0 | 1,334 | 3,324 | 7 | 0 | 0 | **4,672** |
| Total (tonne) | **24** | **0** | **1,463** | **6,056** | **7** | **0** | **1,473** | **9,024** |

| $N_2O$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 12.2 | 0.0 | 0.0 | n/a | 0.0 | 0.0 | n/a | **12.2** |
| Midstream | 6.8 | 0.0 | 0.0 | n/a | 15.8 | 0.0 | n/a | **22.6** |
| Total (tonne) | **19.0** | **0.0** | **0.0** | **0.0** | **15.8** | **0.0** | **0.0** | **34.8** |

| $CO_2e$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 213,554 | n/a | 2,719 | 57,372 | n/a | n/a | 30,938 | **304,583** |
| Midstream | 362,612 | 246 | 28,012 | 69,809 | 995,754 | n/a | n/a | **1,456,433** |
| Total (tonne) | **576,166** | **246** | **30,730** | **127,182** | **995,754** | **0** | **30,938** | **1,761,016** |

| Primary Production & Performance | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Emissions | tonne | 2,754,167 | 681,544 | 683,544 | 691,880 | 697,200 | 234,829 | 212,971 | 233,744 | 225,443 | 232,658 | 225,443 | 232,658 | 232,658 | 226,563 | 234,829 | 227,543 | 234,829 |
| Total BOE | bbl | 106,300,000 | 26,210,959 | 26,502,192 | 26,793,425 | 26,793,425 | 9,028,219 | 8,154,521 | 9,028,219 | 8,736,986 | 9,028,219 | 8,736,986 | 9,028,219 | 9,028,219 | 8,736,986 | 9,028,219 | 8,736,986 | 9,028,219 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emissions for E&P | tonne | 856,895 | 213,688 | 210,518 | 213,684 | 219,005 | 73,707 | 67,359 | 72,622 | 69,491 | 71,537 | 69,491 | 71,537 | 71,537 | 70,611 | 73,707 | 71,591 | 73,707 |
| BOE for E&P | bbl | 53,150,000 | 13,105,479 | 13,251,096 | 13,396,712 | 13,396,712 | 4,514,110 | 4,077,260 | 4,514,110 | 4,368,493 | 4,514,110 | 4,368,493 | 4,514,110 | 4,514,110 | 4,368,493 | 4,514,110 | 4,368,493 | 4,514,110 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission for E&P | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission for E&P | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy for E&P | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy for E&P | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emissions for Midstream | tonne | 1,897,272 | 467,856 | 473,026 | 478,195 | 478,195 | 161,122 | 145,613 | 161,122 | 155,952 | 161,122 | 155,952 | 161,122 | 161,122 | 155,952 | 161,122 | 155,952 | 161,122 |
| BOE for Midstream | bbl | 53,150,000 | 13,105,479 | 13,251,096 | 13,396,712 | 13,396,712 | 4,514,110 | 4,077,260 | 4,514,110 | 4,368,493 | 4,514,110 | 4,368,493 | 4,514,110 | 4,514,110 | 4,368,493 | 4,514,110 | 4,368,493 | 4,514,110 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission for Midstream | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission for Midstream | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy for Midstream | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy for Midstream | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

| Secondary Production Measures | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Forecast Emissions | Units | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| BOE | bbl | 106,300,000 | | | | |
| Forecast Emissions (Excl Flaring | tonne | 2,753,393 | | | | |
| Flaring Emissions | tonne | 775 | | | | |
| Total Forecast Emissions | tonne | **2,754,167** | **0** | **0** | **0** | **0** |

| Report by Location | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | Total $CO_2e$ | Energy (10^3 Btu (LHV)) |
|---|---|---|---|---|---|---|---|
| E&P | 601,845 | 11,767 | 25.6 | 247,112 | 7,938 | 856,895 | 9,376,469,385 |
| Midstream | 1,629,608 | 12,334 | 27.9 | 259,022 | 8,642 | 1,897,272 | 19,722,093,151 |
| Total (tonne) | 2,231,452 | 24,102 | 53.5 | 506,135 | 16,580 | 2,754,167 | 29,098,562,536 |

| Report by Module | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | $CO_2e$ | Energy (10^3 Btu (LHV)) |
|---|---|---|---|---|---|---|---|
| Combustion | 1,053,067 | 44 | 34.7 | 925 | 10,762 | 1,064,753 | 16,897,101,138 |
| Flare | 753 | 1 | 0.0 | 17 | 5 | 775 | n/a |
| Flashing | 0 | 4,245 | 0.0 | 89,142 | 0 | 89,142 | n/a |
| Fugitive | n/a | 17,142 | n/a | 359,973 | n/a | 359,973 | n/a |
| Indirect Emission | 1,177,611 | 8 | 18.8 | 171 | 5,814 | 1,183,596 | 12,201,461,398 |
| Miscellaneous | 0 | 0 | 0.0 | 0 | 0 | 0 | n/a |
| Venting | 21 | 2,662 | n/a | 55,907 | n/a | 55,928 | n/a |
| Total (tonne) | 2,231,452 | 24,102 | 53.5 | 506,135 | 16,580 | 2,754,167 | 29,098,562,536 |

| Key Input Data | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diesel / Distillate (No. 2 | 10^3 gal | 18,144 | 4,688 | 4,213 | 4,361 | 4,883 | 1,642 | 1,510 | 1,536 | 1,392 | 1,429 | 1,392 | 1,429 | 1,429 | 1,502 | 1,642 | 1,598 | 1,642 |
| Gasoline | 10^3 gal | 1,417 | 350 | 353 | 357 | 357 | 120 | 109 | 120 | 117 | 120 | 117 | 120 | 120 | 117 | 120 | 117 | 120 |
| Unitah Fuel Gas | 10^6 Btu (HHV) | 7,830,564 | 1,930,824 | 1,952,278 | 1,973,731 | 1,973,731 | 665,062 | 600,701 | 665,062 | 643,608 | 665,062 | 643,608 | 665,062 | 665,062 | 643,608 | 665,062 | 643,608 | 665,062 |
| GNB Fuel Gas | 10^6 Btu (HHV) | 8,128,535 | 2,004,296 | 2,026,566 | 2,048,836 | 2,048,836 | 690,369 | 623,559 | 690,369 | 668,099 | 690,369 | 668,099 | 690,369 | 690,369 | 668,099 | 690,369 | 668,099 | 690,369 |
| Electricity | GWh | 1,235 | 305 | 308 | 311 | 311 | 105 | 95 | 105 | 102 | 105 | 102 | 105 | 105 | 102 | 105 | 102 | 105 |

| $CO_2$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 601,824 | 0 | 0 | n/a | 0 | 0 | 21 | **601,845** |
| Midstream | 451,244 | 753 | 0 | n/a | 1,177,611 | 0 | 0 | **1,629,608** |
| Total (tonne) | 1,053,067 | 753 | 0 | 0 | 1,177,611 | 0 | 21 | 2,231,452 |

| $CH_4$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 34 | 0 | 408 | 8,663 | 0 | 0 | 2,662 | **11,767** |
| Midstream | 10 | 1 | 3,837 | 8,478 | 8 | 0 | 0 | **12,334** |
| Total (tonne) | 44 | 1 | 4,245 | 17,142 | 8 | 0 | 2,662 | 24,102 |

| $N_2O$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 25.6 | 0.0 | 0.0 | n/a | 0.0 | 0.0 | n/a | **25.6** |
| Midstream | 9.1 | 0.0 | 0.0 | n/a | 18.8 | 0.0 | n/a | **27.9** |
| Total (tonne) | 34.7 | 0.0 | 0.0 | 0.0 | 18.8 | 0.0 | 0.0 | 53.5 |

| $CO_2e$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 610,482 | n/a | 8,559 | 181,926 | n/a | n/a | 55,928 | **856,895** |
| Midstream | 454,272 | 775 | 80,583 | 178,047 | 1,183,596 | n/a | n/a | **1,897,272** |
| Total (tonne) | 1,064,753 | 775 | 89,142 | 359,973 | 1,183,596 | 0 | 55,928 | 2,754,167 |

| Primary Production & Performance | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Emissions | tonne | 5,484,666 | 1,357,206 | 1,361,178 | 1,377,820 | 1,388,462 | 467,668 | 424,041 | 465,498 | 448,925 | 463,327 | 448,925 | 463,327 | 463,327 | 451,166 | 467,668 | 453,126 | 467,668 |
| Total BOE | bbl | 205,566,667 | 50,687,671 | 51,250,868 | 51,814,064 | 51,814,064 | 17,459,087 | 15,769,498 | 17,459,087 | 16,895,890 | 17,459,087 | 16,895,890 | 17,459,087 | 17,459,087 | 16,895,890 | 17,459,087 | 16,895,890 | 17,459,087 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emissions for E&P | tonne | 2,406,281 | 598,117 | 593,683 | 601,920 | 612,561 | 206,233 | 187,822 | 204,062 | 195,895 | 201,892 | 195,895 | 201,892 | 201,892 | 198,136 | 206,233 | 200,096 | 206,233 |
| BOE for E&P | bbl | 102,783,333 | 25,343,836 | 25,625,434 | 25,907,032 | 25,907,032 | 8,729,543 | 7,884,749 | 8,729,543 | 8,447,945 | 8,729,543 | 8,447,945 | 8,729,543 | 8,729,543 | 8,447,945 | 8,729,543 | 8,447,945 | 8,729,543 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission for E&P | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission for E&P | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy for E&P | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy for E&P | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emissions for Midstream | tonne | 3,078,385 | 759,089 | 767,495 | 775,900 | 775,900 | 261,435 | 236,218 | 261,435 | 253,030 | 261,435 | 253,030 | 261,435 | 261,435 | 253,030 | 261,435 | 253,030 | 261,435 |
| BOE for Midstream | bbl | 102,783,333 | 25,343,836 | 25,625,434 | 25,907,032 | 25,907,032 | 8,729,543 | 7,884,749 | 8,729,543 | 8,447,945 | 8,729,543 | 8,447,945 | 8,729,543 | 8,729,543 | 8,447,945 | 8,729,543 | 8,447,945 | 8,729,543 |
| $CO_2e$ / BOE | tonne/bbl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Actual Emission for Midstream | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Emission for Midstream | tonne/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Emission Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Actual Energy for Midstream | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Standard Energy for Midstream | 10^6 Btu/Day | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Energy Index | Index | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

| Secondary Production Measures | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Forecast Emissions | Units | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| BOE | bbl | 205,566,667 | | | | |
| Forecast Emissions (Excl Flaring | tonne | 5,483,168 | | | | |
| Flaring Emissions | tonne | 1,498 | | | | |
| Total Forecast Emissions | tonne | **5,484,666** | **0** | **0** | **0** | **0** |

| Report by Location | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | Total $CO_2e$ | Energy (10^3 Btu (LHV)) |
|---|---|---|---|---|---|---|---|
| E&P | 1,905,882 | 22,884 | 64.0 | 480,557 | 19,842 | 2,406,281 | 30,552,083,573 |
| Midstream | 2,613,769 | 21,433 | 46.9 | 450,090 | 14,526 | 3,078,385 | 32,123,458,098 |
| Total (tonne) | **4,519,651** | **44,317** | **110.9** | **930,647** | **34,368** | **5,484,666** | **62,675,541,671** |

| Report by Module | $CO_2$ | $CH_4$ | $N_2O$ | $CH_4$ ($CO_2e$) | $N_2O$ ($CO_2e$) | $CO_2e$ | Energy (10^3 Btu (LHV)) |
|---|---|---|---|---|---|---|---|
| Combustion | 2,725,513 | 102 | 82.3 | 2,138 | 25,509 | 2,753,160 | 44,101,657,114 |
| Flare | 1,456 | 2 | 0.0 | 33 | 9 | 1,498 | n/a |
| Flashing | 0 | 13,709 | 0.0 | 287,883 | 0 | 287,883 | n/a |
| Fugitive | n/a | 24,870 | n/a | 522,260 | n/a | 522,260 | n/a |
| Indirect Emission | 1,792,639 | 12 | 28.5 | 261 | 8,850 | 1,801,750 | 18,573,884,557 |
| Miscellaneous | 0 | 0 | 0.0 | 0 | 0 | 0 | n/a |
| Venting | 43 | 5,622 | n/a | 118,072 | n/a | 118,115 | n/a |
| Total (tonne) | **4,519,651** | **44,317** | **110.9** | **930,647** | **34,368** | **5,484,666** | **62,675,541,671** |

| Key Input Data | Units | YTD | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diesel / Distillate (No. 2 | 10^3 gal | 36,800 | 9,501 | 8,554 | 8,850 | 9,894 | 3,328 | 3,059 | 3,115 | 2,826 | 2,902 | 2,826 | 2,902 | 2,902 | 3,046 | 3,328 | 3,238 | 3,328 |
| Gasoline | 10^3 gal | 4,926 | 1,215 | 1,228 | 1,242 | 1,242 | 418 | 378 | 418 | 405 | 418 | 405 | 418 | 418 | 405 | 418 | 405 | 418 |
| Unitah Fuel Gas | 10^6 Btu (HHV) | 28,826,094 | 7,107,804 | 7,186,780 | 7,265,755 | 7,265,755 | 2,448,244 | 2,211,317 | 2,448,244 | 2,369,268 | 2,448,244 | 2,369,268 | 2,448,244 | 2,448,244 | 2,369,268 | 2,448,244 | 2,369,268 | 2,448,244 |
| GNB Fuel Gas | 10^6 Btu (HHV) | 14,183,885 | 3,497,396 | 3,536,256 | 3,575,116 | 3,575,116 | 1,204,659 | 1,088,079 | 1,204,659 | 1,165,799 | 1,204,659 | 1,165,799 | 1,204,659 | 1,204,659 | 1,165,799 | 1,204,659 | 1,165,799 | 1,204,659 |
| Electricity | GWh | 1,880 | 464 | 469 | 474 | 474 | 160 | 144 | 160 | 155 | 160 | 155 | 160 | 160 | 155 | 160 | 155 | 160 |

| $CO_2$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 1,905,839 | 0 | 0 | n/a | 0 | 0 | 43 | **1,905,882** |
| Midstream | 819,674 | 1,456 | 0 | n/a | 1,792,639 | 0 | 0 | **2,613,769** |
| Total (tonne) | **2,725,513** | **1,456** | **0** | **0** | **1,792,639** | **0** | **43** | **4,519,651** |

| $CH_4$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 82 | 0 | 788 | 16,391 | 0 | 0 | 5,622 | **22,884** |
| Midstream | 20 | 2 | 12,921 | 8,478 | 12 | 0 | 0 | **21,433** |
| Total (tonne) | **102** | **2** | **13,709** | **24,870** | **12** | **0** | **5,622** | **44,317** |

| $N_2O$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 64.0 | 0.0 | 0.0 | n/a | 0.0 | 0.0 | n/a | **64.0** |
| Midstream | 18.3 | 0.0 | 0.0 | n/a | 28.5 | 0.0 | n/a | **46.9** |
| Total (tonne) | **82.3** | **0.0** | **0.0** | **0.0** | **28.5** | **0.0** | **0.0** | **110.9** |

| $CO_2e$ (by Location & Module) | Combustion | Flare | Flashing | Fugitive | Indirect Emissi | Miscellaneous | Venting | Total (tonne): |
|---|---|---|---|---|---|---|---|---|
| E&P | 1,927,403 | n/a | 16,551 | 344,213 | n/a | n/a | 118,115 | **2,406,281** |
| Midstream | 825,758 | 1,498 | 271,332 | 178,047 | 1,801,750 | n/a | n/a | **3,078,385** |
| Total (tonne) | **2,753,160** | **1,498** | **287,883** | **522,260** | **1,801,750** | **0** | **118,115** | **5,484,666** |