Appendix G
Air Quality Technical Support Document

Greater Natural Buttes
Air Quality Technical Support Document

Vernal Field Office/Utah

Bureau of Land Management

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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. ***D***ata from these two new stations ***were not available for*** use ***in the ozone modeling*** 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,***213***	12,209	4,946	15,084
CO	7,800	9,732	1,***300***	10,887	2,994	12,726
SO_2	391	30	25	55	78	108
PM_{10}	592	565	***1,011***	1,538	2,***657***	3,223
VOC	70,226	184,262	6,***617***	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.***0***	255.2
Toluene	***172.4***	661.9
Ethyl Benzene	12.7	48.5
Xylenes	***185.7***	714.1
Formaldehyde	***71.3***	156.5
n-Hexane	***194.9***	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.

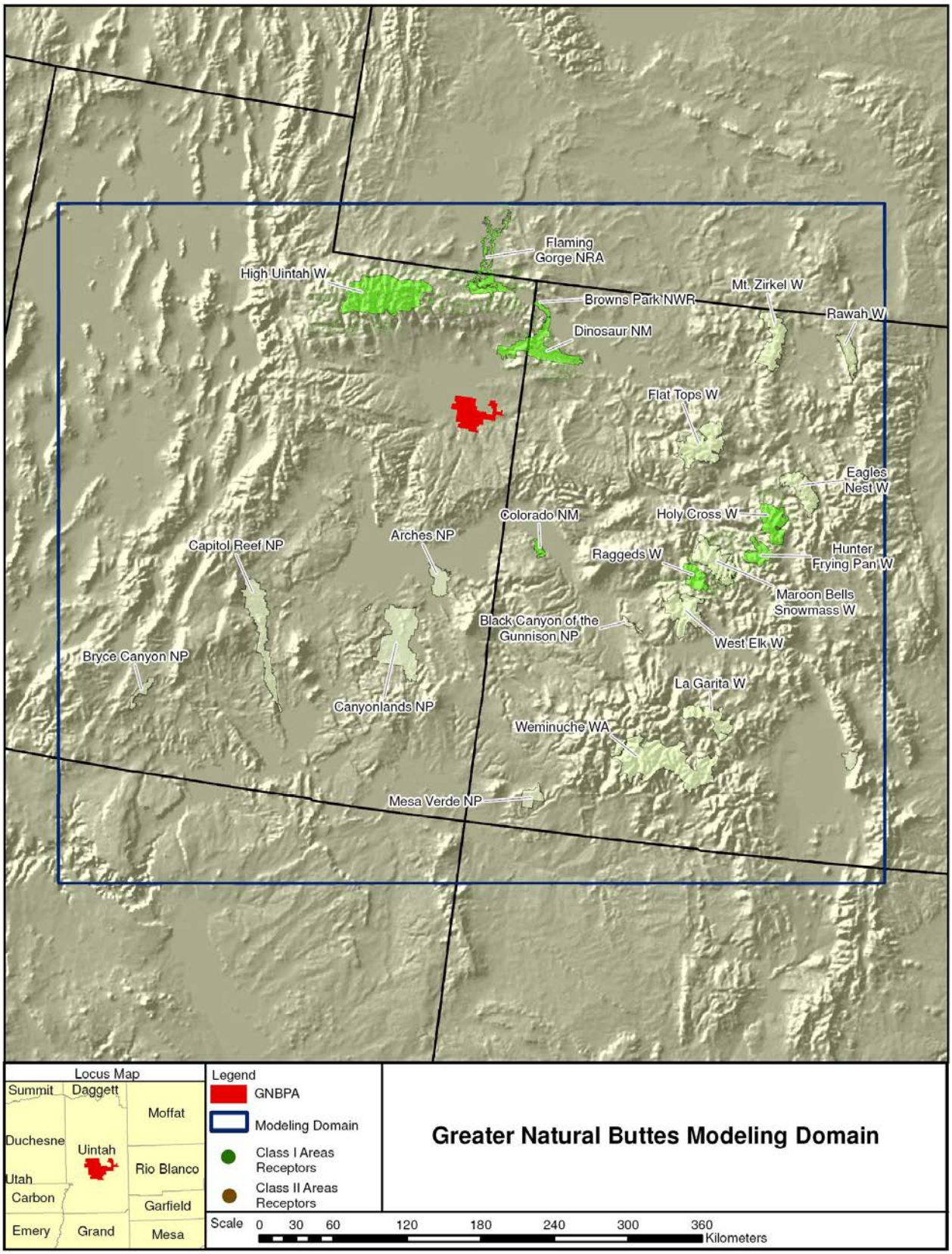

Figure ES-1 Greater Natural Buttes Modeling Domain

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 kilograms per hectare-year 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

Using background data from AQS, the localized impacts on ambient air quality for criteria pollutants of single sources plus background were all less than the NAAQS. The impacts of all multiple production well scenarios also were below the NAAQS. Near-field modeling showed that simultaneous operation of drill rigs on adjacent pads would not cause an exceedance of the NAAQS for 1-hour NO_2. The modeled ambient air concentrations of HAPs do not exceed USEPA RfCs or TSLs for any scenario or pollutant.

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 NEPA ***requirements***, 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.

In response to comments on the Draft EIS, a supplemental air quality analysis was conducted in December 2010. This analysis addresses potential air quality impacts from the project relative to new National Ambient Air Quality Standards (NAAQS) promulgated in 2010 subsequent to the analysis conducted for the Draft EIS. Further, additional analysis was conducted to determine ambient air concentrations of selected hazardous air pollutants (HAPs). The supplemental analysis also discloses additional air quality monitoring data collected in 2010 from stations near the GNBPA.

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.

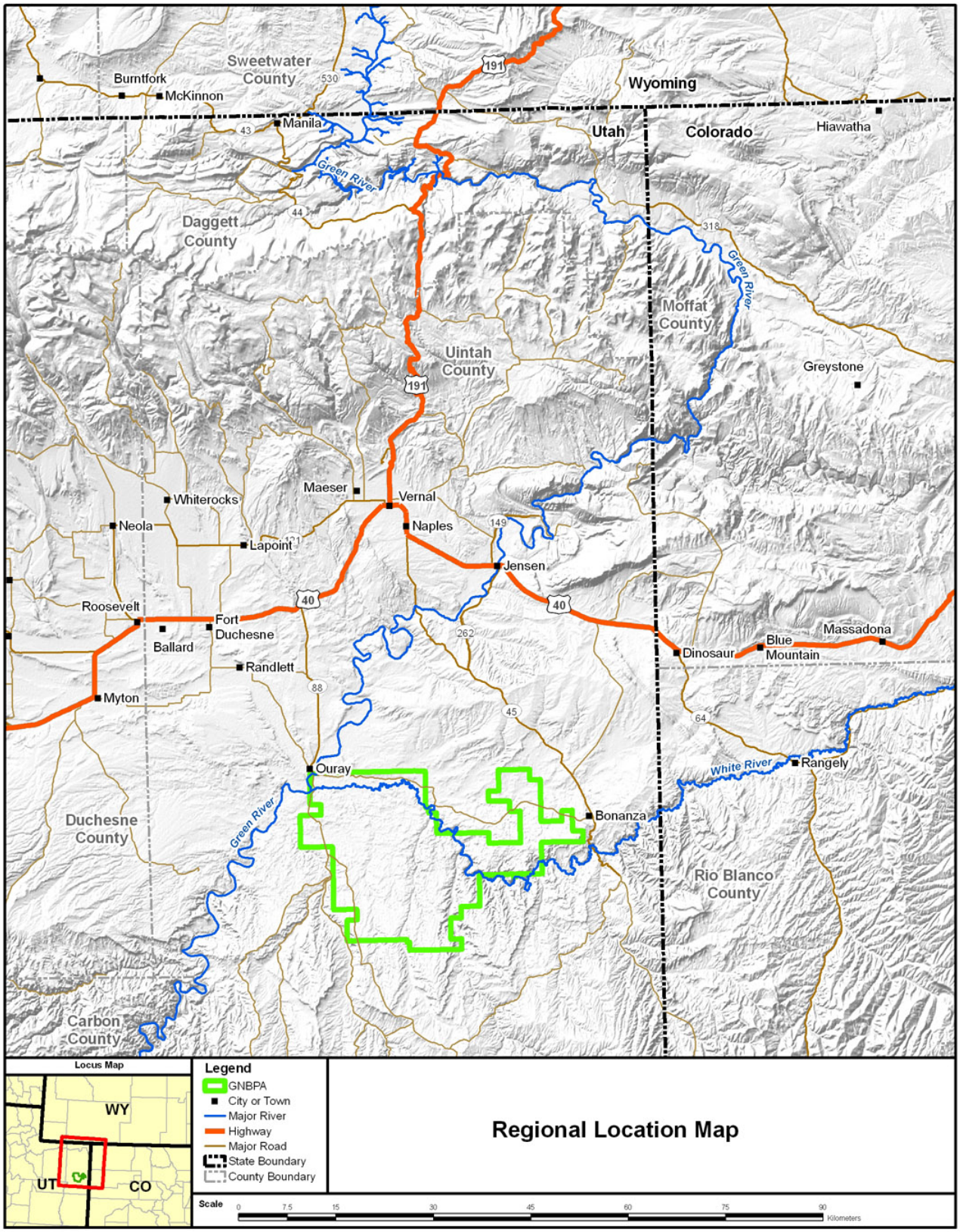


Figure 1-1 Location of GNBPA

KMG has committed to ***a number of*** environmental protection measures to reduce emissions of criteria and HAPs from the proposed project. ***Those measures that were quantified in the modeling analysis*** are summarized in **Table 1-1**.

Table 1-1 Applicant-committed Environmental Protection Measures *Considered in Modeling*

Source Type	Proposed Control	*Considerations in Modeling* Analysis
Natural Gas Fired Engines	For engines ***greater than 500 horsepower (hp)***, install lean burn engines ***or engines equipped to achieve comparable emissions reduction.***	All stationary engines considered for the project are greater than 500 hp, and therefore will be considered lean burn. ***KMG provided manufacturer specified emission rates for compression engines.***
	Install catalyst on all natural gas fired ***compression.***	***Because*** all ***compression*** engines ***considered in the analysis*** are lean burn, the analysis ***assumes*** 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***, where feasible.***	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 ***(90 percent by 2010 and 100 percent*** by 2012***).***[1]	***The use of both Tier 2 and Tier 4 engines was considered in the near-field impact analysis. The far-field and regional analyses were specific to a project year past the implementation of Tier 4 engines. Therefore, the far-field analysis only considered the use of Tier 4 engines.***
Dehydrators	Install ***low-***emission dehydrat***ion units.***	***Consistent with low emission dehydrators, venting emissions were not considered; however, combustion emissions from production heaters were included in the analysis.***
Pneumatics	Install low-bleed pneumatic ***controllers on all new equipment.***	The fugitive emission calculations consider low-bleed pneumatics. ***The projected future baseline emissions considered the replacement of existing pneumatic controllers with 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 completion” ***best management practices.***	No VOC from completions and “green completions” assumed for greenhouse gas analysis.

[1] ***The implementation of Tier 2 engine standards as specified in 40 Code of Federal Regulations (CFR) 89.112 supersedes this Applicant-committed Environmental Protection Measure.***

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 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] 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.

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 Schere 2006***; USEPA*** 1999). 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.

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 ***[FR]*** 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***a***) and is ***similar to the FLAG 2010***

update ***(FLAG 2010)***. Method 6 results were presented as consistent with the BART guideline. That is, the 98th 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

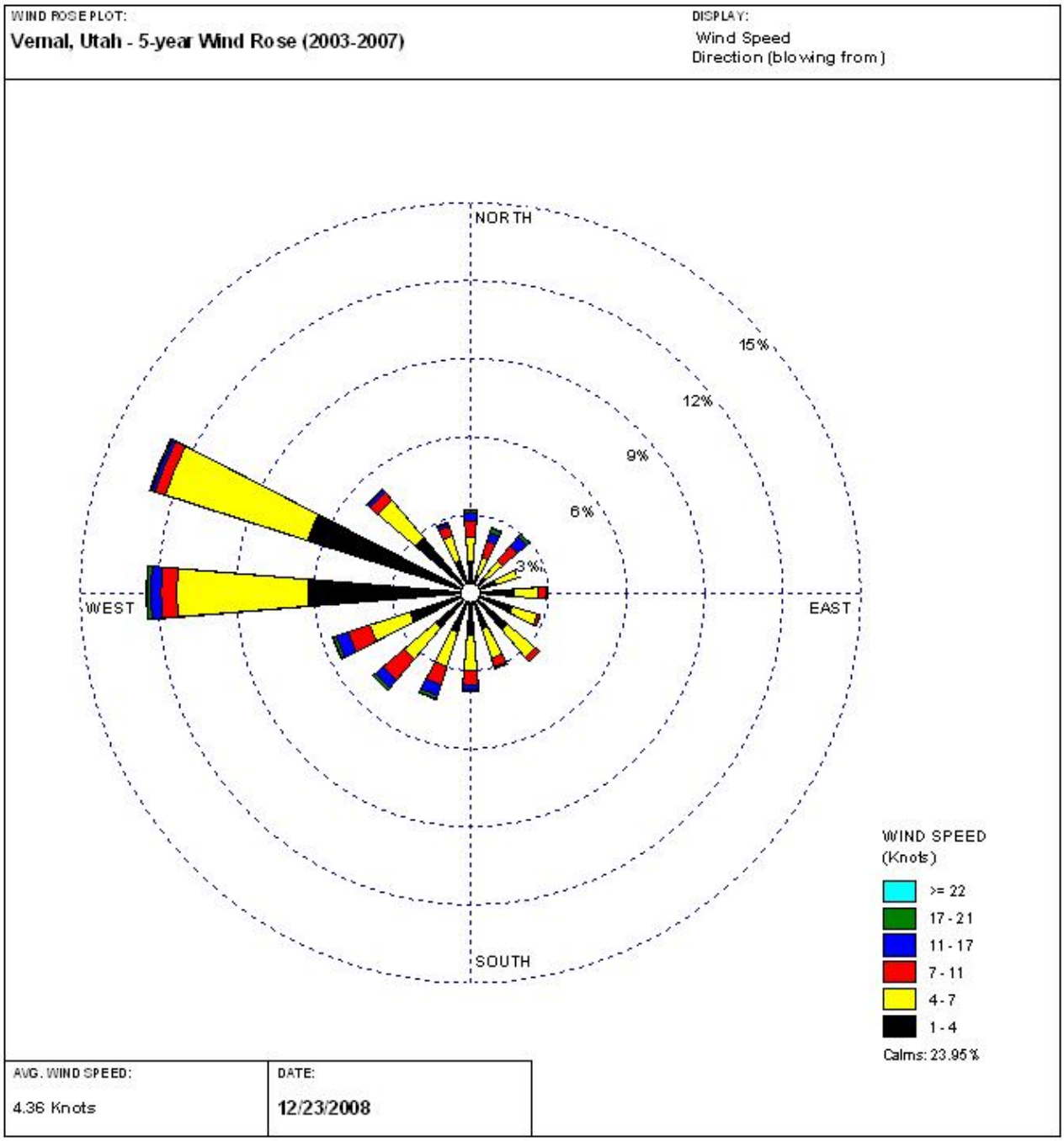


Figure 2-1 Wind Rose from Vernal, Utah, Airport

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 ***measured at 10 m above ground level*** 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 ***impact pattern*** 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. 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 ***were*** obtained from the ***USEPA Air Quality System (AQS)*** 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)	***1-hour***	***98th Percentile***	***2009/2010***	***69.6[2]***	***Uintah***	***Utah***
		98th Percentile	***2010/2011***	***52.7[2]***	***Uintah***	***Utah***
		98th Percentile	***2009/2010***	***58.3[3]***	***Uintah***	***Utah***
		98th Percentile	***2010/2011***	***60.2[3]***	***Uintah***	***Utah***
			AQIA[4]	***Seasonal Diurnal[5]***	***Uintah***	***Utah***
	Annual	H	***2009/2010***	***9.0[2]***	***Uintah***	***Utah***
		H	***2010/2011***	***6.8[2]***	***Uintah***	***Utah***
		H	***2009/2010***	***7.8[3]***	***Uintah***	***Utah***
		H	***2010/2011***	***8.1[3]***	***Uintah***	***Utah***
			AQIA	***9.0***	***Uintah***	***Utah***
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)[6]	***1-hour***	***99th Percentile***	***2007***	***21.7***	***Sweetwater***	***Wyoming***
		99th Percentile	***2008***	***19.7***	***Sweetwater***	***Wyoming***
		99th Percentile	***2009***	***19.0***	***Sweetwater***	***Wyoming***
			AQIA	***21.7***	***Sweetwater***	***Wyoming***

Table 2-2 Background Ambient Air Quality Data

Pollutant	Averaging Period	Ranking[1]	Year	Concentration (µg/m^3)	County	State
SO_2[6] (Continued)	3-hour	H2H	200***7***	***16.0***	Sweetwater	Wyoming
		H2H	200***8***	1***6***.7	Sweetwater	Wyoming
		H2H	***2009***	***10.1***	***Sweetwater***	***Wyoming***
			AQIA	***16.7***	Sweetwater	Wyoming
	24-hour	H2H	200***7***	***5.9***	Sweetwater	Wyoming
		H2H	200***8***	5.***6***	Sweetwater	Wyoming
		H2H	***2009***	***3.9***	***Sweetwater***	***Wyoming***
			AQIA	***5.9***	Sweetwater	Wyoming
	Annual	H	200***7***	***1.5***	Sweetwater	Wyoming
		H	200***8***	***1.5***	Sweetwater	Wyoming
		H	***2009***	***0.8***	***Sweetwater***	***Wyoming***
			AQIA	***1.5***	Sweetwater	Wyoming
PM with an aerodynamic diameter of 10 microns or less (PM_{10})	24-hour	H2H	2004	14.0	Uintah	Utah
		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	***2009/2010***	***19.5***[2]	Uintah	Utah
		98th percentile	***2010/2011***	***23.6***[2]	***Uintah***	***Utah***
		98th percentile	***2009/2010***	***16.3***[3]	***Uintah***	***Utah***
		98th percentile	***2010/2011***	***17.8***[3]	***Uintah***	***Utah***
			AQIA	***21.6***[7]	Uintah	Utah
	Annual	***H***	***2009/2010***	***7.3***[2]	***Uintah***	***Utah***
		H	***2010/2011***	***12.3***[2]	***Uintah***	***Utah***
		H	***2009/2010***	***6.3***[3]	***Uintah***	***Utah***
		H	***2010/2011***	***9.4***[3]	***Uintah***	***Utah***
			AQIA	***12.3***	***Uintah***	***Utah***
Ozone	***8-hour***	***H4H***	***2009/2010***	***117***[2,8]	***Uintah***	***Utah***
		H4H	***2010/2011***	***116***[2,8]	***Uintah***	***Utah***
		H4H	***2009/2010***	***98***[3,8]	***Uintah***	***Utah***
		H4H	***2010/2011***	***100***[3,8]	***Uintah***	***Utah***
			AQIA	***N/A***	***Uintah***	***Utah***

[1] H = Highest value recorded; H2H = High Second High (second highest value from the highest receptor site)***; H4H = High Fourth High (fourth highest value from the highest receptor site)***.

[2] ***Ouray Monitoring Station Data (USEPA AQS Database). 2009/2010 data period = 7/30/09 to 6/30/2010. 20010/2011 period = 7/1/2010 to 6/30/2011.***

[3] ***Redwash Monitoring Station Data (USEPA AQS Database). 2009/2010 data period = 7/30/09 to 6/30/2010. 20010/2011 period = 7/1/2010 to 6/30/2011.***

[4] 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 ***the*** period**.**

[5] ***One*-hour NO_2 background for modeling was based on seasonal hour of day diurnal profiles.**

[6] ***Wamsutter Monitoring Station Data (USEPA AQS Database).***

[7] ***AQIA value for $PM_{2.5}$ 24-hour is 2-year average from the Ouray monitor.***

[8] ***Ozone is measured in parts per billion (ppb).***

The USEPA collected, and is still in the process of collecting, ozone and NO_2 data at monitoring stations near Ouray and Redwash starting July 30, 2009. For this analysis, monitoring data through June 30, 2011, is being used, which constitutes essentially 2 years of data. These data show monitored 8-hour ambient concentrations of ozone that are above the 75 ppb NAAQS; however, compliance with the NAAQS for ozone is established by the 3-year average of the fourth highest daily 8-hour maximum ozone reading. The data also indicate a seasonal variation in which the high values occur exclusively during the December to March winter period. As shown in Figure 2-2, the summer 8-hour daily maximum values at either station do not exceed 75 ppb.

2.4 Standards and Evaluation

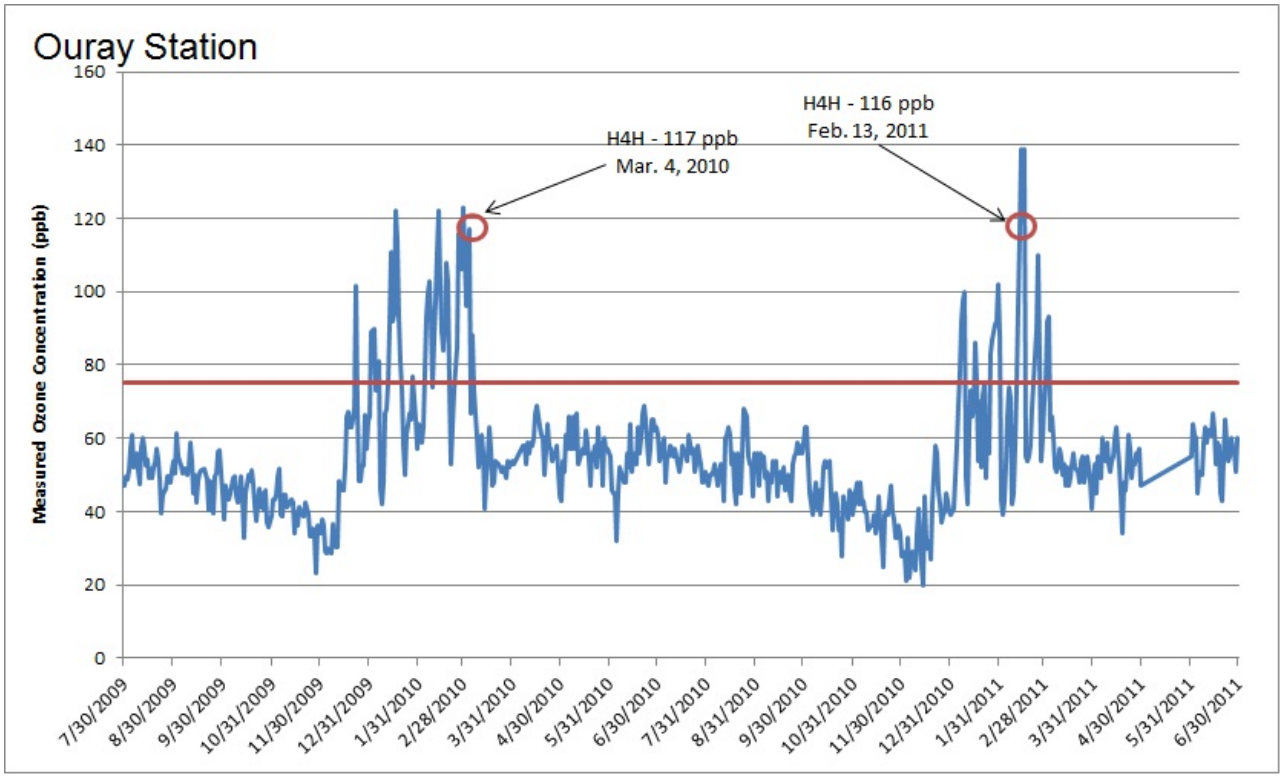
The CAA of 1970 (42 United States Code 7401) as amended in 1977 and 1990 is the basic federal statute governing air pollution. Provisions of the CAA that potentially are relevant to the GNBPA are listed and discussed below:

- 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 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 USEPA announced a 1-hour NO_2 NAAQS of 100 ppb (188 µg/m^3) in the FR on January 22, 2010, which was finalized on February 9, 2010 (75 FR 6474-6537). Further, the USEPA announced a 1-hour SO_2 NAAQS of 75 ppb (197 µg/m^3) on June 2, 2010, which was finalized on June 22, 2010 (FR 35520-35603). The NO_2 and SO_2 standards became effective on April 12 and August 23, 2010, respectively. Compliance with the standard is attained for 1-hour NO_2 when the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour concentrations does not exceed the standard within an area. For 1-hour SO_2, the standard is attained when the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour concentrations does not exceed the standard within an area. The State of Utah has adopted the NAAQS as the SAAQS; however, Wyoming and Colorado have not incorporated these new standards into the State Implementation Plan. Applicable federal and state criteria are presented in **Table 2-3**.



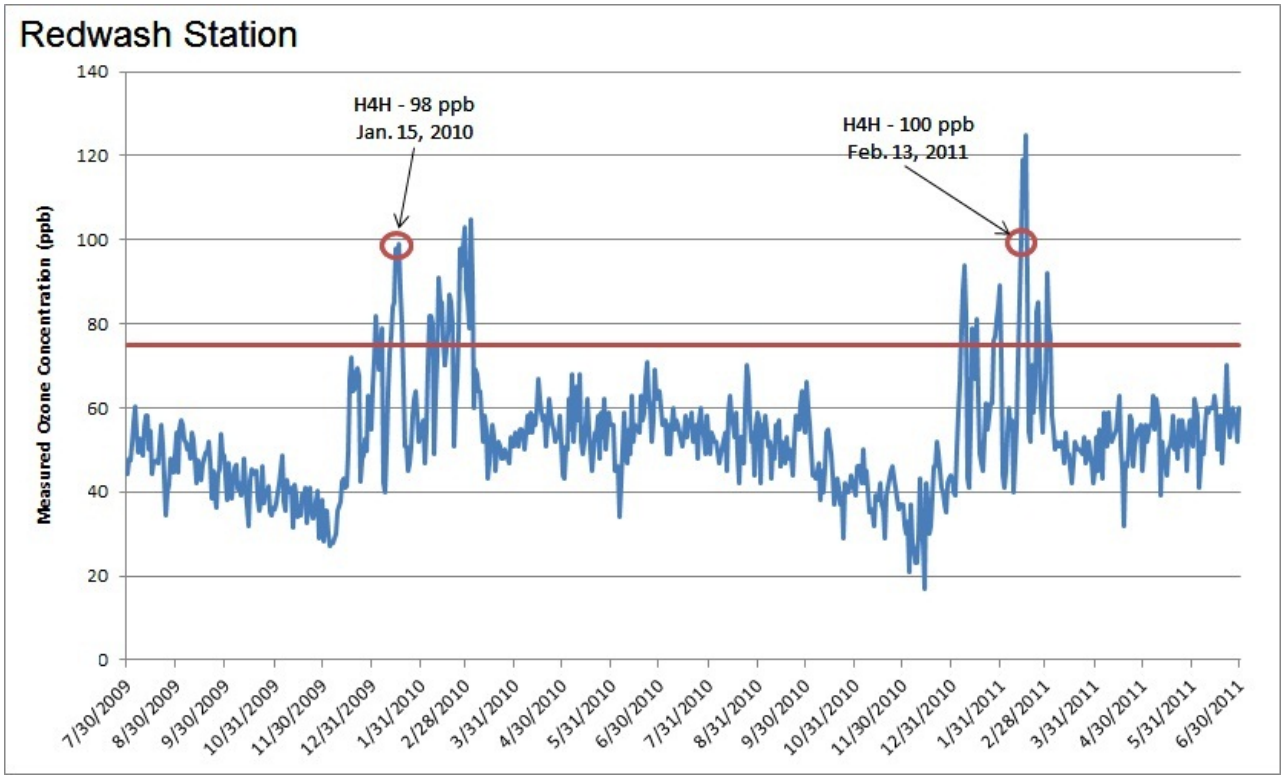


Figure 2-2 Ouray and Redwash Ozone Monitoring Data

Table 2-3 Applicable Ambient Air Quality Standards

Pollutant	Averaging Period	Ambient Air Quality Standards[1]			
		National	Wyoming	Utah	Colorado
NO_2 ***(µg/m³)***	***1-hour[2]***	***188***	***--[3]***	***188***	***--[3]***
	Annual[4]	100	100	100	100
CO ***(µg/m³)***	1-hour[5]	40,000	40,000	40,000	40,000
	8-hour[5]	10,000	10,000	10,000	10,000
SO_2 ***(µg/m³)***	***1-hour[6]***	***197***	***--[3]***	***197***	***--[3]***
	3-hour[5,7]	1,300	1,300	1,300	1,300
	24-hour[5,7]	365	260	365	365
	Annual[4]	80	60	80	80
PM_{10} ***(µg/m³)***	24-hour[8]	150	150	150	150
	Annual[4]	--[9]	50	50	50
$PM_{2.5}$ ***(µg/m³)***	24-hour[10]	35	35	35	35
	Annual[11]	15	15	15	15
Ozone ***(ppb)***	8-hour[12]	75	75	75	75

1 Sources: USEPA 2009, Wyoming Department of Environmental Quality 2008, ***Utah Division of Air Quality (UDAQ) 2010,*** and Colorado Department of Public Health and Environment 2007.

2 ***Three-year average of the 98th percentile of the daily maximum 1-hour average.***

3 ***No state standard has been incorporated into the State Implementation Plan.***

4 ***Never to be exceeded.***

5 ***Not to be exceeded more than once per year.***

6 Three-year average of the ***99th percentile of daily maximum 1-hour average.***

7 ***Secondary standard only.***

8 ***Not to be exceeded more than once per year.***

9 ***The annual PM_{10} NAAQS of 50 µg/m³ was revoked by USEPA on September 21, 2006. See FR Volume 71, Number 200, October 17, 2006.***

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

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

12 ***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.***

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 ($\mu g/m^3$)		
		Annual Arithmetic Mean	24-hour Maximum	3-hour Maximum
Class I	NO_2	2.5	-	-
	SO_2	2	5	25
	PM_{10}	4	8	-

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 II	NO_2	25	-	-
	SO_2	20	91	512
	PM_{10}	17	30	-

On June 3, 2010, the USEPA issued the final rule that "tailors" the applicability of PSD requiring USEPA and/or permitting authorities to implement PSD permitting requirements for greenhouse gases (GHGs) (75 FR 31514). The "Tailoring Rule" takes effect on January 21, 2011, for new or modified sources that have the potential to emit (PTE) or net increase in emissions more than 75,000 tpy of carbon dioxide (CO_2) equivalents (CO_2e) and would be considered major for other PSD pollutants. On or after July 1, 2011, this rule will apply to any new source with the PTE of 100,000 tpy CO_2e and exceeds the major source threshold of any GHG on a mass basis regardless of the PTE of other PSD pollutants. Further, modification at an existing major source that results in a net emissions increase of 75,000 tpy CO_2e also will be reviewed under the PSD rules.

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 hp (bhp), located at either a major source or area source of HAP.

On August 20, 2010, the USEPA published further revisions to this rule (71 FR 51570 et. seq) to address emissions from existing stationary spark-ignition (SI) engines less than or equal to 500 hp at major sources and all existing stationary SI engines located at area sources.

2.5 Carbon Dioxide and Other Greenhouse Gases

In *Massachusetts v. EPA*, the U.S. Supreme Court (April 7, 2007) held that CO_2 satisfies the definition of "air pollutant" and that USEPA has authority to regulate emissions of CO_2 and other 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 October 30, 2009, the USEPA promulgated the final mandatory reporting rule for GHGs under 40 CFR Part 98, which requires a wide range of sources to record and report selected GHG emissions including CO_2, methane (CH_4), nitrous oxide (N_2O), and some halogenated compounds. A CO_2e value is calculated for combined emissions of these gases based on their comparative global warming potential. This rule applies to sources that emit 25,000 tpy or more CO_2e. Further, the USEPA issued the final reporting GHG requirements for petroleum and natural gas production on November 30, 2010 (40 CFR Part 98 Subpart W) (75 FR 74458). The rule specifically identifies monitoring and reporting requirements for natural gas systems including combustion units (Subpart C) as well as on-shore gas production, storage, processing, and transmission (Subpart W).

The rule does not require any controls or establish any ***emission limits*** related to GHG emissions. Therefore, there is no requirement at this time that would affect development of the proposed project under ***this*** rule, other than the ***requirement for the operator to develop a monitoring plan and maintain*** 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 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[2]/well-yr)	(MMscf/yr)	(bbl[3]/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[2]/well-yr)	(MMscf/yr)	(bbl[3]/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.
[2] MMscf = million standard cubic feet.
[3] bbl = barrel.

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

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)
1987	32	-22	3.4	0	3.7	0.0
1986	33	13	3.2	42	3.0	0.0
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 Bill Barrett	Retrofit existing high bleed pneumatics with low bleed pneumatics. All new facilities must install low bleed pneumatics.	0.3% Uintah 100.0% Carbon 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] 50% Carbon[6] 1% Duchesne[6]
	Dominion XTO Energy		16% Uintah 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

Based on data provided by KMG, each rig was assumed to be driven by up to three Caterpillar G3512LE diesel-fired engines or equivalent. These engines would run in tandem with only two of the engines operating at a time. Further, drilling would be concluded at each well by the operation of a workover rig equipped with a Caterpillar C13 engine or equivalent to complete the well.

Although the peak production year would occur after the compliance date for Tier 4 engines, KMG has only committed to the use of Tier 2 engines. The regional emissions inventory for the analysis only considered the use of Tier 4 engines because this inventory is used to determine regional impacts to ambient air quality in a specific projected year that is well past the Tier 4 compliance date for all alternatives. The near-field modeling analysis must consider the use of both Tier 2 and Tier 4 engines in the field because drilling would commence prior to the Tier 4 compliance date. Therefore, emissions estimates were calculated using emissions factors of NO_X, CO, PM_{10}, $PM_{2.5}$, and VOCs for both Tier 2 and Tier 4 engine standards from Table 1 of 40 CFR 1089.101 to meet the needs for both action alternatives.

The emission factor for SO_2 was derived using **Equation 3-1** assuming 15 ppm ***weight (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

$$EF_{SO2} = \frac{15\ lb\ S}{10^6\ lb\ fuel}\ x\ \frac{6.8\ lb\ fuel}{gal}\ x\ \frac{gal}{140{,}000\ Btu}\ x\ \frac{7{,}000\ Btu}{hp-hr}\ x\ \frac{64.06\ lb\ SO_2}{32.06\ lb\ S}\ x\ \frac{453.6\ g}{lb} = 4.6x10^{-3}\ g/hp-hr$$

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

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

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

Drill Rig Engine Emissions								
Rig Size = 1,476 hp								
Annual Utilization = 0.67 (2 of 3 engines)								
Daily Load Factor = 0.65								
Overall Load Factor = 0.43 (for 24-hour and annual emissions); 1.00 for hourly emissions								
Duration = 15 days/well; 24 hours/day								
	Tier 2				*Tier 4*			
	Emission	*Emission Rate*			*Emission*	*Emission Rate*		
	Factor	*Hourly*	*24-hour*	*Annual*	*Factor*	*Hourly*	*24-hour*	*Annual*
Pollutant	*(g/hp-hr)*	*(lb/hr)*	*(lb/hr)*	*(tons/well)*	*(g/hp-hr)*	*(lb/hr)*	*(lb/hr)*	*(tons/well)*
NO_X	*4.8*	*15.6*	*10.2*	*3.7*	*2.6*	*8.5*	*5.5*	*2.0*
CO	*2.6*	*8.5*	*5.5*	*2.0*	*2.6*	*8.5*	*5.5*	*2.0*
SO_2	*0.0046*	*0.02*	*0.001*	*0.004*	*0.0046*	*0.02*	*0.001*	*0.004*
$PM_{10/2.5}$	*0.15*	*0.5*	*0.3*	*0.1*	*0.015*	*0.05*	*0.03*	*0.01*
VOC	*0.14*	*0.5*	*0.3*	*0.1*	*0.14*	*0.5*	*0.3*	*0.1*
Benzene	*2.9E-03*	*9.3E-03*	*6.0E-03*	*2.2E-03*	*2.9E-03*	*9.3E-03*	*6.0E-03*	*2.2E-03*
Toluene	*2.1E-03*	*6.8E-03*	*4.4E-03*	*1.6E-03*	*2.1E-03*	*6.8E-03*	*4.4E-03*	*1.6E-03*
Ethylbenzene	*4.3E-04*	*1.4E-03*	*9.2E-04*	*3.3E-04*	*4.3E-04*	*1.4E-03*	*9.2E-04*	*3.3E-04*
Xylene	*1.5E-03*	*4.8E-03*	*3.1E-03*	*1.1E-03*	*1.5E-03*	*4.8E-03*	*3.1E-03*	*1.1E-03*
Formaldehyde	*1.7E-02*	*5.4E-02*	*3.5E-02*	*1.3E-02*	*1.7E-02*	*5.4E-02*	*3.5E-02*	*1.3E-02*
n-Hexane	*2.2E-04*	*7.3E-04*	*4.7E-04*	*1.7E-04*	*2.2E-04*	*7.3E-04*	*4.7E-04*	*1.7E-04*
Completion Rig Engine Emissions								
Rig Size = 475 hp								
Annual Utilization = 1.00 (1 of 1 engine)								
Daily Load Factor = 0.65								
Overall Load Factor = 0.65 (for 24-hour and annual emissions); 1.00 for hourly emissions								
Duration = 3 days/well; 12 hours/day								
	Tier 2				*Tier 4*			
	Emission	*Emission Rate*			*Emission*	*Emission Rate*		
	Factor	*Hourly*	*24-hour*	*Annual*	*Factor*	*Hourly*	*24-hour*	*Annual*
Pollutant	*(g/hp-hr)*	*(lb/hr)*	*(lb/hr)*	*(tons/well)*	*(g/hp-hr)*	*(lb/hr)*	*(lb/hr)*	*(tons/well)*
NO_X	*4.8*	*5.0*	*3.3*	*0.06*	*2.6*	*2.7*	*1.8*	*0.03*
CO	*2.6*	*2.7*	*1.8*	*0.03*	*2.6*	*2.7*	*1.8*	*0.03*
SO_2	*0.005*	*0.005*	*0.003*	*0.00006*	*0.005*	*0.003*	*0.00006*	*0.005*
$PM_{10/2.5}$	*0.15*	*0.2*	*0.1*	*0.0018*	*0.015*	*0.0016*	*0.010*	*0.00018*
VOC	*0.14*	*0.2*	*0.1*	*0.0017*	*0.14*	*0.2*	*0.1*	*0.0017*
Benzene	*2.9E-03*	*3.0E-03*	*1.9E-03*	*3.5E-05*	*2.9E-03*	*3.0E-03*	*1.9E-03*	*3.5E-05*
Toluene	*2.1E-03*	*2.2E-03*	*1.4E-03*	*2.6E-05*	*2.1E-03*	*2.2E-03*	*1.4E-03*	*2.6E-05*
Ethylbenzene	*4.3E-04*	*4.5E-04*	*3.0E-04*	*5.3E-06*	*4.3E-04*	*4.5E-04*	*3.0E-04*	*5.3E-06*
Xylene	*1.5E-03*	*1.6E-03*	*1.0E-03*	*1.8E-05*	*1.5E-03*	*1.6E-03*	*1.0E-03*	*1.8E-05*
Formaldehyde	*1.7E-02*	*1.7E-02*	*1.1E-02*	*2.0E-04*	*1.7E-02*	*1.7E-02*	*1.1E-02*	*2.0 E-04*
n-Hexane	*2.2E-04*	*2.3E-04*	*1.5E-04*	*2.7E-06*	*2.2E-04*	*2.3E-04*	*1.5E-04*	*2.7E-06*

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.***0*** gal/hr based on ***140***,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. ***SO_2 emissions are based on the use of diesel fuel with 15 ppmw sulfur content. Because*** 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 ***Pollutant Emissions from Rig Boilers per Well Drilled***

Design Firing Rate = 2.8 MMBtu/hr				
= 20.0 gallons/hour[1]				
Annual Operating Hours = 4,380				
	Emission Factor	*Emission Rate*		
		Hourly	*Annual*	
Pollutant	*(lb/10³ gal)*	*(lb/hr-rig)*	*(tpy/rig)*	*(tons/well)*
NO_X	*18.0*	*0.4*	*0.8*	*0.03*
CO	*5.0*	*0.1*	*0.2*	*0.009*
SO_2	*0.2*	*0.004*	*0.009*	*0.0004*
PM_{10} ($PM_{2.5}$)	*2.0*	*0.04*	*0.09*	*0.004*
VOC	*0.34*	*0.007*	*0.01*	*0.0006*
Benzene	*2.1E-04*	*4.3E-06*	*9.4E-06*	*3.9E-07*
Toluene	*6.2E-03*	*1.2E-04*	*2.7E-04*	*1.1E-05*
Ethylbenzene	*6.4E-05*	*1.3E-06*	*2.8E-06*	*1.2E-07*
Xylene	*1.1E-04*	*2.2E-06*	*4.8E-06*	*2.0E-07*
Formaldehyde	*3.3E-02*	*6.6E-04*	*1.4E-03*	*6.0E-05*
n-Hexane	*No data*	*No data*	*No data*	*No data*

[1] Based on 140,000 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 **Round Trip Distance = 11 miles/round trip** **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. ***Annual emissions are presented for both Tier 2 and Tier 4 engines. The regional emissions inventory uses Tier 4 emissions because development under the project alternatives would occur after the Tier 4 implementation date. The near-field modeling uses both Tier 2 and Tier 4 emissions to evaluate impacts from both options.***

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

	Criteria Pollutant Emissions (tons/well)					
Activity	***NO_X***	***CO***	***SO_2***	***PM_{10}***	***$PM_{2.5}$***	***VOC***
Tier 2 Engines						
Drill Rig	***3.7***	***2.0***	***0.004***	***0.1***	***0.1***	***0.1***
Completion Rig	***0.06***	***0.03***	***0.00006***	***0.0002***	***0.0002***	***0.002***
Rig Boiler	***0.03***	***0.009***	***0.0004***	***0.004***	***0.004***	***0.0006***
Drill Road Traffic	***-***	***-***	***-***	***0.9***	***0.1***	***-***
Completion Road Traffic	***-***	***-***	***-***	***0.7***	***0.1***	***-***
Rig Hauling Traffic	***-***	***-***	***-***	***0.05***	***0.007***	***-***
Hauling Tailpipe	***0.05***	***0.2***	***0.002***	***-***	***-***	***0.04***
Total	***3.8***	***2.2***	***0.005***	***1.7***	***0.4***	***0.1***
Tier 4 Engines						
Drill Rig	***2.0***	***2.0***	***0.004***	***0.01***	***0.01***	***0.1***
Completion Rig	***0.03***	***0.03***	***0.00006***	***0.0002***	***0.0002***	***0.002***
Rig Boiler	***0.03***	***0.009***	***0.0004***	***0.004***	***0.004***	***0.0006***
Drill Road Traffic	***-***	***-***	***-***	***0.9***	***0.1***	***-***
Completion Road Traffic	***-***	***-***	***-***	***0.7***	***0.1***	***-***
Rig Hauling Traffic	***-***	***-***	***-***	***0.05***	***0.007***	***-***
Hauling Tailpipe	***0.05***	***0.2***	***0.002***	***-***	***-***	***0.04***
Total	***2.1***	***2.2***	***0.006***	***1.6***	***0.3***	***0.1***

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

Activity	*Criteria Pollutant Emissions (tons/well)*					
	NO_X	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*VOC*
	Hazardous Air Pollutant Emissions (tons/well)					
Activity	*Benzene*	*Toluene*	*Ethylbenzne*	*Xylene*	*Formaldehyde*	*n-Hexane*
Tier 2 and Tier 4 Engines						
Drill Rig	*232E-03*	*1.6E-03*	*3.3E-04*	*1.1E-03*	*1.3E-02*	*1.7E-04*
Completion Rig	*3.5E-05*	*2.6E-05*	*5.3E-06*	*1.8E-05*	*2.0E-04*	*2.7E-06*
Rig Boiler	*3.9E-07*	*1.1E-05*	*1.2E-07*	*2.0E-07*	*6.0E-05*	*No data*
Total	*2.2E-03*	*1.6E-03*	*3.4E-04*	*1.1E-03*	*1.3E-02*	*1.7E-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.

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

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**.

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.

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/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**.

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

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)**
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 **Methane = 92.5% of TOC by weight** **Ethane = 3.7% of TOC by weight** **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

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						
Methane = 92.5% of TOC by weight						
Ethane = 3.7% of TOC by weight						
Condensate = 98.31% of VOC by weight						
VOC Emissions						
Source	**Service**	**Quantity**	**TOC Emission Factor**	**TOC Emissions**	**VOC[1, 2]**	
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

Pollutant	Light Oil			Gas			Total
	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 **Round Trip Distance = 1.4 miles/round trip** **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 **Heat Content = 950 Btu/scf** **Fuel Sulfur Content = 0.012 gr/scf** **Rated Engine Size = 1,265 bhp** **Fuel Consumption = 8.9 MMBtu/hr**					
Pollutant	**Emission Factor[1]**		**Control Efficiency (%)**	**Emission Rate (lb/hr)**	**Emission Rate (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 **Heat Content = 950 Btu/scf** **Fuel Sulfur Content = 0.012 gr/scf** **Rated Engine Size = 1,340 bhp** **Fuel Consumption = 9.4 MMBtu/hr**					
Pollutant	**Emission Factor[1]**		**Control Efficiency (%)**	**Emission Rate (lb/hr)**	**Emission Rate (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 **Heat Content = 950 Btu/scf** **Fuel Sulfur Content = 0.012 gr/scf** **Rated Engine Size = 2,370 bhp** **Fuel Consumption = 16.59 MMBtu/hr**					
Pollutant	**Emission Factor[1]**		**Control Efficiency (%)**	**Emission Rate (lb/hr)**	**Emission Rate (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 ***G3608*** 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 **Total Proposed Compression = 73,415 bhp** **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 **Total Proposed Compression = 167,540 bhp** **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 ***15*** 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**.

For the analysis conducted for the Draft EIS, it was assumed that a fleet of 14 rigs would operate under the Proposed Action. For the Supplement to the Draft EIS, the number of operating rigs was increased to 15 for the Proposed Action. This adjustment was due to a small change to the drilling schedule for this alternative. Consequently, the increase in the number of operating rigs resulted in a decrease in the number of producing wells in the inventory as well as a material increase in NO_X and CO. The NO_X increased 142.1 tpy (6.8 percent), while CO increased 144.4 tpy (12.5 percent). The change in other criteria pollutants and HAPs were inconsequential.

Table 3-47 Summary of Criteria Pollutant Emissions *for* 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	360	0	755.5	782.0	2.0	589.9	94.4	53.3
Wellbores Drilled (Non-producing)	91	11	0	23.1	23.9	0.1	10.1	1.7	1.7
Total Drilling Emissions[1]				778.6	805.9	2.0	600.0	96.1	54.9
Production and Operation Activities									
Producing Wells (above baseline)	3,675	3,315	3,675	394.2	354.9	14.2	384.2	83.2	6,309.4
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	2.6	2.6	21.3
Total Production and Operating Emissions[1]				1,434.1	493.7	23.0	410.6	109.5	6,562.3
Total Project Emissions[1]				2,212.7	1,299.6	25.0	1,010.6	205.7	6,617.3

[1] **Totals may vary slightly due to rounding.**

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 *for* 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	***360***	0	0.***8***	0.6	0.1	0.***4***	***4.6***	0.***06***
Wellbores Drilled (Non-producing)	91	***11***	0	0.02	0.02	0.***004***	0.01	0.1	0.002
Total Drilling Emissions[1]				**0.*8***	**0.6**	**0.1**	**0.*4***	***4.8***	**0.*06***
Production and Operation Activities									
Producing Wells (above baseline)	3,675	3,***315***	3,675	65.***3***	17***1.0***	12.***5***	18***4.9***	0.3	19***2.9***
Compression Engines				0.5	0.5	0.04	0.2	59.4	1.2
Water Tank Batteries Operating	2	2	2	0.2	0.2	0.***009***	0.1	***0.0***	0.5
Water Injection Facilities Operating	15	13	15	0.06	0.***05***	0.005	0.02	6.8	0.1
Total Production and Operating Emissions[1]				**66.*1***	**17*1.8***	**12.*5***	**18*5.3***	**66.*5***	**19*4.8***
Total Project Emissions[1]				**67.*0***	**17*2.4***	**12.7**	**18*5.7***	***71.3***	**19*4.9***

[1] Totals may vary slightly due to rounding.

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.

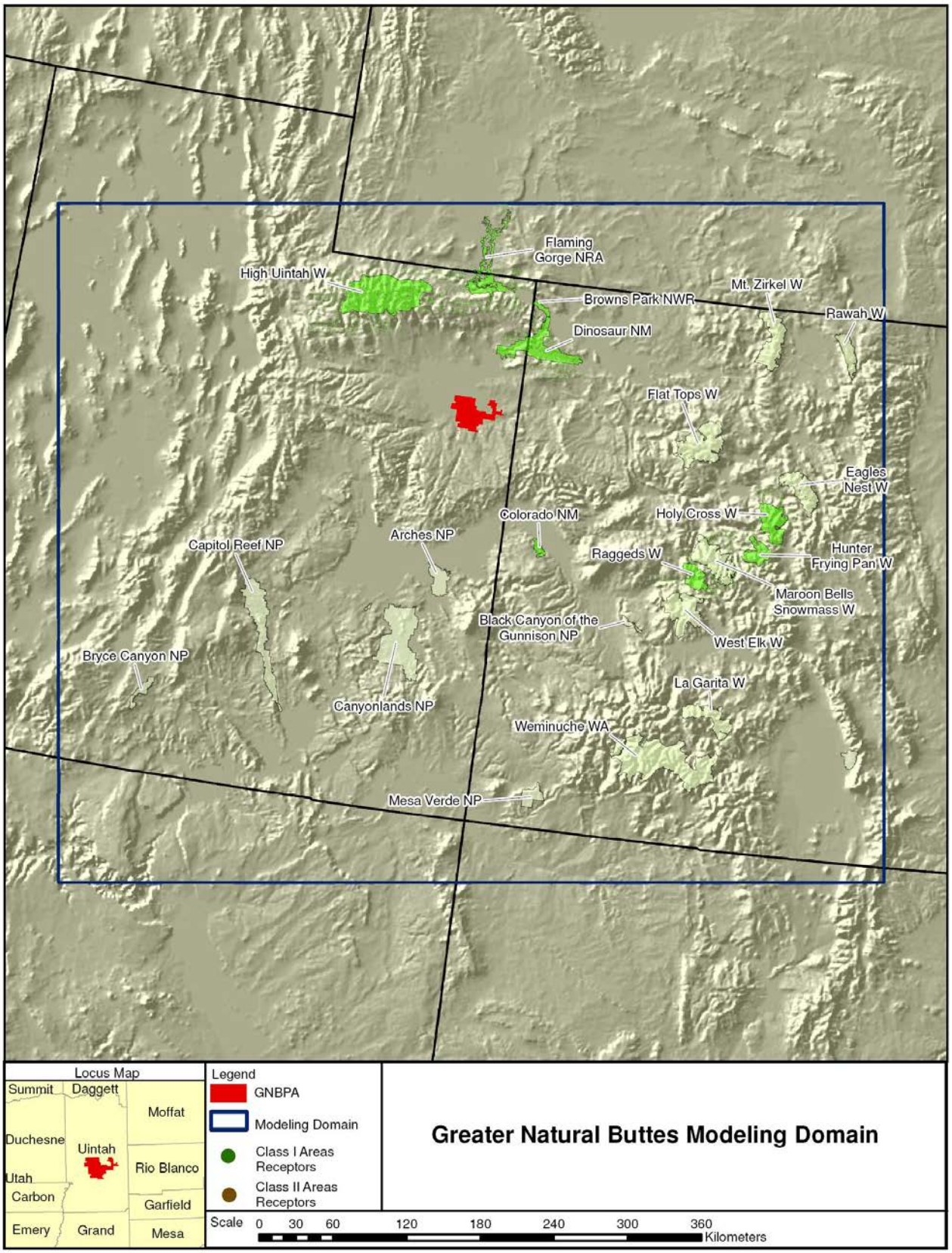


Figure 4-1 Modeling Domain and Location of Class I and Class II Receptors

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.

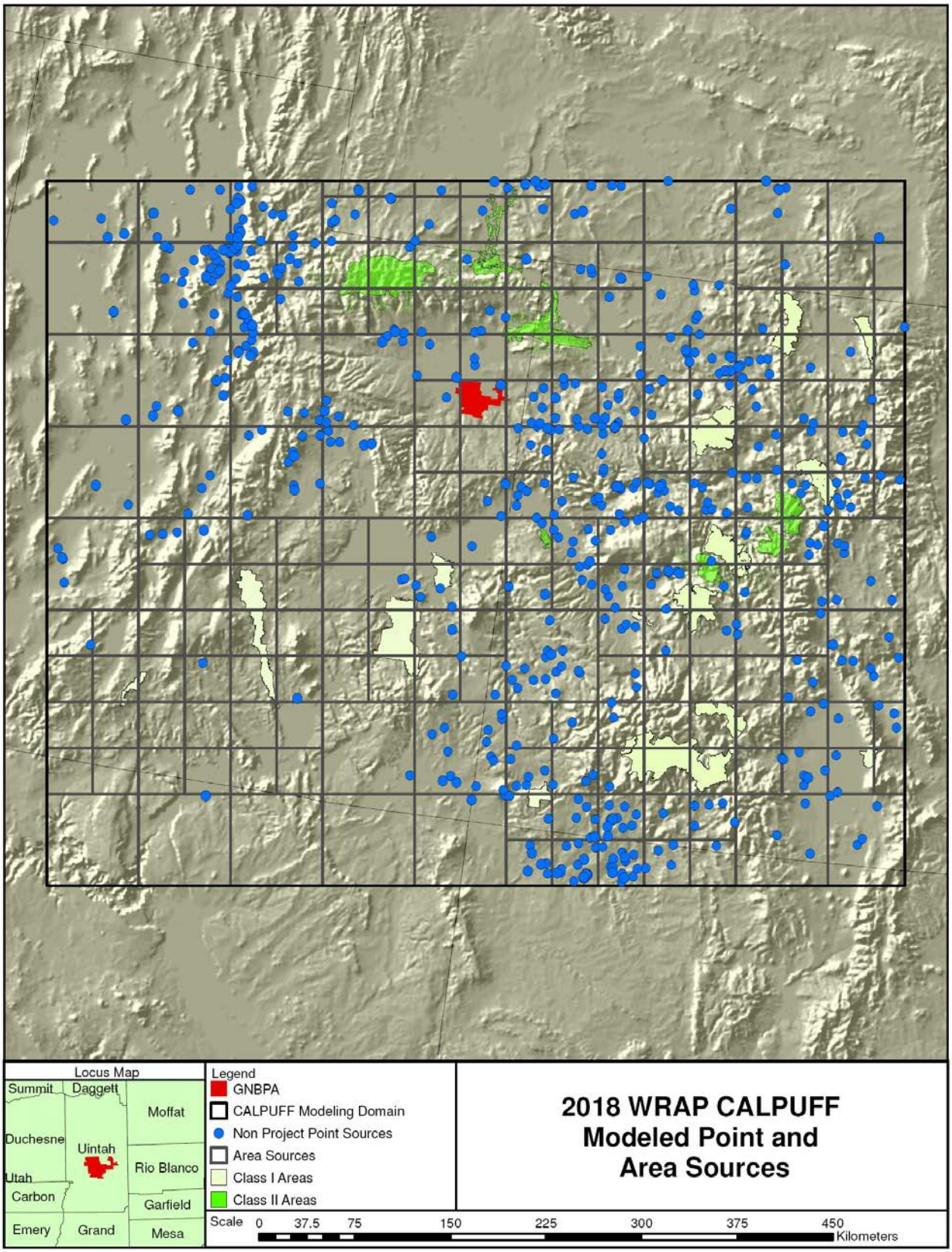


Figure 4-2 2018 CALPUFF Modeled Point and Area Sources

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.

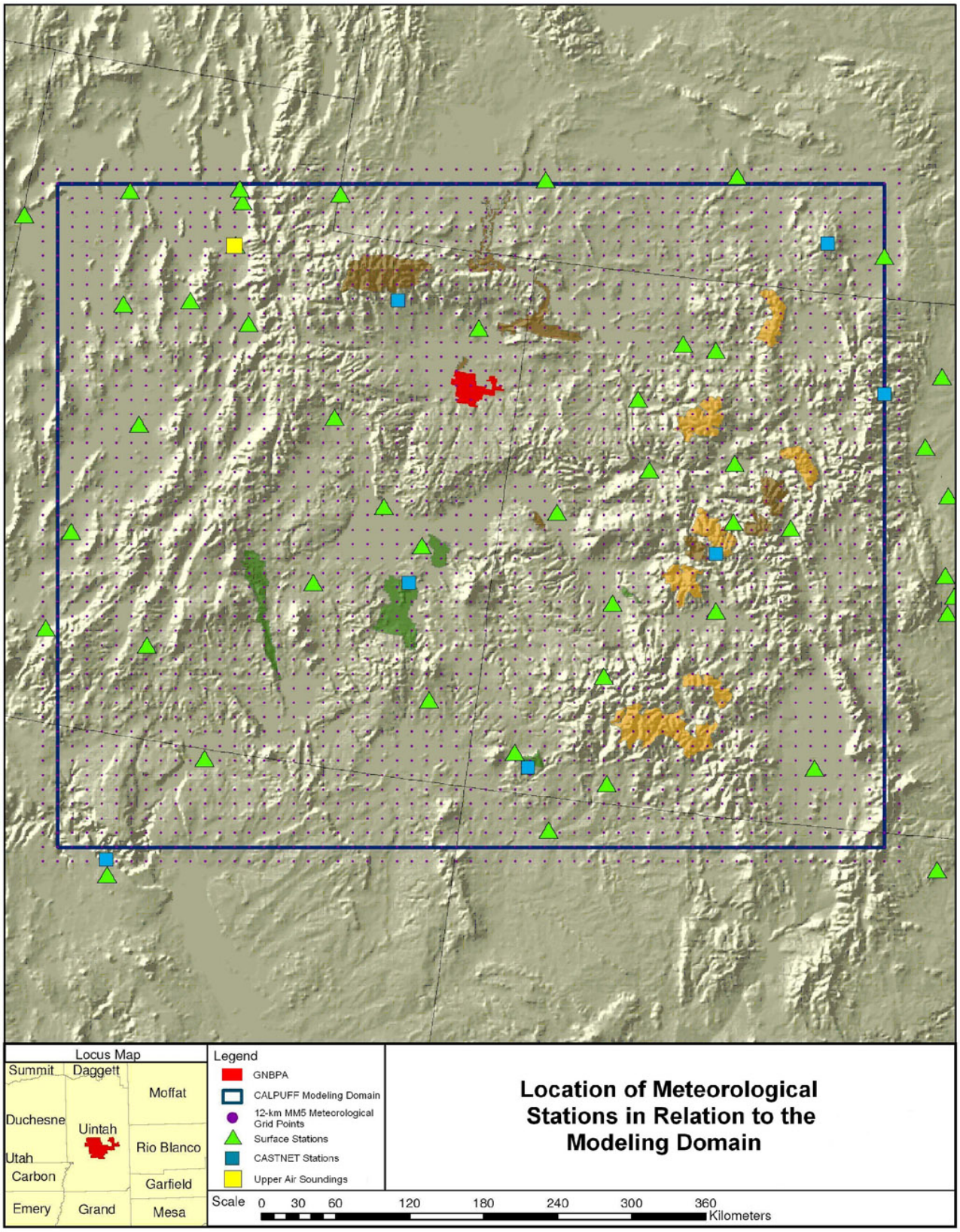


Figure 4-3 Meteorological Stations Selected for Input to CALMET

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 Schere 2006***; USEPA*** 1999). 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.

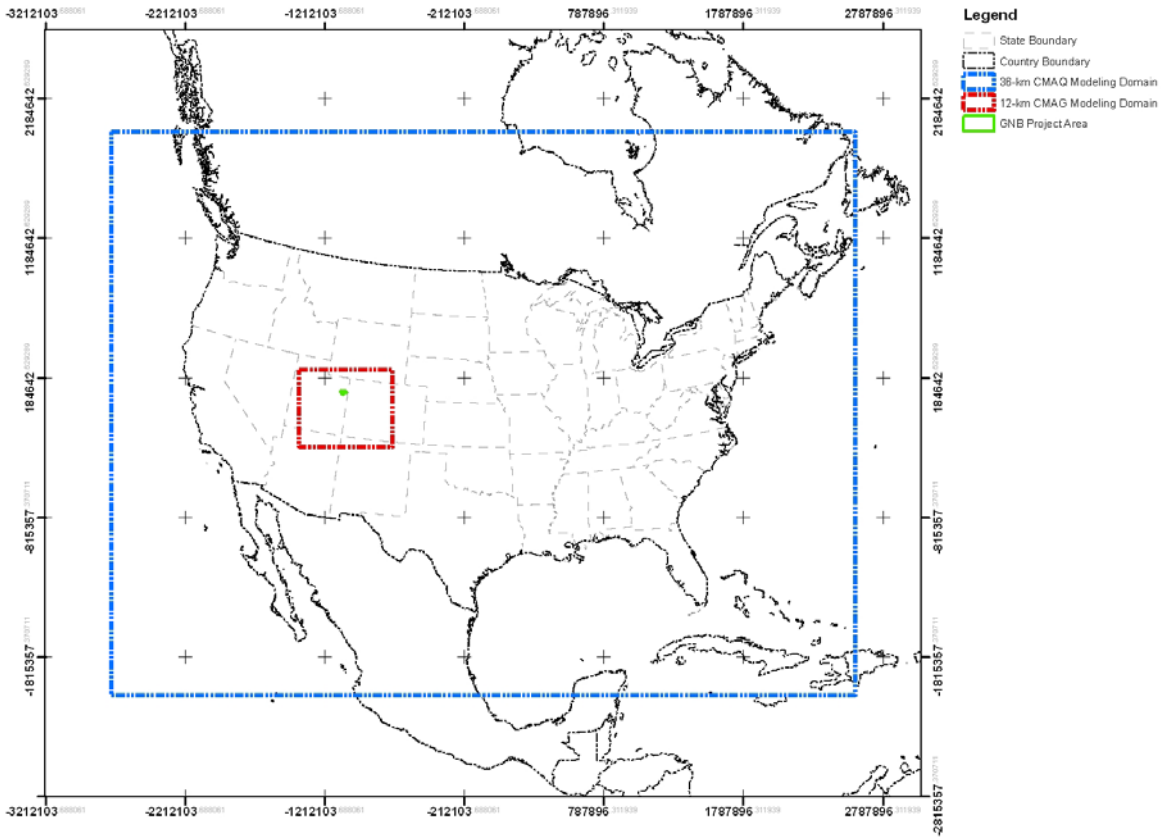
4.2.2 Modeling Domains

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

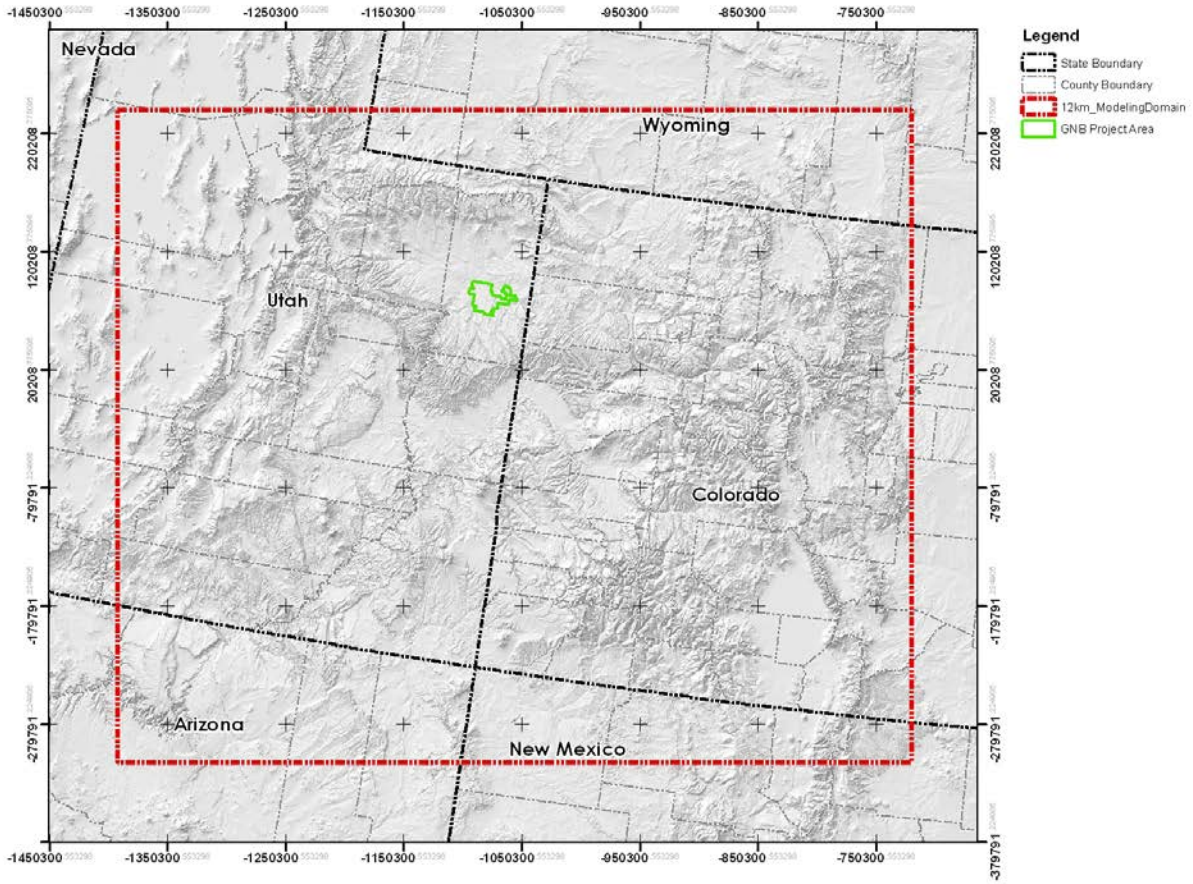


Figure 4-5 12-km CMAQ Domain for the GNB Study

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.

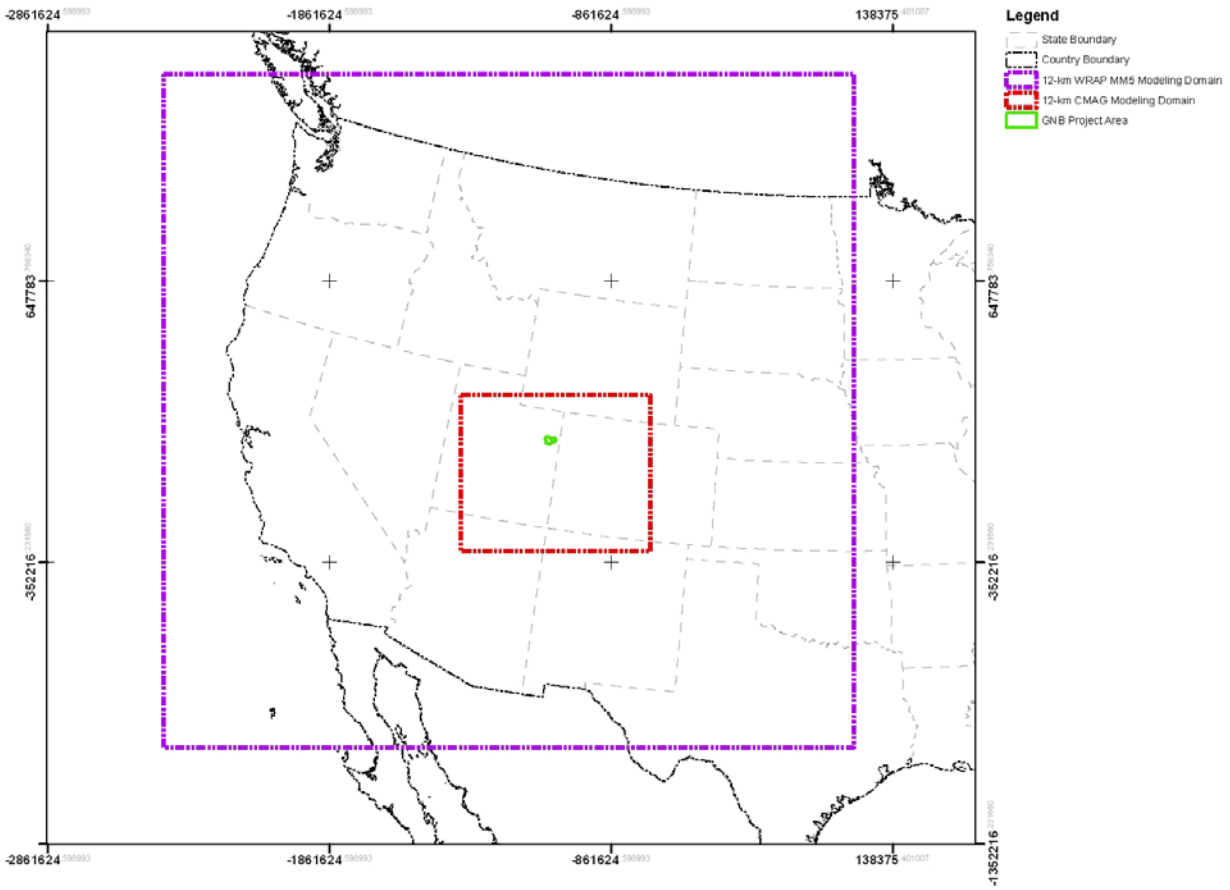


Figure 4-6 12-km WRAP MM5 with 12-km CMAQ Domain in the GNB Study

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	Schell 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 ***09292; updated 1-hour NO_2 modeling was conducted with Version 11103***). 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 potentially could have an impact on surrounding air quality. ***The air quality assessment addresses impacts associated with emissions from both Tier 2 and Tier 4 engines.***

AERMOD (USEPA 2004) was adopted by USEPA in a final rule (FR 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. AERMOD ***(Versions 09292 and 11103)*** 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.

4.3.1 Criteria Pollutant Analysis

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.

For the newly promulgated 1-hour SO_2 and 1-hour NO_2 NAAQS modeling, special modeling techniques were needed beyond what was required for the other pollutants. USEPA's Guideline on Air Quality Models (USEPA 2005e) provides a tiered approach for modeling NO_2 that provides for increased levels of refinement for the treatment of the in-plume conversion of nitric oxide (NO) to NO_2. For this analysis, a Tier 3 approach was followed, as discussed in the June 2010 USEPA Clarification Memo regarding the application of AERMOD for 1-hour NO_2 modeling (USEPA 2010a). The Tier 3 approach involves using the Plume Volume Molar Ratio Method (PVMRM), which computes the available moles of ozone to combine with the moles of NO. The moles of ozone available to combine with the in-plume moles of NO are restricted to the plume cross-sectional area at each downwind distance considered. The PVMRM option appears to provide a more realistic treatment of the conversion of NO to NO_2 as a function of distance downwind from the source than the Ozone Limiting Method (OLM) or the other NO_2 screening options. Because PVMRM better simulates the NO to NO_2 conversion chemistry during plume expansion, it is particularly well suited for near-field receptors and, therefore, simulating the project sources where the maximum modeled NO_X concentrations would occur near the stacks. In addition, unlike OLM, PVMRM is designed to work with either single or multiple plumes as is the case for the project.

The application of AERMOD with PVMRM requires specification of the equilibrium ratio and the in-stack NO_2/NO_X ratio. The default equilibrium ratio for the NO_2/NO_X ratio in AERMOD of 0.90 was used and the in-stack NO_2/NO_X ratio of 0.1 was used. The use of the 0.1 in-stack ratio is supported by stack-test data as provided in Appendix B.

PVMRM requires the use of hourly ozone data with concurrent meteorological data to approximate the rate of conversion of NO to NO_2. The current meteorological inputs to AERMOD are based on the years 2002 through 2006. Since the ozone monitoring near the GNBPA did not begin until July 2009, concurrent hourly ozone monitoring data are not available from either the Ouray or Redwash monitors. Therefore, diurnal profiles of hourly ozone background concentrations were developed using data from July 2009 through June 2011 for the Ouray and Redwash monitors for each season defined as follows:

- ***Winter – December, January, February, and March;***
- ***Spring – April and May;***
- ***Summer – June, July, August; and***
- ***Fall – September, October, and November.***

For each of these seasons at each monitor, the highest monitored concentration for each hour of the day was selected to represent all of the hours for the entire season. The ozone data indicates that the Ouray winter peak value is slightly higher than other seasons, but the other seasons are comparable in trend and magnitude. The diurnal values developed for the Ouray monitor were used to develop a full year of hourly ozone values for each season because it is closest to the GNBPA. Figure 4-7 shows the diurnal profile of hourly ozone used in this study.

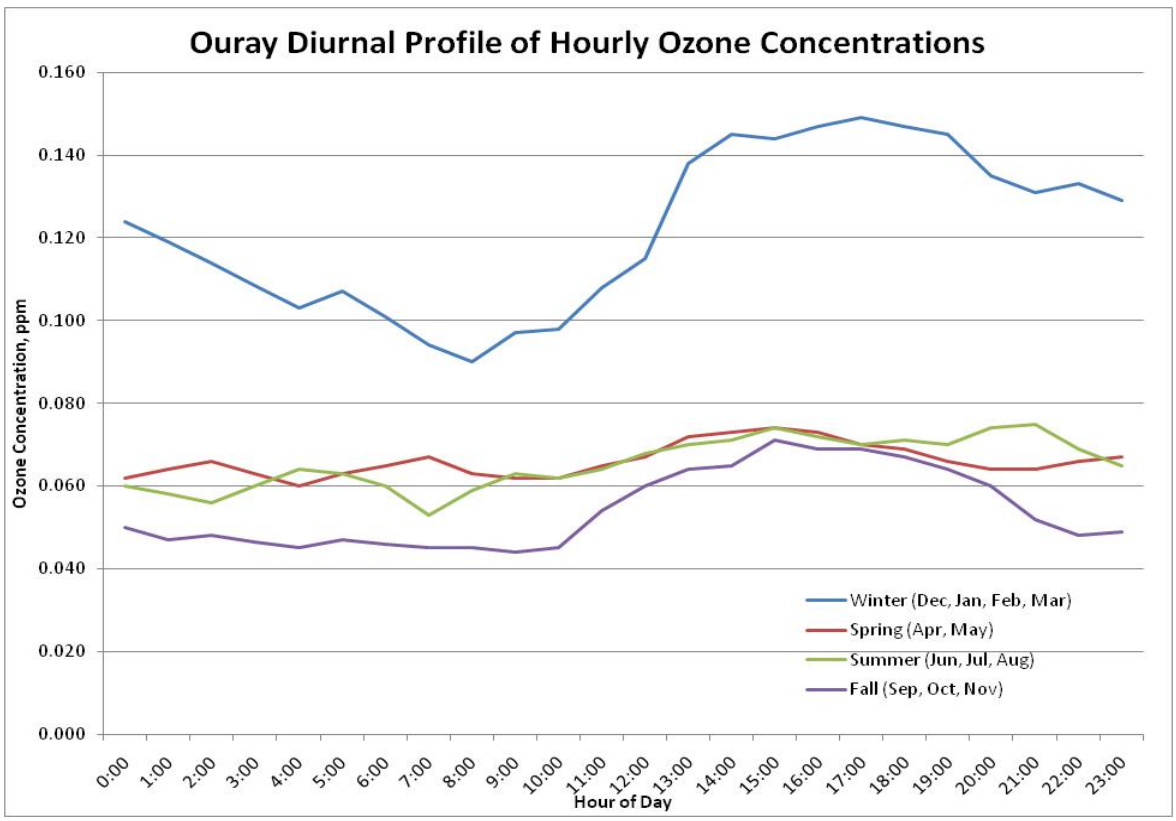


Figure 4-7 Ouray Diurnal Ozone Profile of Maximum Hourly Values by Season

For 1-hour SO_2, the 5-year average of the 99th percentile highest daily 1-hour maximum modeled SO_2 concentrations was computed and added to the representative 1-hour SO_2 background concentration to determine compliance with the NAAQS.

For 1-hour NO_2, compliance with the NAAQS was assessed by combining the 5-year average of the 98th percentile highest daily 1-hour maximum modeled NO_2 concentrations and the representative 1-hour NO_2 background concentration. This approach follows USEPA guidance released on March 1, 2011 (USEPA 2011), in the form of a clarification memo that addresses different options on how to combine model and monitored concentrations to assess compliance with the 1-hour NO_2 NAAQS. In addition to the March 2011 USEPA guidance, a new AERMOD model version (11103) has been released with the capability of calculating the correct form of the model design concentration for 1-hour NO_2 and SO_2. This new AERMOD model version was used to update the 1-hour NO_2 modeling methodology to be consistent with the March 2011 USEPA Guidance. As such, the 1-hour NO_2 background concentrations used to assess compliance with the NAAQS are now based on seasonal diurnal profiles as opposed to a single design concentration that is added to the design model concentration. The seasonal diurnal profiles were developed using guidance in the USEPA March 2011 clarification memo and implemented in AERMOD using the model feature SEASHR.

The seasonal diurnal profiles were based on the 98th percentile concentration of available hourly monitored concentrations for each specific season/hour of day combination. Seasonal diurnal profiles were developed for each year (2009/2010 and 2010/2011) and each monitor (Ouray and Redwash). A 2-year average 98th percentile concentration was calculated for each year's seasonal diurnal profiles. The seasonal diurnal profiles input into AERMOD represent an array of 96 values (4 seasons x 24 hours per day) based on a composite maximum between the Ouray and Redwash 2-year average 98th percentile seasonal diurnal profiles. Figure 4-8 shows the seasonal diurnal profiles used as input to AERMOD. Regional background concentrations are discussed in Section 2.3.

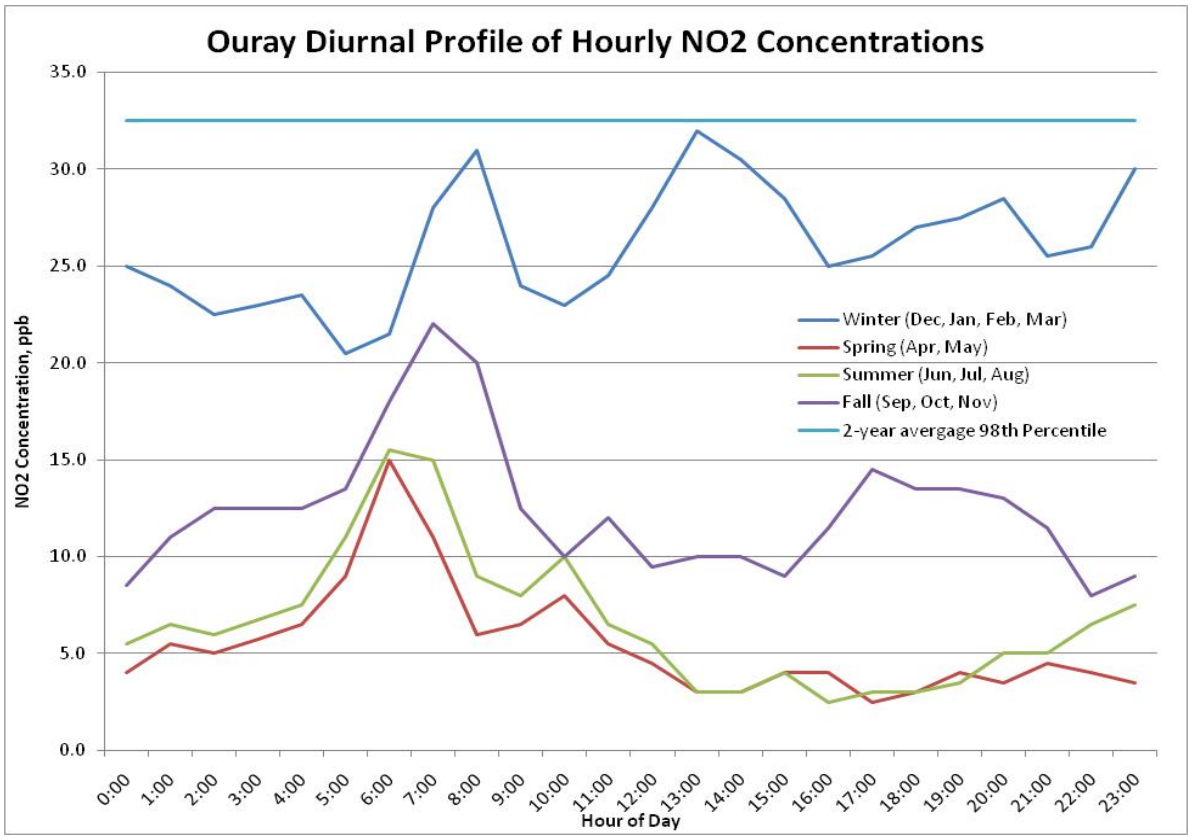
4.3.1.1 Single Source *Group* Impact Analysis

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 ***consisting of 2 drill rig engines and a rig boiler (assuming a completion rig would not operate simultaneously on the same pad as the 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-*9*** 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 ***for Tier 2 and Tier 4 engines***.

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 emissions for drilling operations were based on the emissions from one well including a drill rig ***(two rig engines)*** 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.



Data in ppb.

Figure 4-8 Ouray Diurnal NO_2 Profile of 98th Percentile Maximum Hourly Values by Season

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 ***are*** reported in ***Chapter 5.0***.

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.

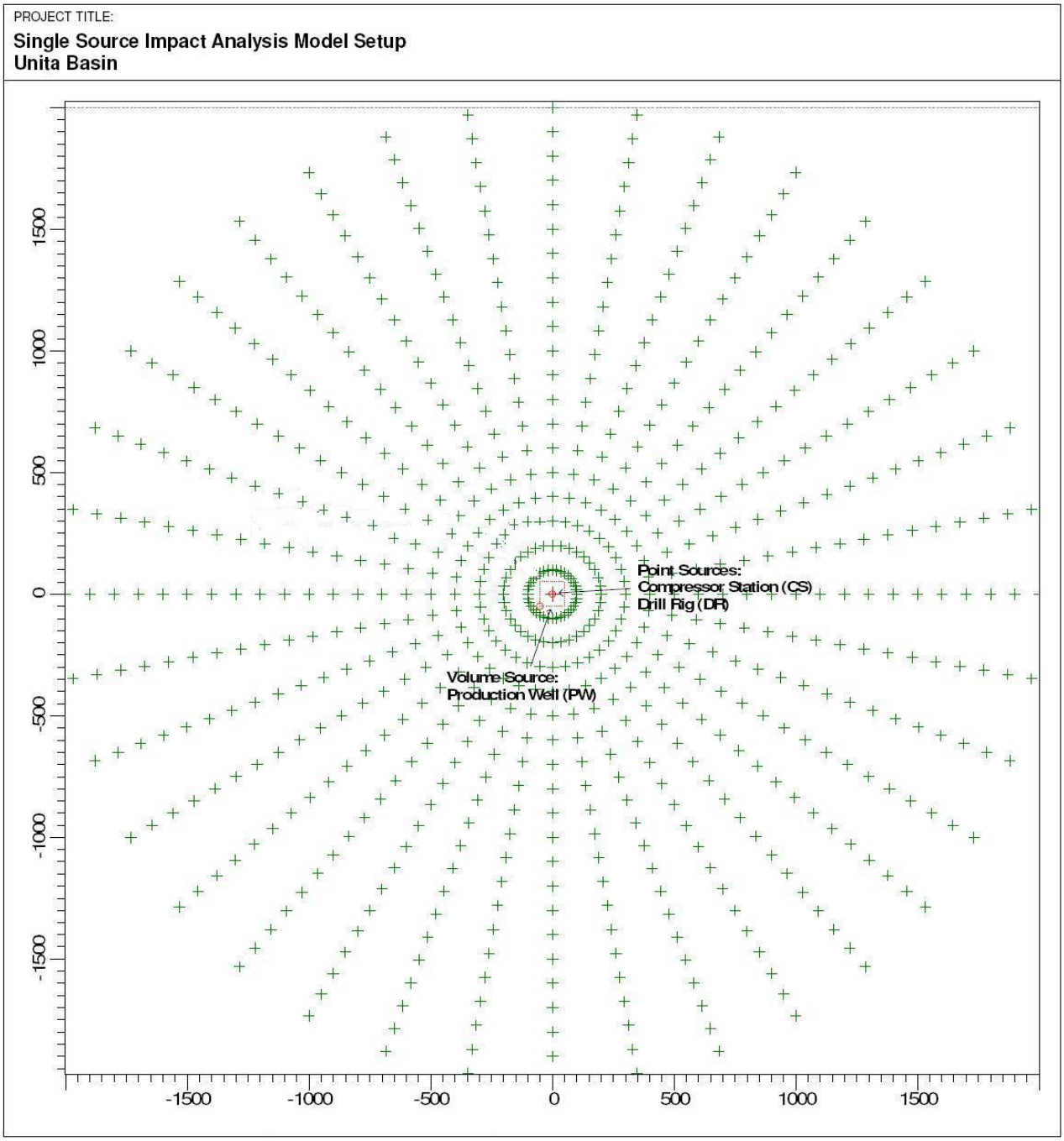


Figure 4-9 ***Single Source Impact Analysis Model Setup and Receptor Location***

Table 4-6 Project Source Modeling Parameters and Emission Rates

Tier 2 Engines

Point Source Parameters

ID	Activity	Operating Hours (hr/day)	Emission Rate per activity (g/s)											Stack Parameters[1]				
			NO_X		CO		SO_2				PM_{10}	$PM_{2.5}$		Stack	H	V	T	D
			1-hr	Annual	1-hr	8-hr	1-hr	3-hr	24-hr	Annual	24-hr	24-hr	Annual	Orientation	(m)	(m/s)	(K)	(m)
CS	Compressor Station	24	1.68	1.68	0.19	0.19	0.012	0.012	0.012	0.012	0.14	0.14	0.14	Vertical	10.0	51.1	755	0.30
DR	Drill Rig	24	1.97	0.10	1.07	1.07	0.002	0.002	0.001	0.0001	0.04	0.04	0.003	Vertical	6.1	71.7	672	0.25
CR	Completion Rig	12	0.63	0.002	0.34	0.34	0.0006	0.0006	0.0002	0.000002	0.006	0.006	0.00005	Vertical	3.0	101.5	770	0.13
RB	Rig Boiler	24	0.04	0.02	0.01	0.01	0.0005	0.0005	0.0005	0.0003	0.005	0.005	0.002	Vertical	4.0	5.3	450	0.39

Volume Source Parameters

ID	Activity	Operating Hours (hr/day)	Emission Rate per activity (g/s)											Source Dimensions[1]			Release Parameters[1]		
			NO_X		CO		SO_2				PM_{10}	$PM_{2.5}$		W	Area	H	σ_y-init	σ_z-init	H_r
			1-hr	Annual	1-hr	8-hr	1-hr	3-hr	24-hr	Annual	24-hr	24-hr	Annual	(m)	(m^2)	(m)	(m)	(m)	(m)
PW	Production Well	24	0.0066	0.0033	0.0056	0.0056	0.00022	0.00022	0.00022	0.00011	0.00050	0.00050	0.00056	71.1	5,058.5	5	16.54	2.33	2.50

Tier 4 Engines

Point Source Parameters

ID	Activity	Operating Hours (hr/day)	Emission Rate per activity (g/s)											Stack Parameters[1]				
			NO_X		CO		SO_2				PM_{10}	$PM_{2.5}$		Stack	H	V	T	D
			1-hr	Annual	1-hr	8-hr	1-hr	3-hr	24-hr	Annual	24-hr	24-hr	Annual	Orientation	(m)	(m/s)	(K)	(m)
CS	Compressor Station	24	1.68	1.68	0.19	0.19	0.012	0.012	0.012	0.012	0.14	0.14	0.14	Vertical	10.0	51.1	755	0.30
DR	Drill Rig	24	1.07	0.06	1.07	1.07	0.002	0.002	0.001	0.0001	0.004	0.004	0.0003	Vertical	6.1	71.7	672	0.25
CR	Completion Rig	12	0.34	0.0009	0.34	0.34	0.0006	0.0006	0.0002	0.000002	0.0006	0.0006	0.000005	Vertical	3.0	101.5	770	0.13
RB	Rig Boiler	24	0.04	0.02	0.01	0.01	0.0005	0.0005	0.0005	0.0003	0.005	0.005	0.002	Vertical	4.0	5.3	450	0.39

Volume Source Parameters

ID	Activity	Operating Hours (hr/day)	Emission Rate per activity (g/s)											Source Dimensions[1]			Release Parameters[1]		
			NO_X		CO		SO_2				PM_{10}	$PM_{2.5}$		W	Area	H	σ_y-init	σ_z-init	H_r
			1-hr	Annual	1-hr	8-hr	1-hr	3-hr	24-hr	Annual	24-hr	24-hr	Annual	(m)	(m^2)	(m)	(m)	(m)	(m)
PW	Production Well	24	0.0066	0.0033	0.0056	0.0056	0.00022	0.00022	0.00022	0.00011	0.00050	0.00050	0.00056	71.1	5,058.5	5	16.54	2.33	2.50

[1] Units for dimensions and parameters

H = height

V = vertical exhaust speed

T = temperature

D = diameter

W = width

Hr = height of release

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-*10*** through **4-*12*** 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.

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. ***Modeling was conducted over the short term to address the new 1-hour standards and over a 1-year time frame to address other criteria pollutant standards, as described below.***

Short-term modeling was conducted using four well pad sites, all with simultaneous drilling operations. Specifically, the modeling scenario consisted of one drill rig with two drill rig engines and a rig boiler, which were all assumed to be operating continuously at the same time at each well pad site. A second operating scenario consisted of a completion rig assumed to be operating continuously at each well pad site. Modeling indicated that the completion rig scenario would have a lower air quality impact, so results are presented only for the scenario consisting of one drill rig with two drill rig engines and a rig boiler operating on four well pad sites. The four well pads were centered in a 2 x 2 array in the center of the section at a 400-m interval. The 400-m interval represents the maximum density for a 40-acre surface spacing resulting in the greatest potential for source impact overlap. For this analysis, it also was assumed that the four well pads would actively drill simultaneously within a given day, which is conservative and would capture the peak impacts that could occur at any downwind receptor.

For annual impacts, emissions from the drill rig (two drill rig engines), completion rig, and rig boiler were modeled over a 1-year time frame. For the project alternatives, it was assumed that the maximum downhole spacing was 10 acres (64 wells per section); however, the surface spacing of the wells varies by alternative. A 40-acre surface spacing (16 pads per section) represents a worst-case scenario for this analysis because of the denser concentration of emission sources. Therefore, the annual modeling was based on the emissions from 64 wells drilled in a section, with 4 wells drilled at each of the 16 well pads.

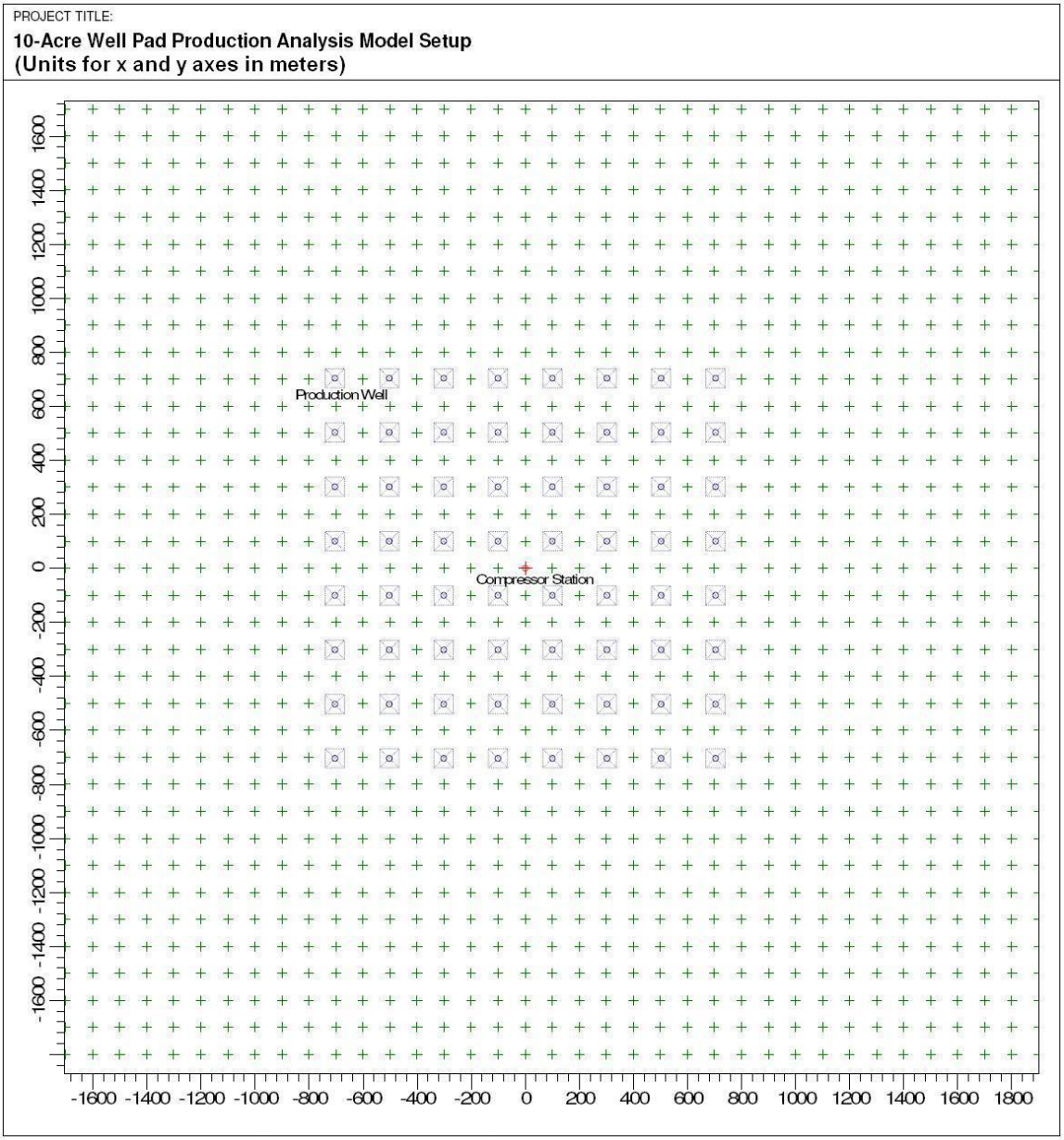


Figure 4-10 10-Acre Well Pad Production Analysis Model Setup and Receptor Location

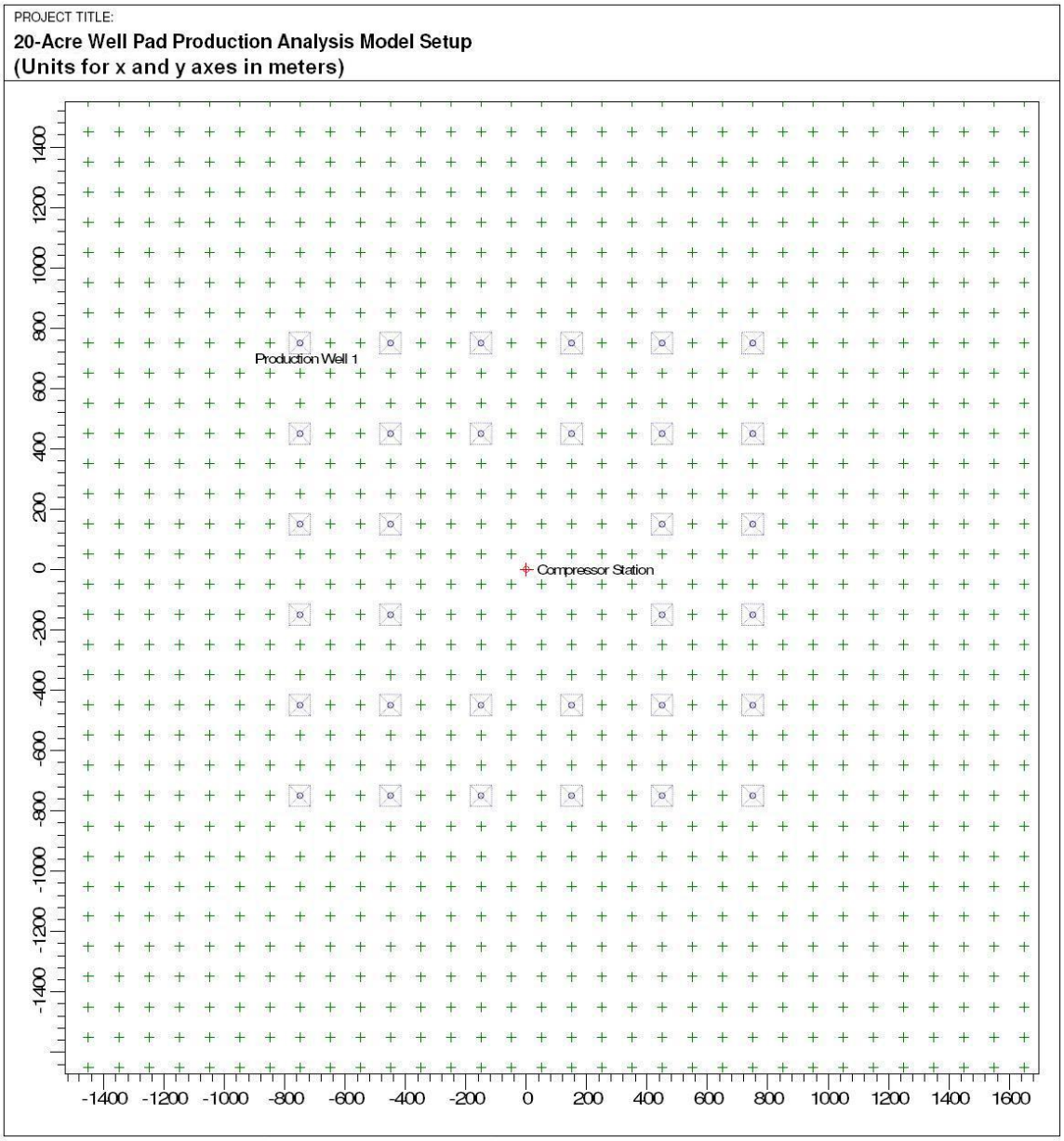


Figure 4-11 20-Acre Well Pad Production Analysis Model Setup and Receptor Location

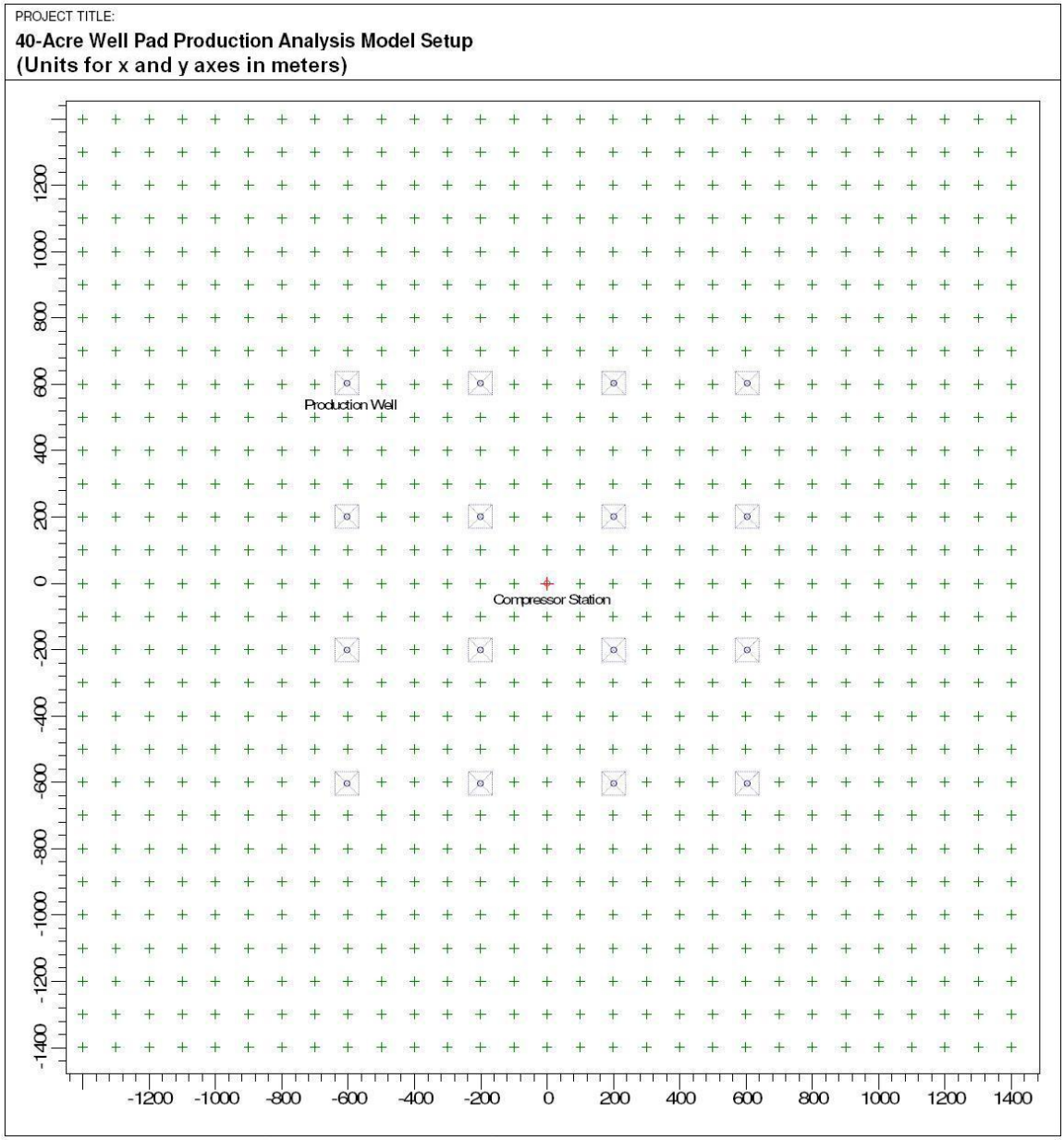


Figure 4-12 40-Acre Well Pad Production Analysis Model Setup and Receptor Location

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-*13*** show***s an*** example of the source/receptor model setup for the short-term well pad construction analysis, ***and Figure 4-14 shows an example of the setup for the annual analysis***. **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 ***Chapter 5.0***.

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**.

4.3.3 HAPs Analysis

The ambient air concentration of selected HAPs was evaluated by modeling the emission rates for HAPs listed in Table 4-7. The HAP modeling analysis employed the same key elements of the modeling analysis as for modeling the criteria pollutants, such as:

- ***AERMOD (Version 09292);***
- ***5 years of hourly meteorological data, 2002 through 2006 consisting of surface observations from Vernal, Utah, and upper air data from Salt Lake City, Utah;***
- ***Assumed flat terrain; and***
- ***No building downwash.***

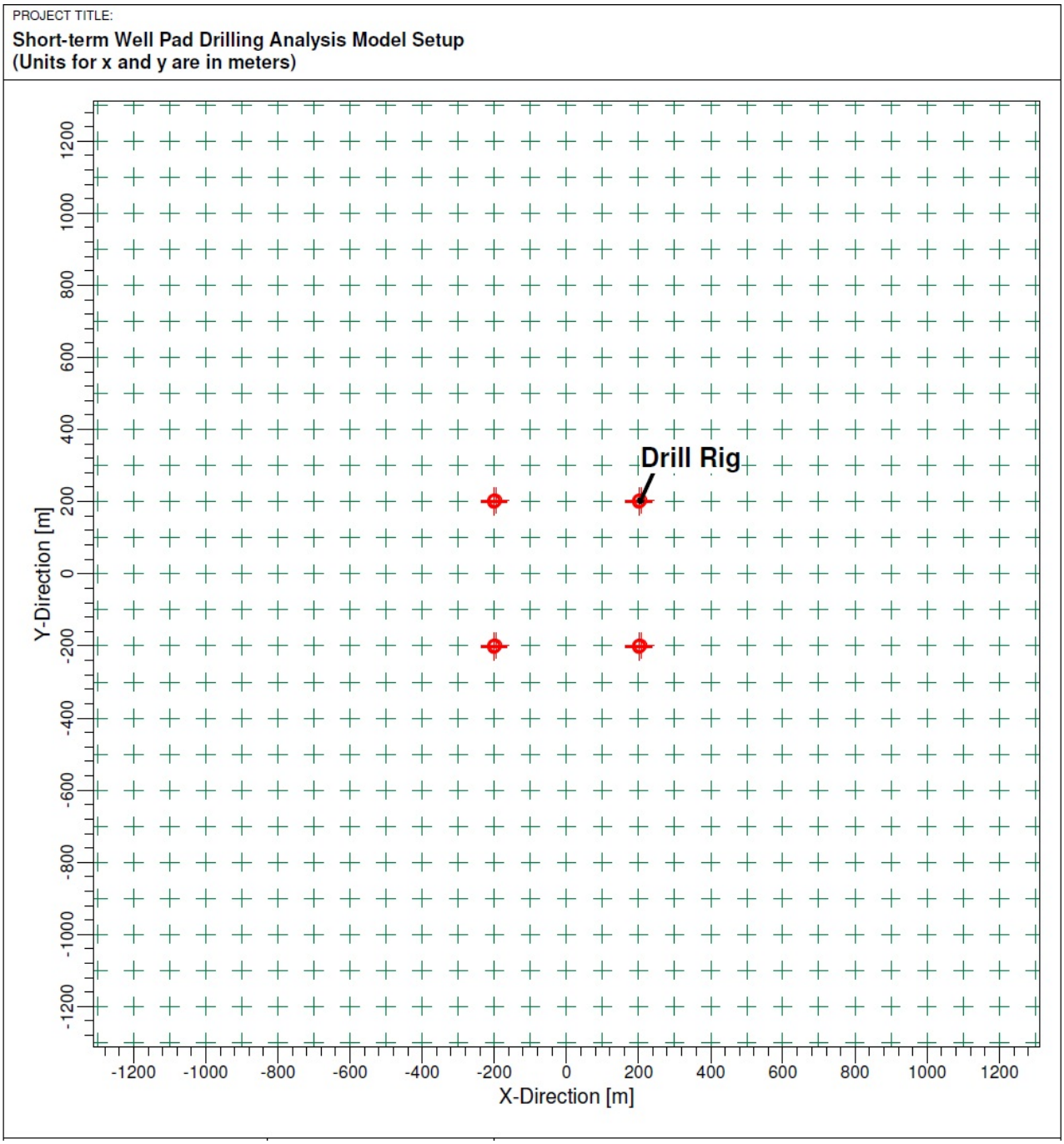


Figure 4-13 Short-term Drill Rig Analysis Model Setup and Receptor Location *(400-m spacing)*

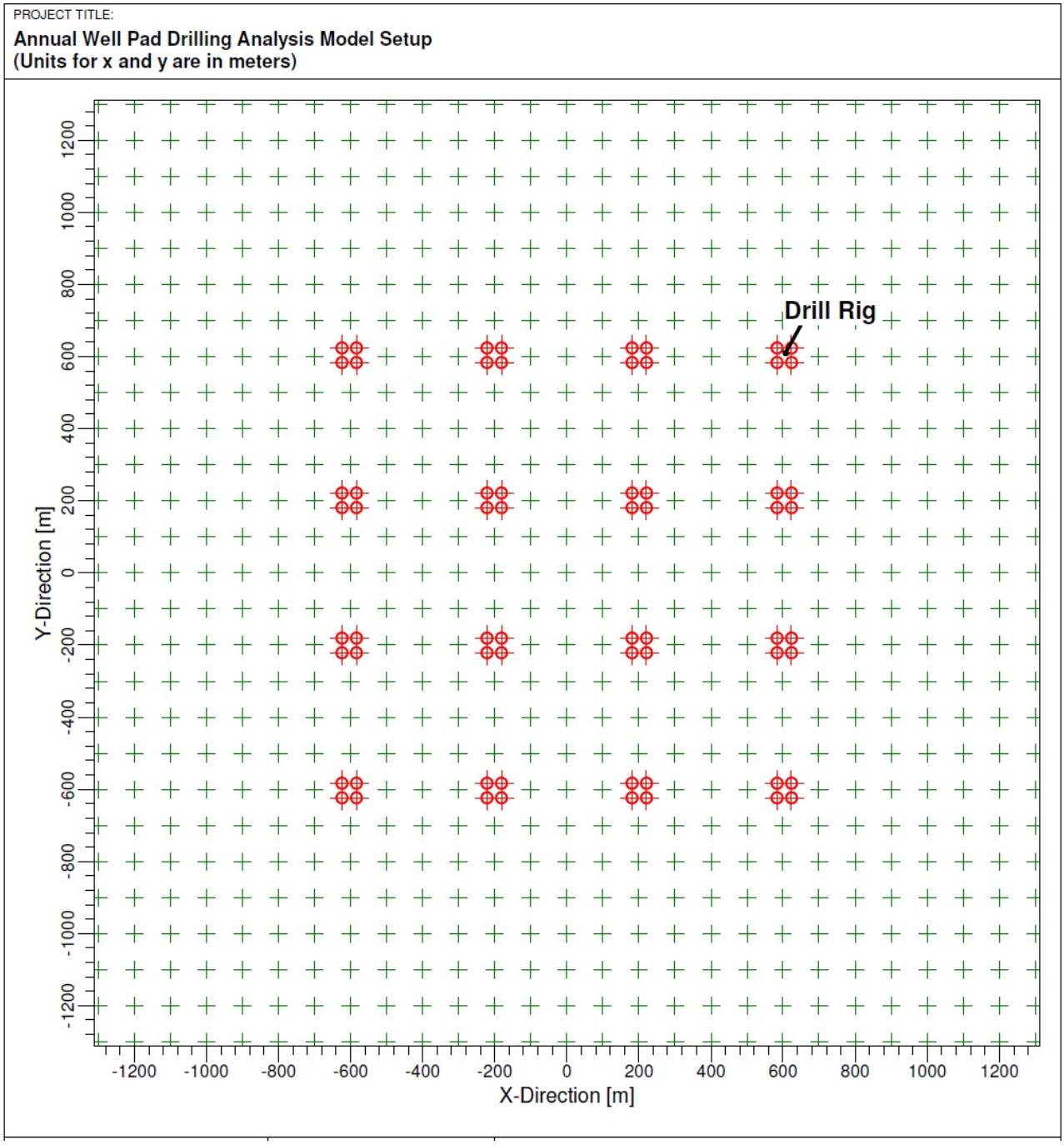


Figure 4-14 Annual Drill Rig Analysis Model Setup and Receptor Location

Table 4-7 HAP Emission Rates

Activity	Operating Hours (hr/day)	Emission Rate per activity (g/s)											
		Benzene		Toluene		Ethyl Benzene		Xylene		Formaldehyde		n-Hexane	
		24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual
Compressor Station	24	1.56E-03	1.56E-03	1.45E-03	1.45E-03	1.41E-04	1.41E-04	6.52E-04	6.52E-04	1.87E-01	1.87E-01	3.94E-03	3.94E-03
Drill Rig	24	7.59E-04	6.24E-05	5.58E-04	4.59E-05	1.16E-04	9.51E-06	3.95E-04	3.25E-05	4.41E-03	3.62E-04	5.94E-05	4.88E-06
Completion Rig	12	1.22E-04	1.00E-06	8.99E-05	7.39E-07	1.86E-05	1.53E-07	6.35E-05	5.22E-07	7.09E-04	5.83E-06	9.55E-06	7.85E-08
Rig Boiler	24	4.49E-08	1.12E-08	1.56E-05	3.25E-07	1.56E-05	3.34E-09	1.60E-07	5.72E-09	2.75E-07	1.73E-06	0	0
Production Well	24	1.29E-03	1.26E-03	2.99E-03	2.95E-03	7.96E-05	1.37E-04	2.23E-03	2.18E-03	5.55E-04	5.53E-04	3.65E-03	3.63E-03

AERMOD was run for all scenarios outlined in Section 4.3.1 using the 5 years of meteorological data to estimate air concentrations of formaldehyde, benzene, toluene, ethyl benzene, xylene(s), and n-hexane. The maximum modeled concentrations over the 5-year period for each applicable HAP/averaging period (i.e., annual and 24-hour) was compared to the Toxic Screening Level (TSLs) and Reference Concentrations for Chronic Inhalation (RfCs). See Chapter 5.0 for this comparison.

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	***2***	35
		Annual	0.497	0.004	0.493	***1***	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	***2***	35
		Annual	0.354	0.002	0.352	***1***	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	***2***	35
		Annual	0.387	0.003	0.385	***1***	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	***2***	35
		Annual	0.345	0.001	0.344	***1***	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	***2***	35
		Annual	0.667	0.001	0.666	***1***	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	***2***	35
		Annual	0.307	0.002	0.305	***1***	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 ($\mu g/m^3$)		
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	***2***	35
		Annual	0.261	0.004	0.258	***1***	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	***2***	35
		Annual	0.393	0.001	0.393	***1***	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	***2***	35
		Annual	0.301	0.002	0.298	***1***	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	***2***	35
		Annual	0.412	0.003	0.409	***1***	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	***2***	35
		Annual	0.675	0.001	0.674	***1***	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	***2***	35
		Annual	0.248	0.002	0.247	***1***	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	***9***	35
		Annual	0.496	0.004	0.492	***4***	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	***9***	35
		Annual	1.178	0.099	1.079	***4***	15
Flaming Gorge National Recreation Area (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	***9***	35
		Annual	2.464	0.245	2.219	***4***	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	***9***	35
		Annual	0.351	0.007	0.343	***4***	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	***9***	35
		Annual	0.621	0.002	0.619	***4***	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	***9***	35
		Annual	0.393	0.002	0.392	***4***	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	***9***	35
		Annual	0.245	0.002	0.244	***4***	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	***9***	35
		Annual	0.325	0.017	0.308	***4***	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	***2***	35
		Annual	0.501	0.008	0.493	***1***	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	***2***	35
		Annual	0.356	0.004	0.352	***1***	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	***2***	35
		Annual	0.390	0.005	0.385	***1***	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	***2***	35
		Annual	0.346	0.002	0.344	***1***	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	***2***	35
		Annual	0.667	0.001	0.666	***1***	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	***2***	35
		Annual	0.309	0.004	0.305	***1***	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	***2***	35
		Annual	0.263	0.009	0.258	***1***	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	***2***	35
		Annual	0.394	0.001	0.393	***1***	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	***2***	35
		Annual	0.303	0.005	0.298	***1***	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	***2***	35
		Annual	0.415	0.006	0.409	***1***	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	***2***	35
		Annual	0.675	0.001	0.674	***1***	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	***2***	35
		Annual	0.249	0.003	0.247	***1***	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	***9***	35
		Annual	0.499	0.009	0.492	***4***	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	***9***	35
		Annual	1.276	0.197	1.079	***4***	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	***9***	35
		Annual	2.716	0.497	2.219	***4***	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	***9***	35
		Annual	0.358	0.015	0.343	***4***	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	***9***	35
		Annual	0.623	0.004	0.619	***4***	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	***9***	35
		Annual	0.395	0.003	0.392	***4***	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	***9***	35
		Annual	0.247	0.004	0.244	***4***	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	***9***	35
		Annual	0.341	0.033	0.308	***4***	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 ***Estimating Natural Visibility Conditions*** Under the

Regional Haze ***Program***" (USEPA 2003***b***) 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***a***). 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 µeq/l or less than 0.12 µeq/l at all identified lakes for the Proposed Action and Optimal Recovery Alternative, respectively.

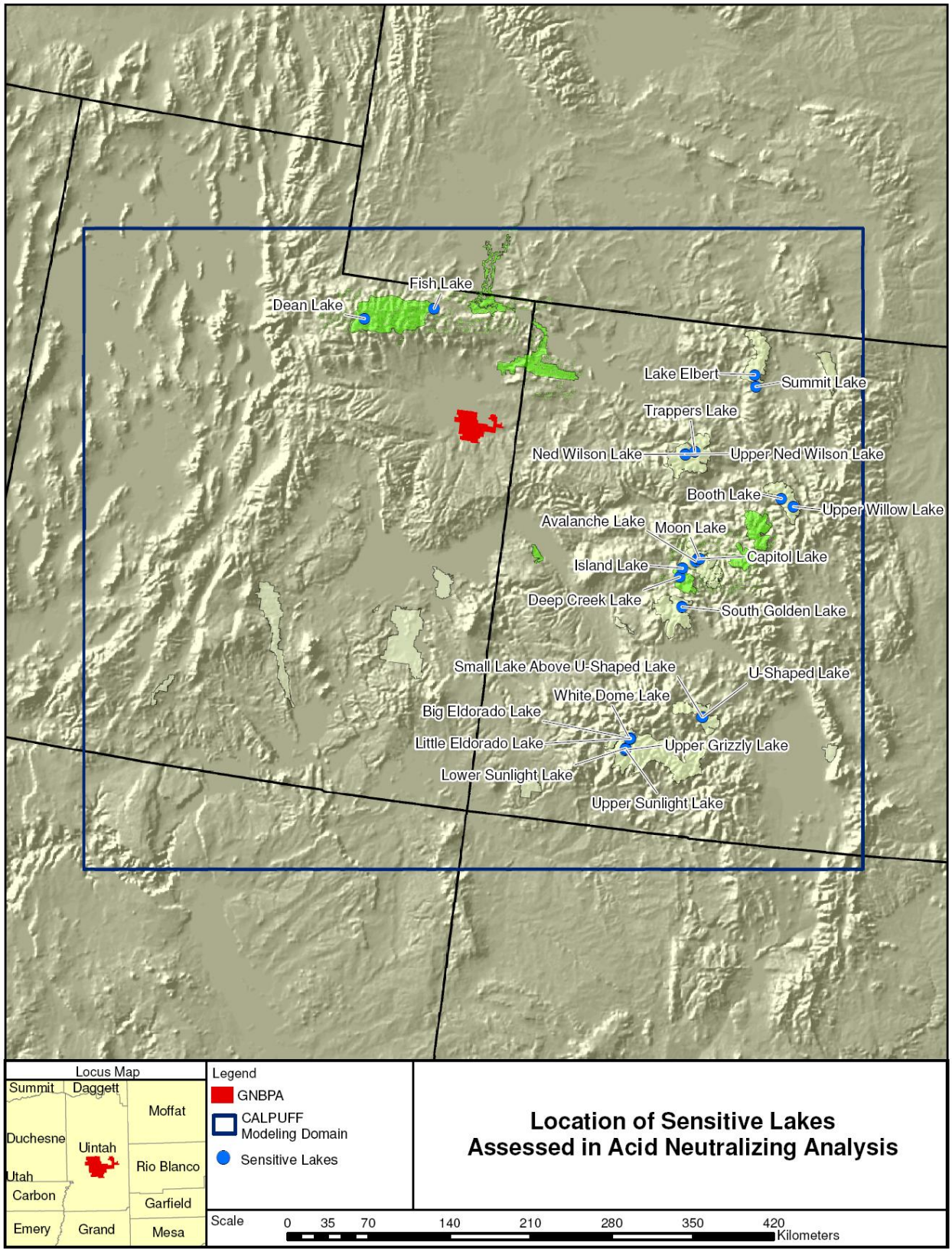


Figure 5-1 Sensitive Lakes Analyzed in the Acid Neutralizing Capacity Analysis

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, 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

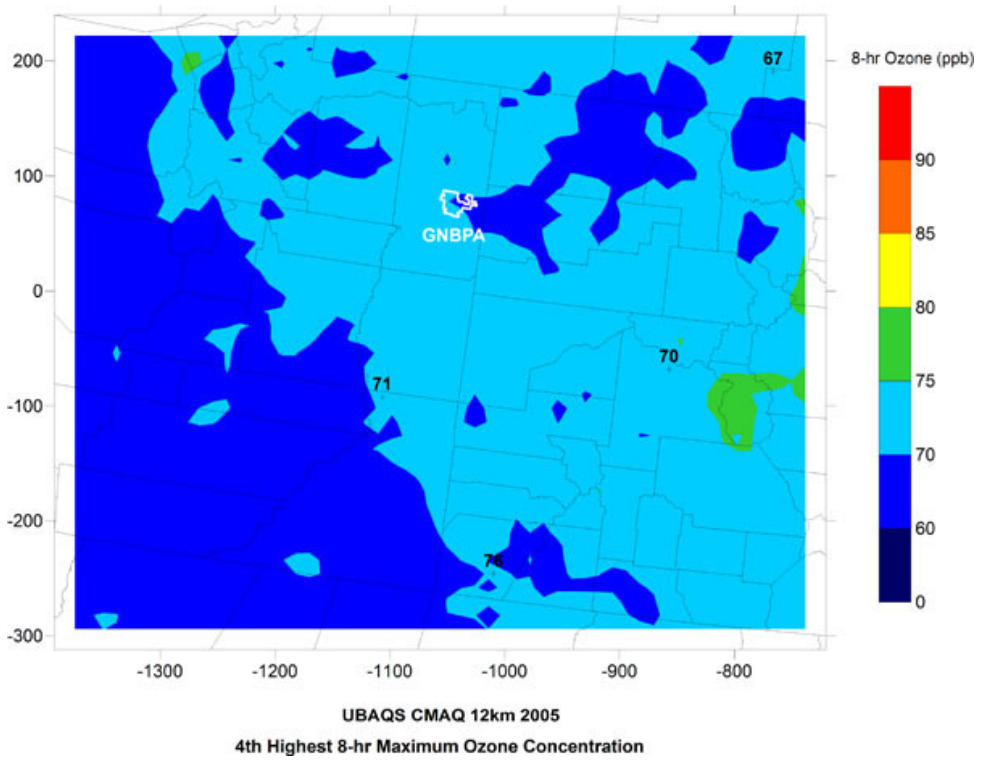
	Bias (Percent)			Error (Percent)			
Year/Quarter	Fractional	Normalized Mean	Mean Normalized	Fractional	Normalized Mean Gross	Mean Normalized Gross	Number[1]
2005 Quarter 2	-5.80	-5.16	-4.82	11.16	10.65	10.51	2,015
2005 Quarter 3	-16.75	-15.04	-14.89	17.52	15.82	15.70	1,388
2006 Quarter 1	-5.00	-4.52	-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

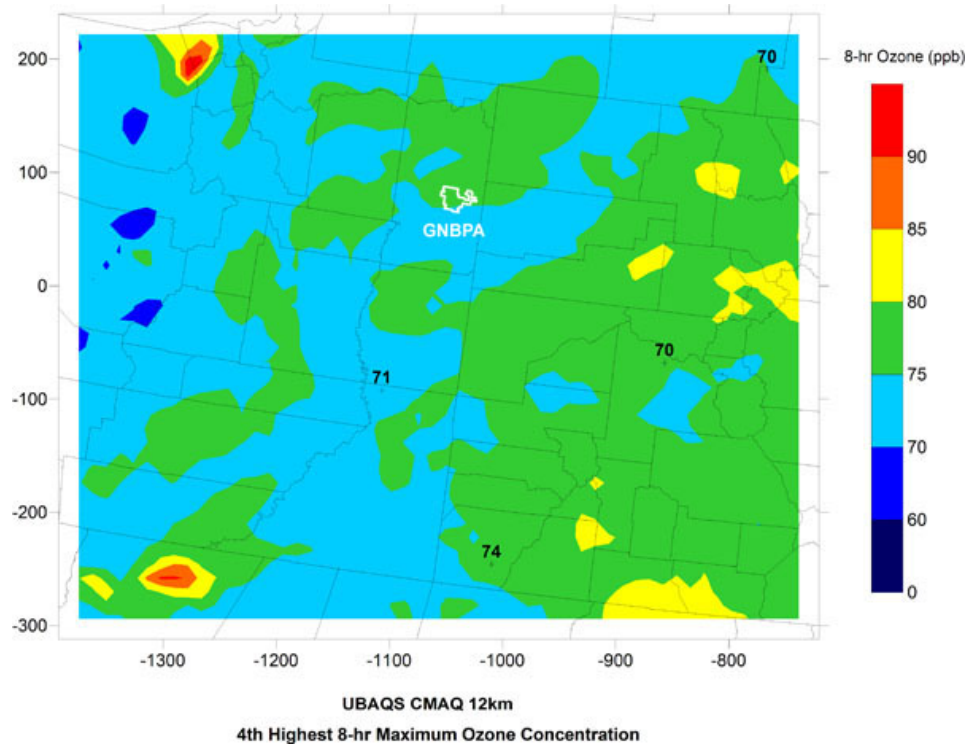


Figure 5-2 Depiction of Predicted and Observed Fourth highest Daily Maximum 8-hour Ozone Concentrations for 2005 and 2006

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 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.

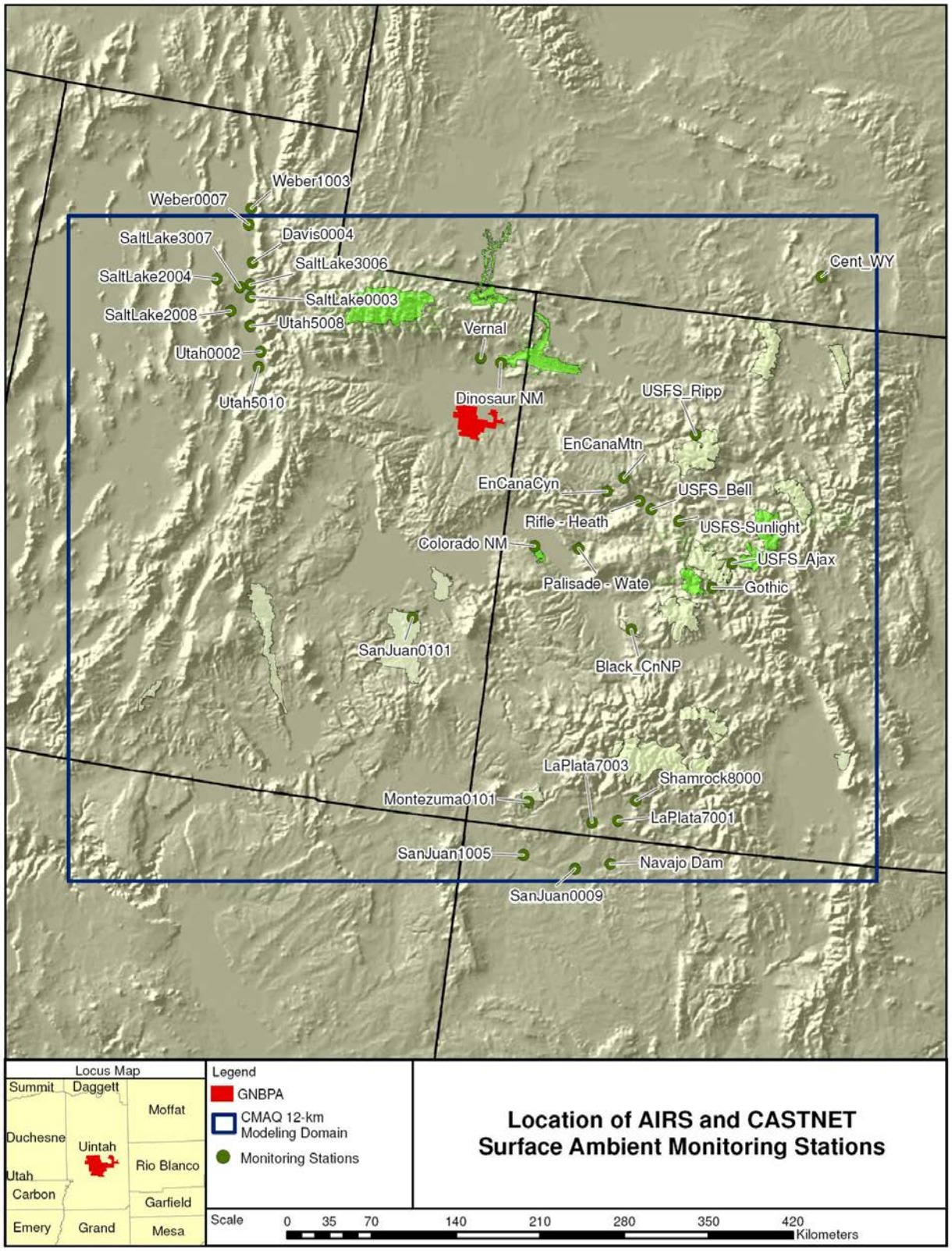


Figure 5-3 Ozone Monitoring Stations

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 DVc	2018 Projected Baseline DVf	2018 Projected Baseline RRF	2017 Proposed Action DVf	2017 Proposed Action RRF	2026 Optimal Recovery DVf	2026 Optimal Recovery 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.

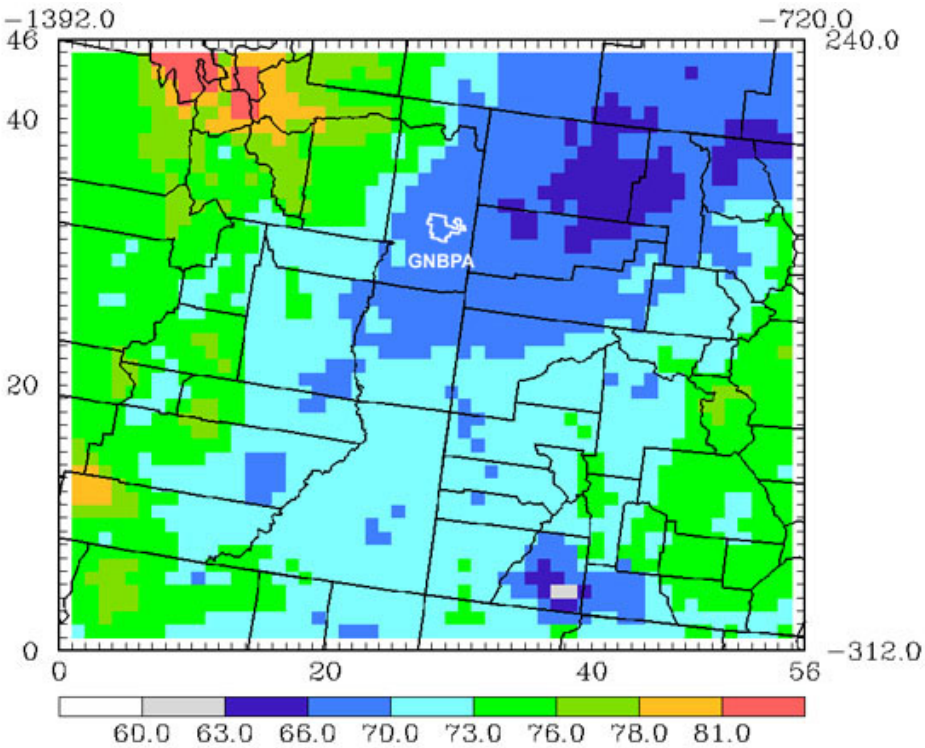
Figure 5-5 presents the 2018 Projected Baseline design values. For both years of meteorology, the CMAQ model generally is estimating a decrease in the design value across the domain. **Figure 5-6** presents the future design values that include the 2017 Proposed Action emissions. The results are nearly 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 Uintah 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

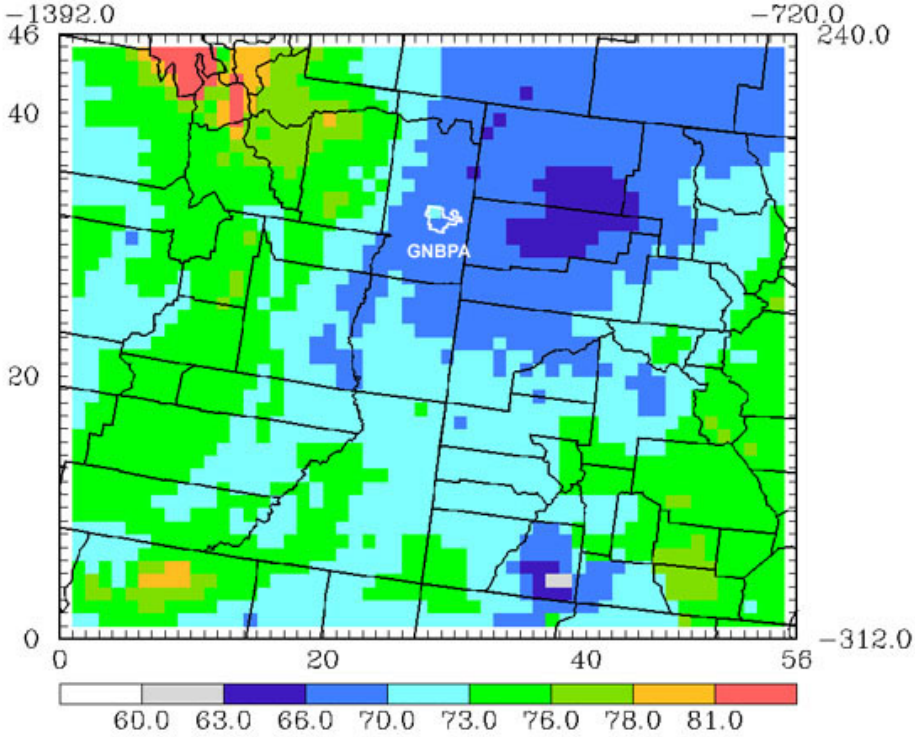
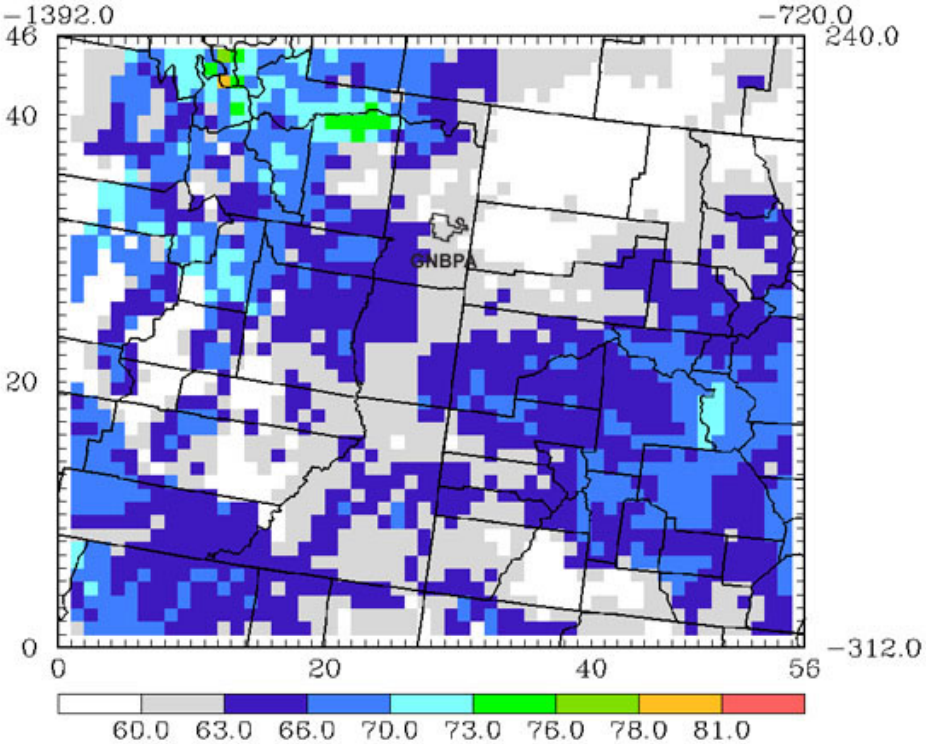


Figure 5-4 Baseline 8-hour Ozone Design Values

2005



2006

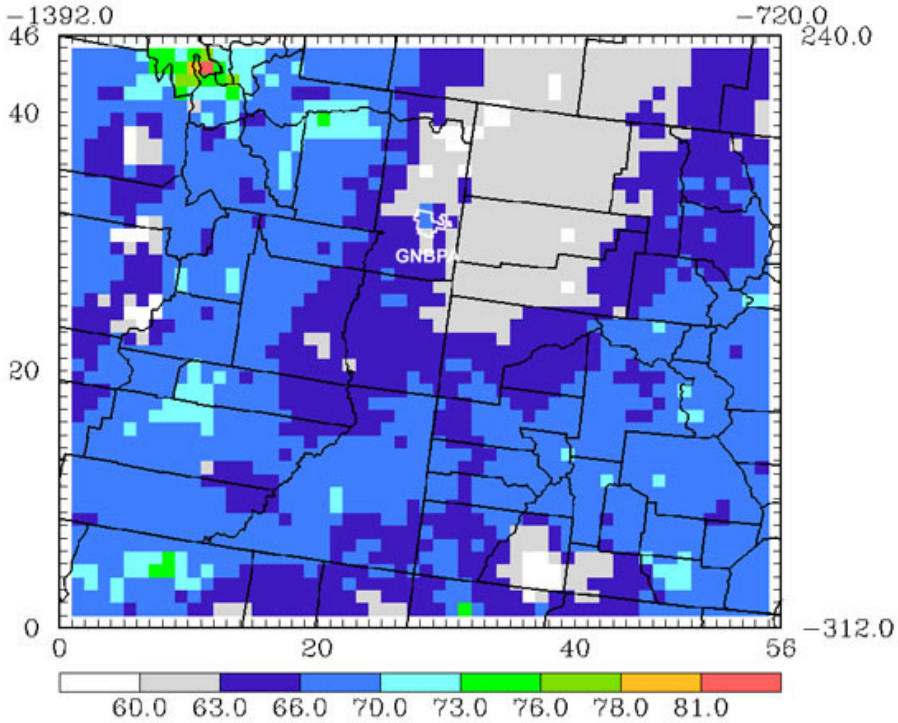
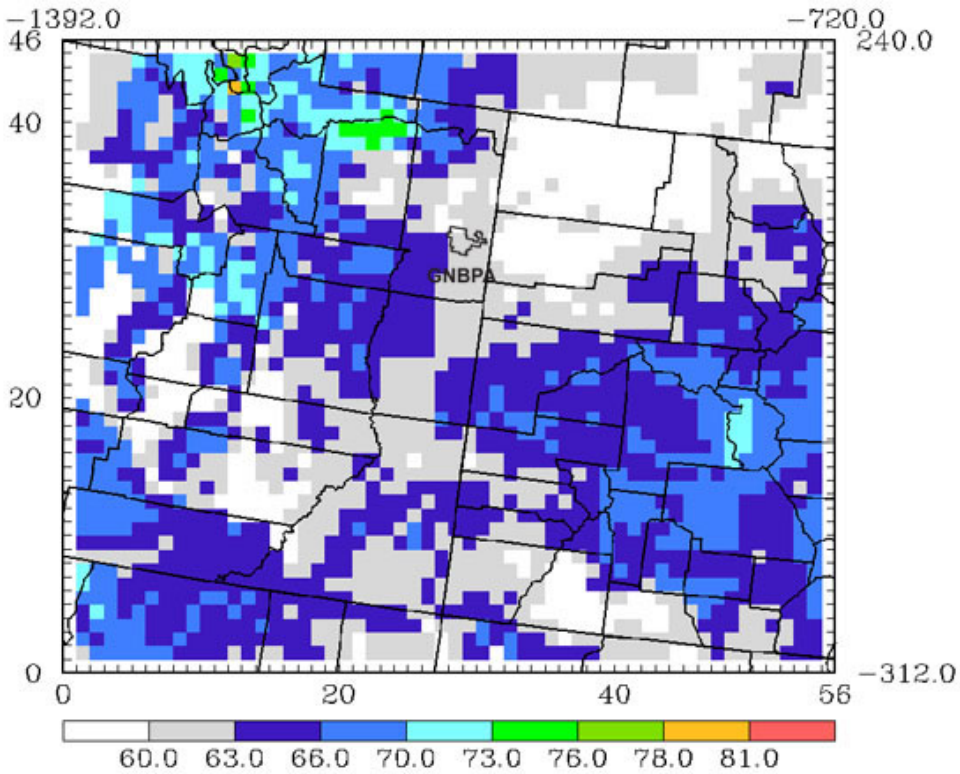


Figure 5-5 Annual 8-hour Ozone Future Design Values for 2018 Projected Baseline

2005



2006

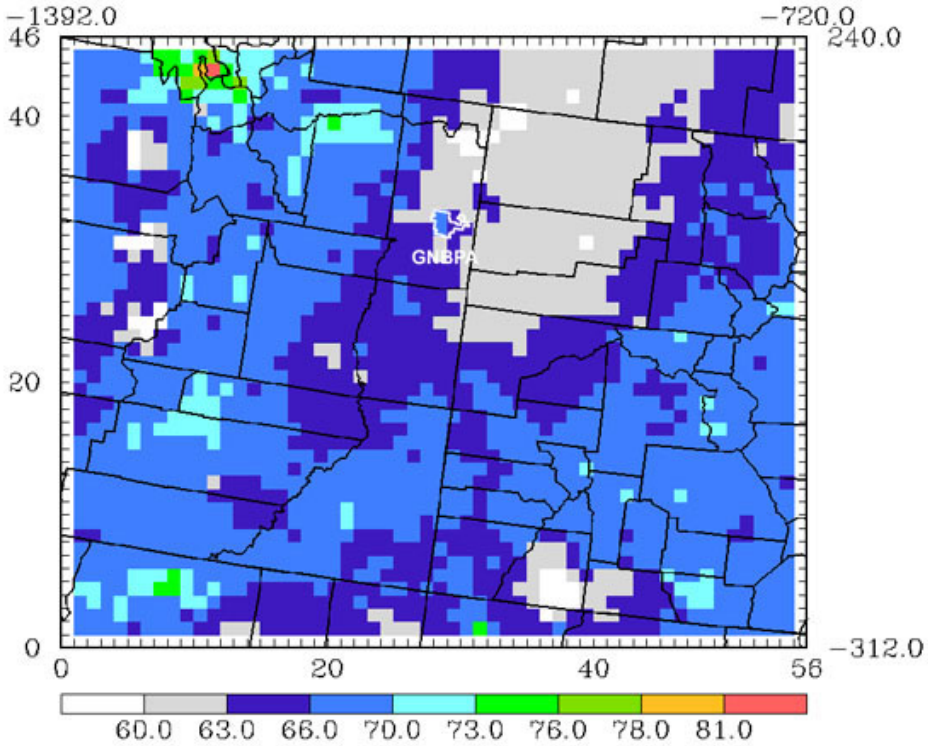
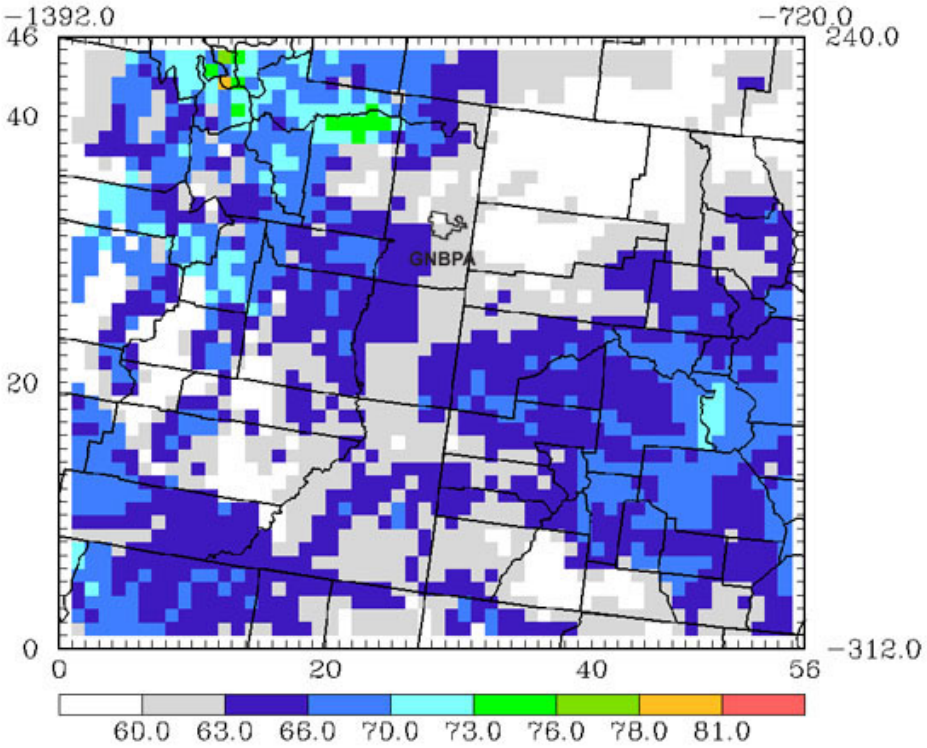


Figure 5-6 Annual 8-hour Ozone Future Design Values for 2017 Proposed Action

2005



2006

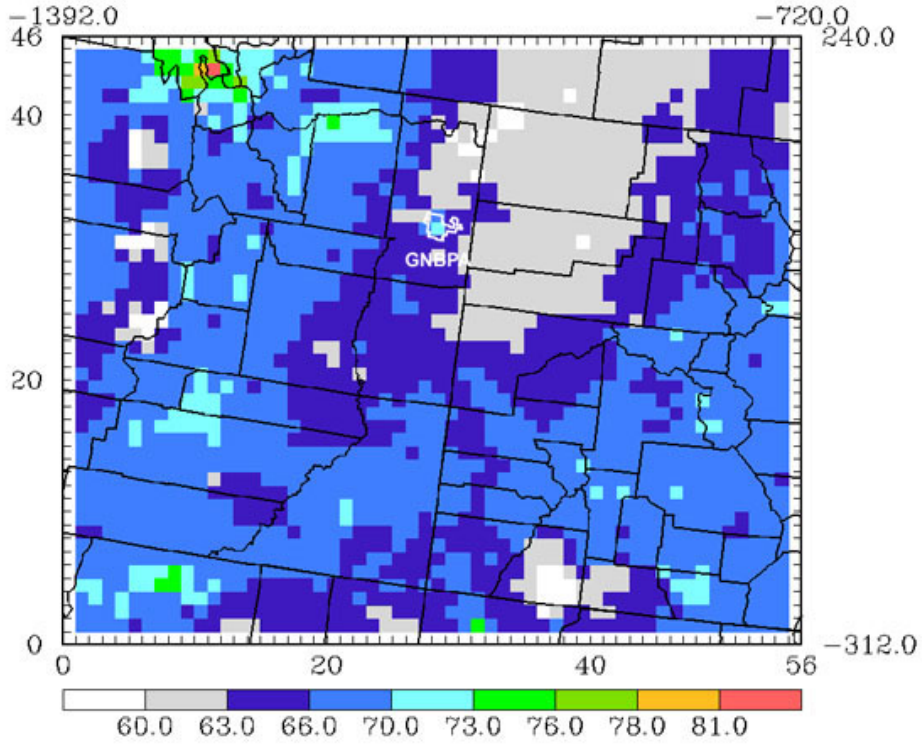
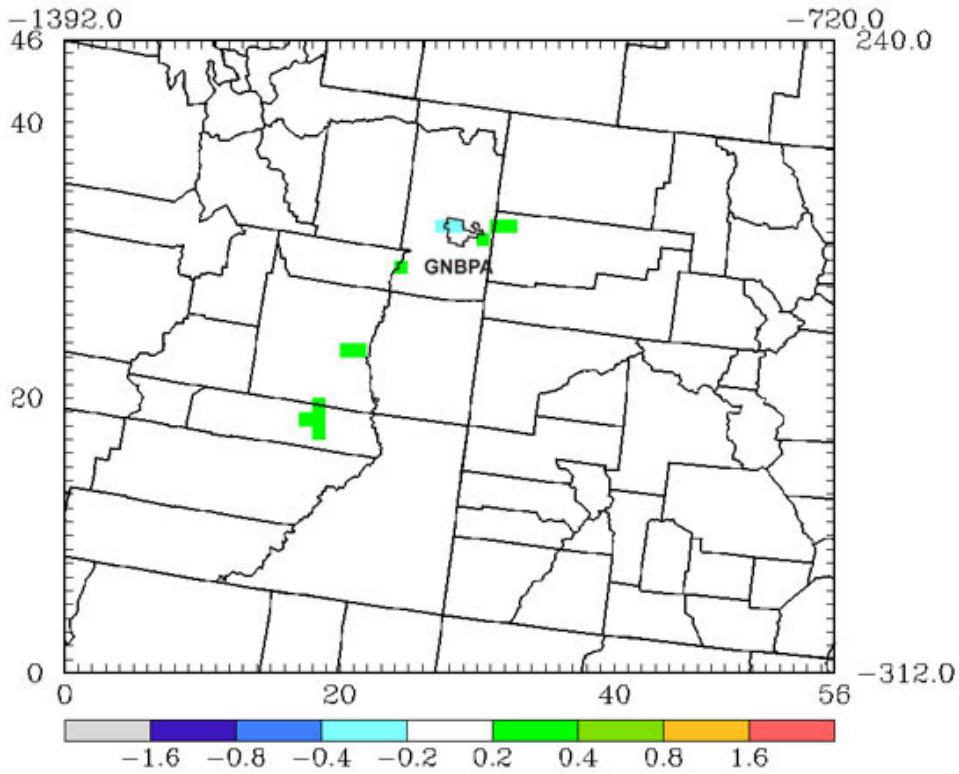


Figure 5-7 Annual 8-hour Ozone Future Design Values for 2026 Optimal Recovery Alternative

2005



2006

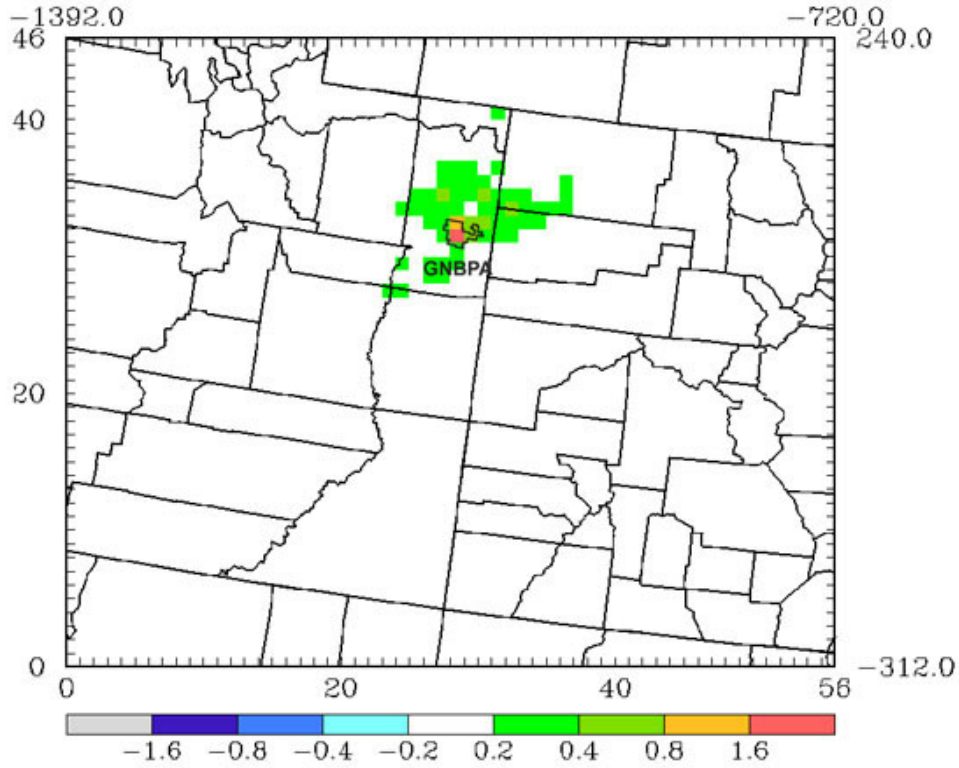
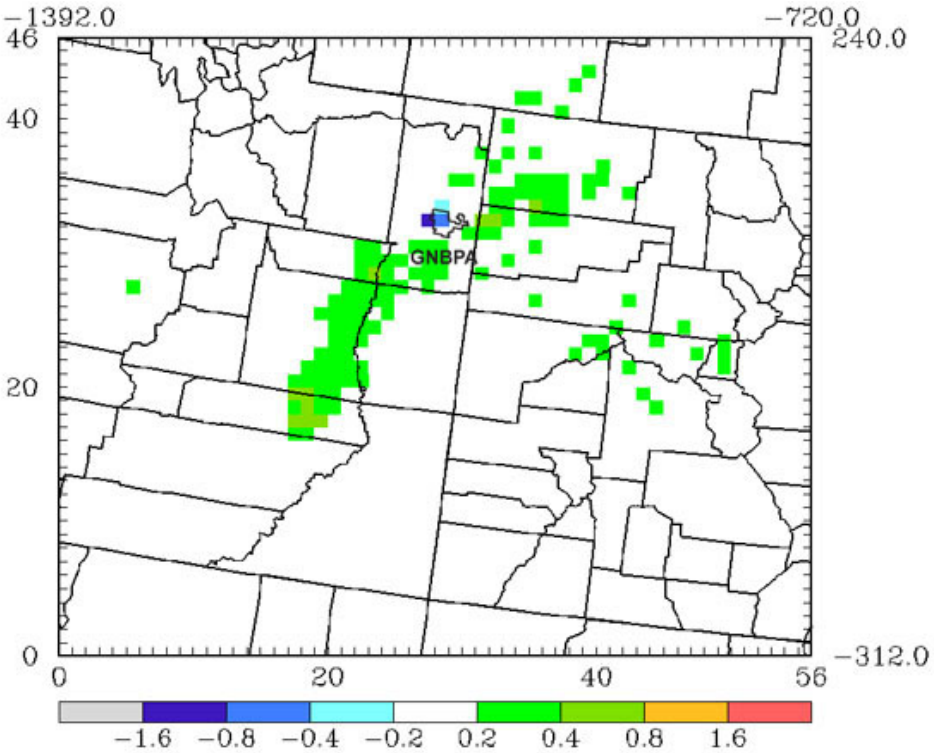


Figure 5-8 Annual 8-hour Ozone Future Design Value Differences for Proposed Action Minus 2018 Projected Baseline



2006

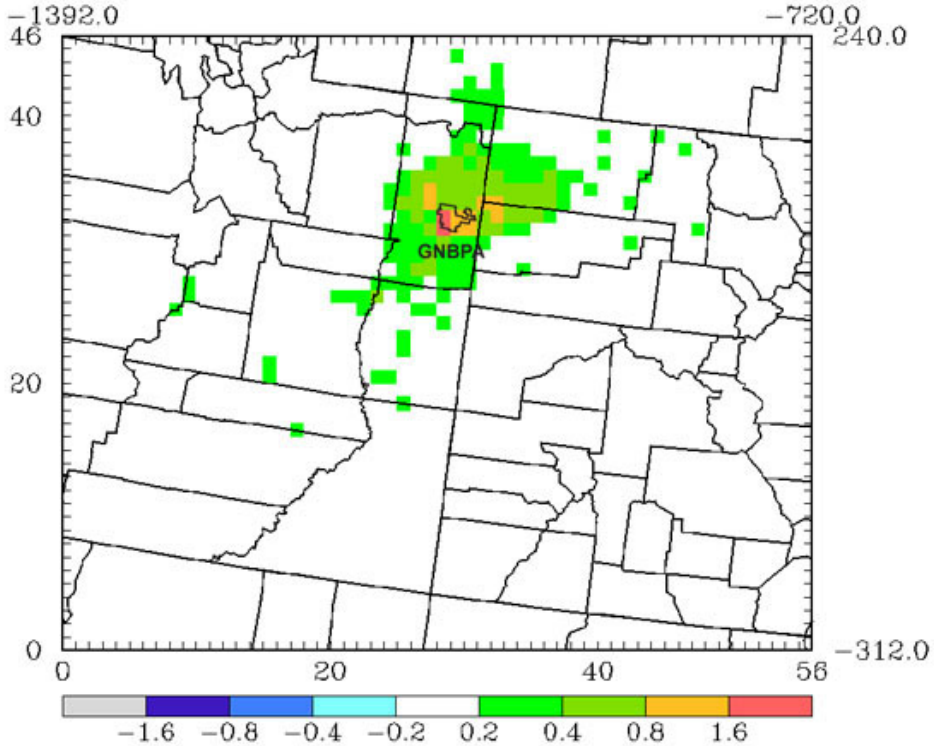
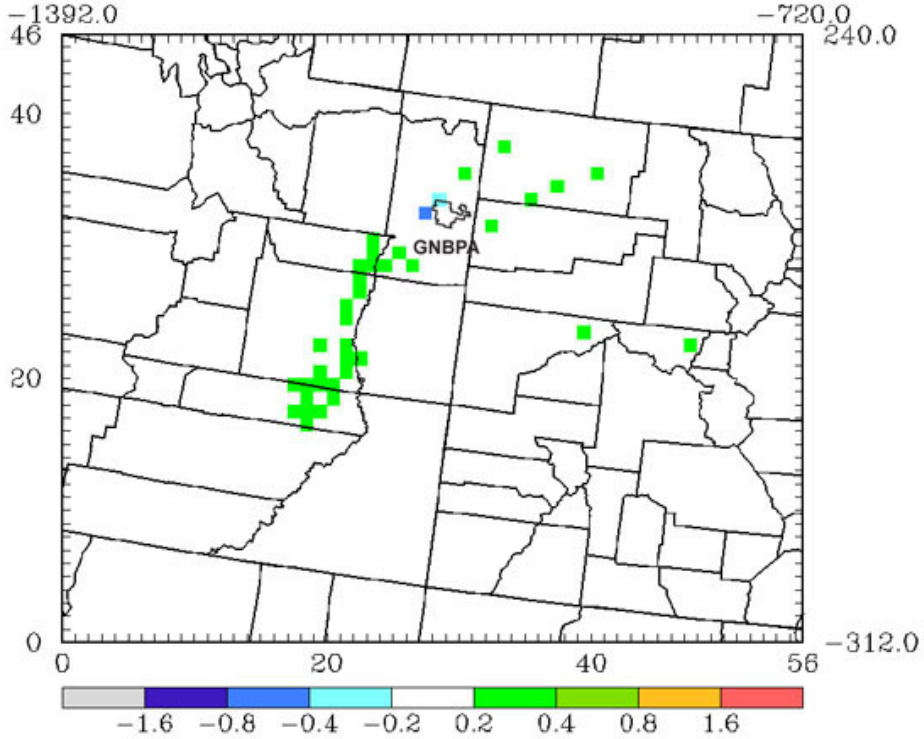


Figure 5-9 Annual 8-hour Ozone Future Design Value Differences for Optimal Recovery Minus 2018 Projected Baseline

2005



2006

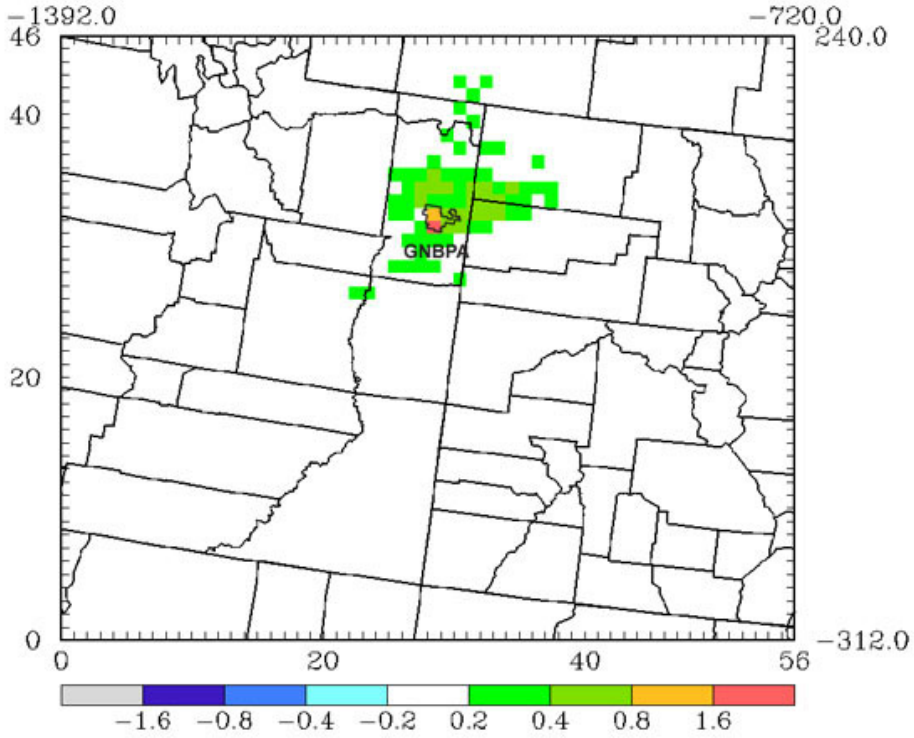


Figure 5-10 Annual 8-hour Ozone Future Design Value Differences for Optimal Recovery Minus Proposed Action

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 makes 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.

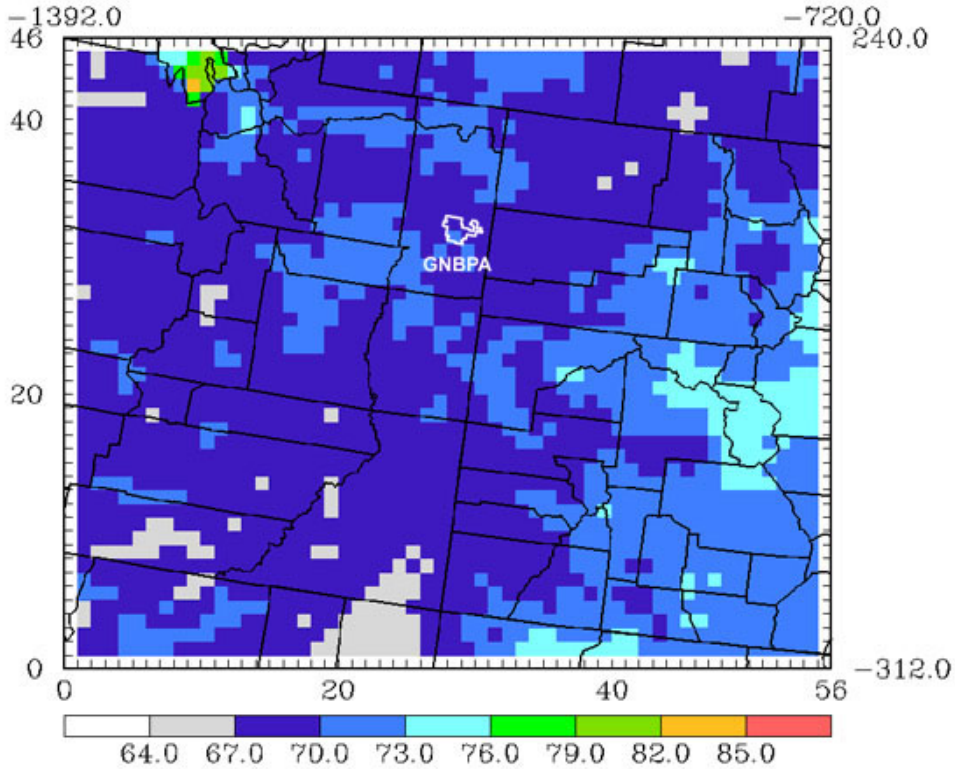
As was performed for the unmonitored area analysis, differences between the alternatives were prepared. **Figure 5-14** presents the differences in the modeled fourth highest ozone levels between the Proposed Action and the Projected Baseline using the 2005 and 2006 meteorological data. For the 2005 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

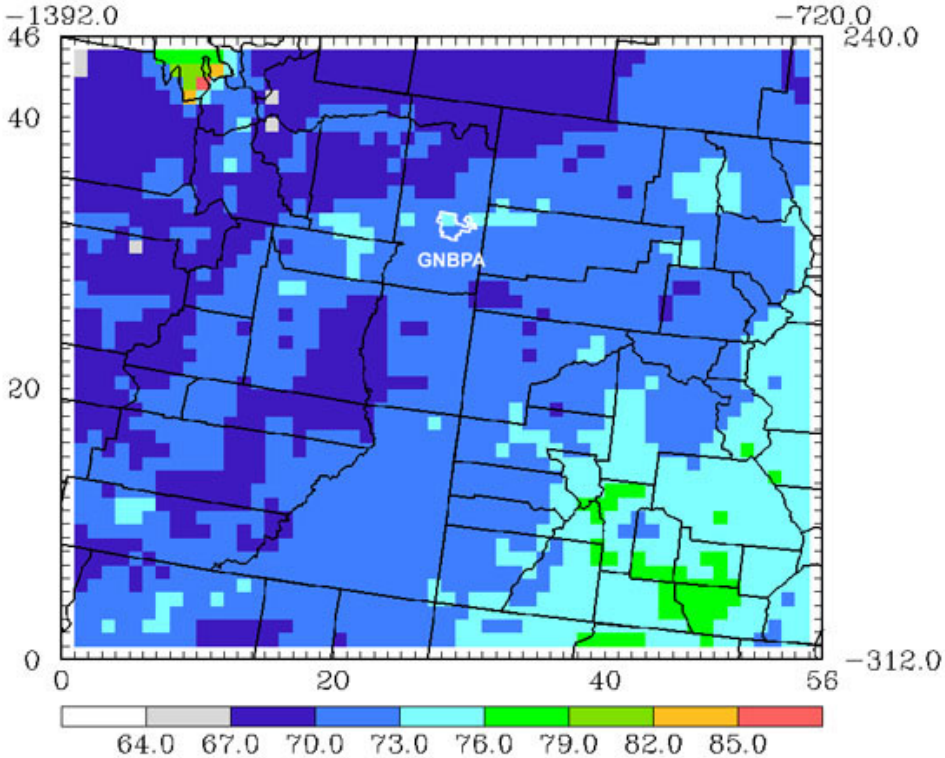
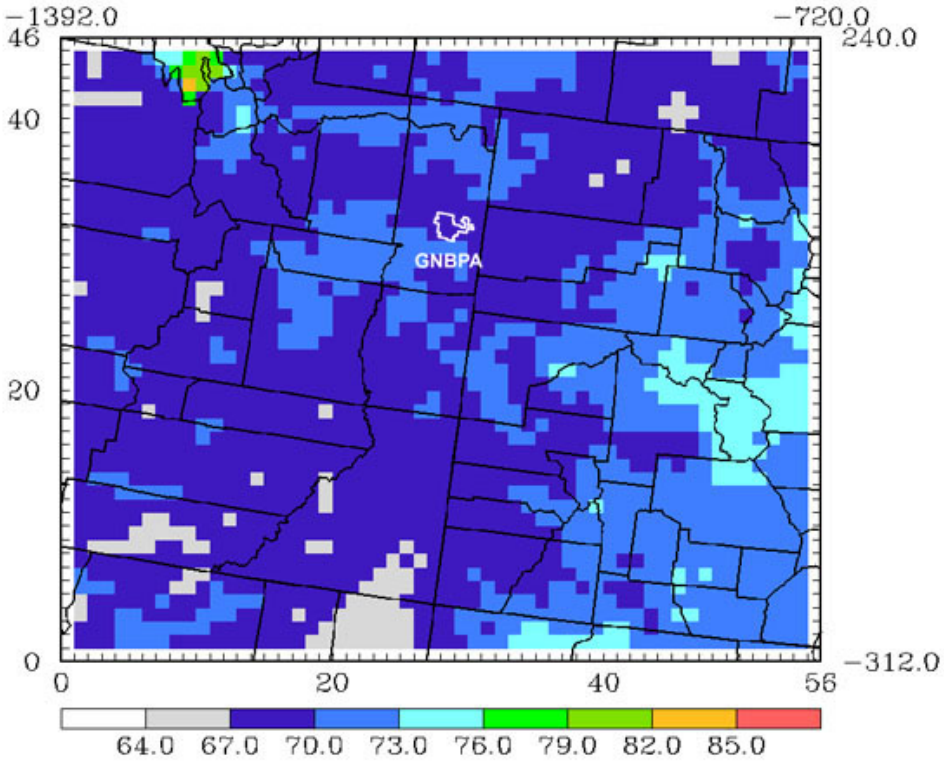


Figure 5-11 Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for 2018 Projected Baseline

2005



2006

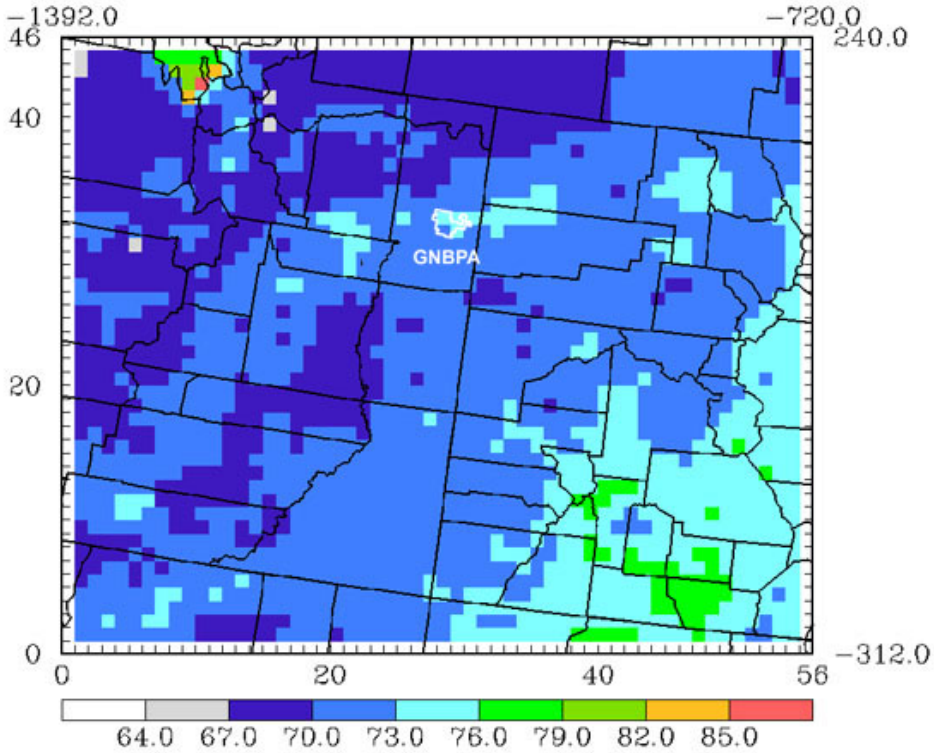
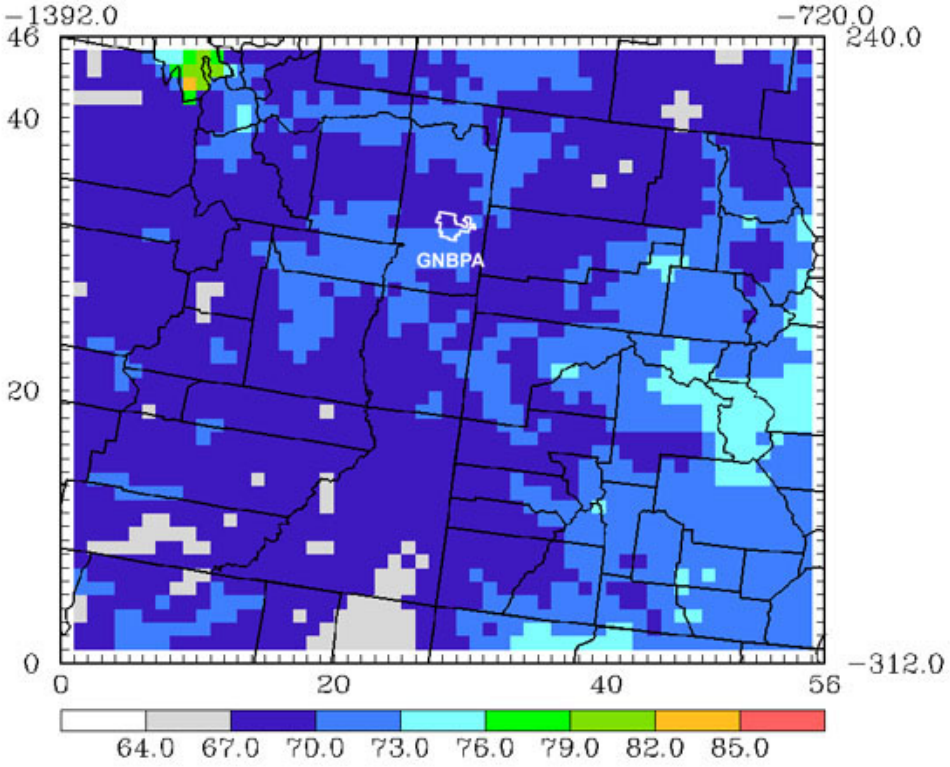


Figure 5-12 Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for 2017 Proposed Action

2005



2006

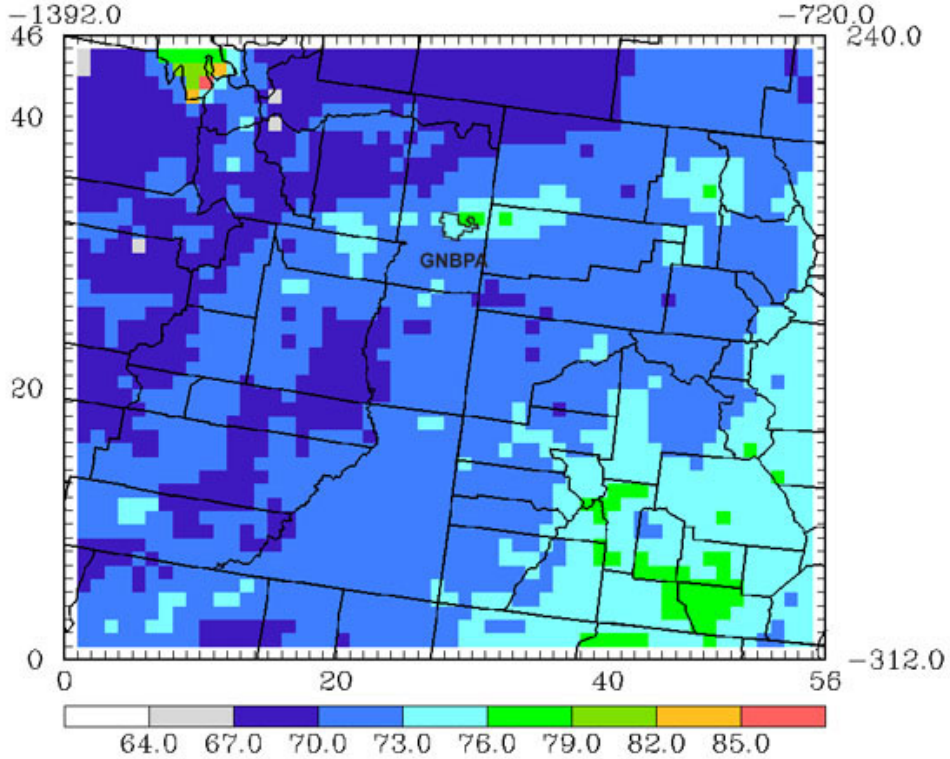
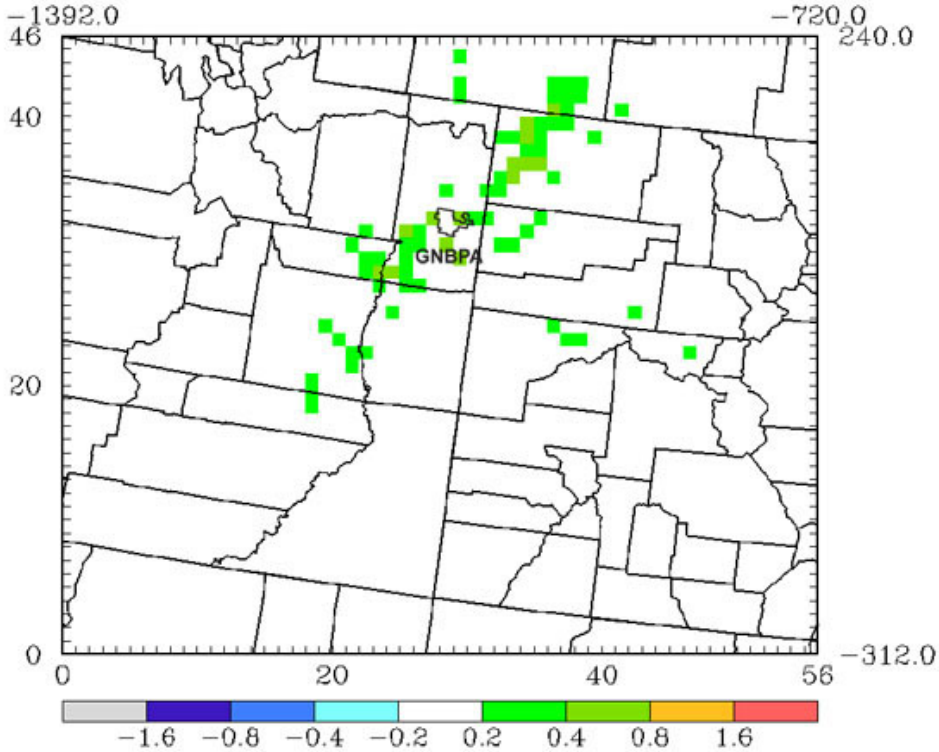


Figure 5-13 Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for 2026 Optimal Recovery

2005



2006

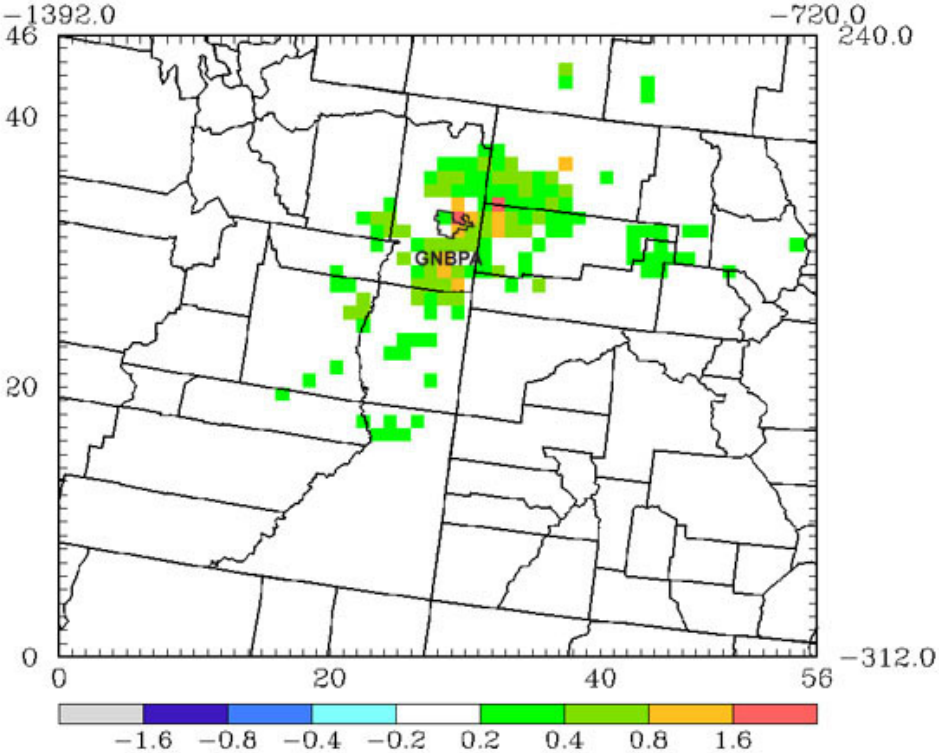
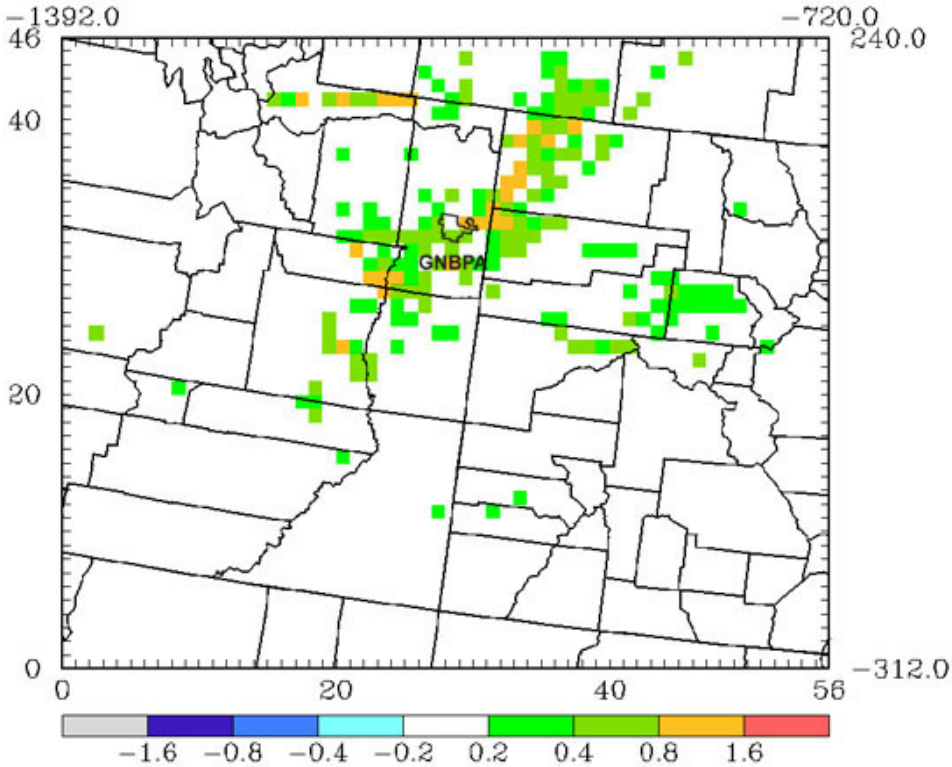


Figure 5-14 Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Proposed Action Minus 2018 Projected Baseline

2005



2006

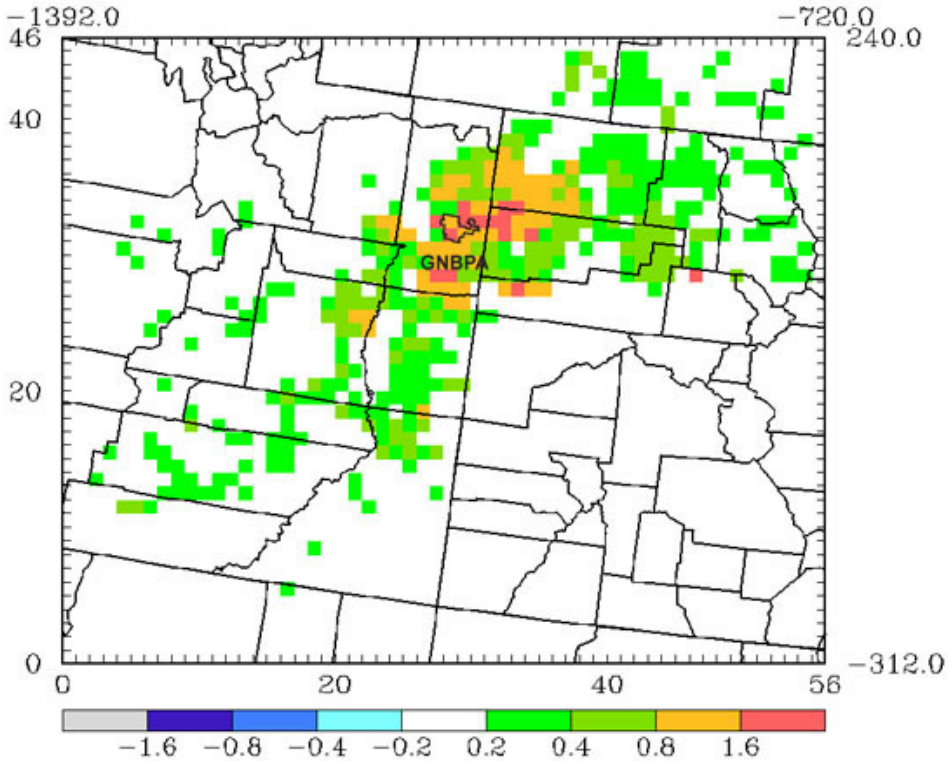
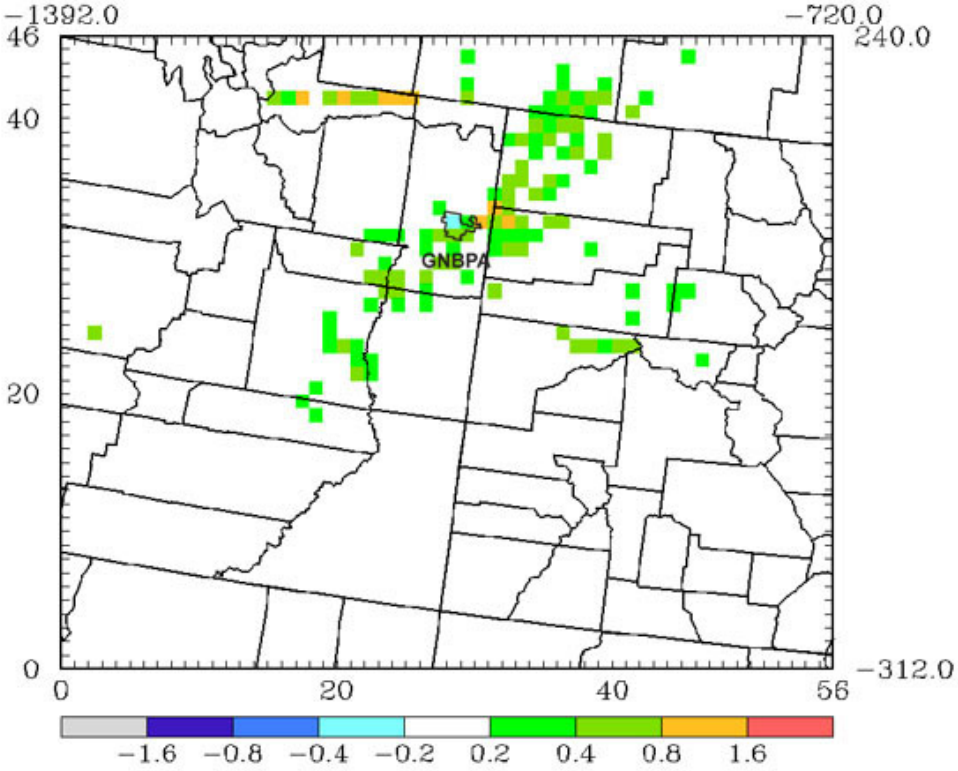


Figure 5-15 Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Optimal Recovery Minus 2018 Projected Baseline

2005



2006

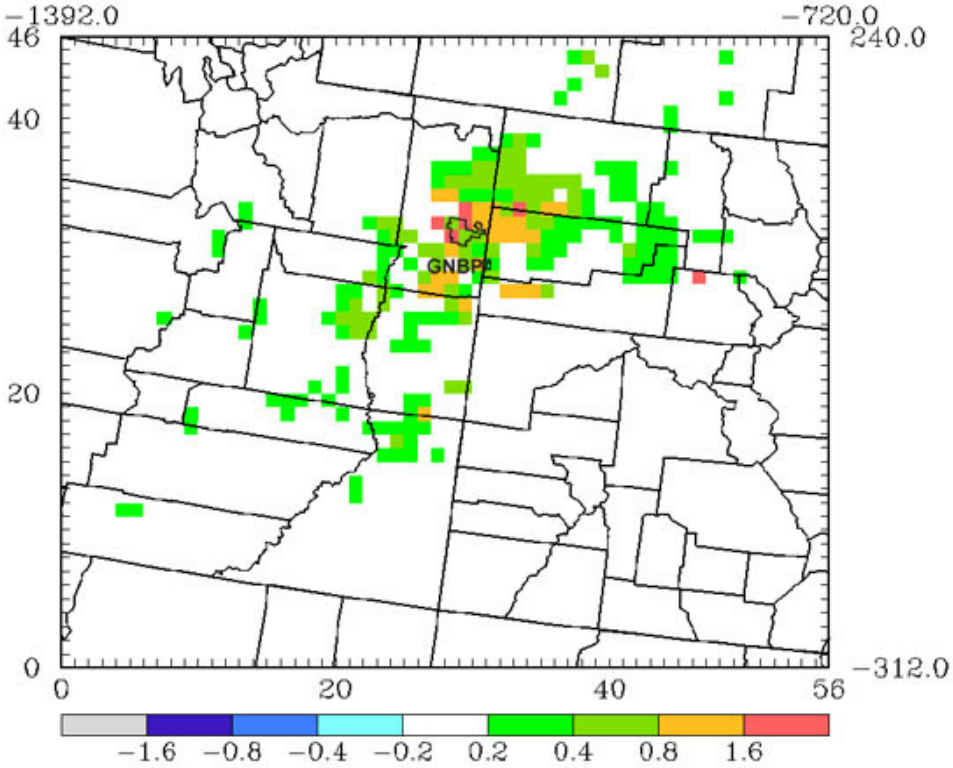


Figure 5-16 Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Optimal Recovery Minus Proposed Action

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

5.3.1 Criteria Pollutant Analysis

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. The AERMOD modeling approach consisted of three phases: 1) single source ***group*** 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 ***annual*** 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 ***well pad drilling***, 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.

Near-field modeling showed that simultaneous operation of drill rigs on adjacent pads would not cause an exceedance of the NAAQS for 1-hour NO_2. The extent of 1-hour NO_2 impacts are shown in the plots in Figures 5-17 and 5-18 for Tier 2 and Tier 4 engines, respectively. The values on these plots represent the 5-year average of annual 98th percentile values, including background. These figures show that peak impacts occur at receptors adjacent to the drill rigs (within 100 m).

5.3.2 HAP Analysis

AECOM evaluated the ambient air concentration of HAPs by modeling the emission rates for the HAPs listed in Table 4-7. AERMOD was run for all scenarios outlined in Section 4.3.1 using 5 years of meteorological data to estimate air concentrations of formaldehyde, benzene, toluene, ethyl benzene, xylene(s), and n-hexane. The maximum modeled concentrations over the 5-year period for each applicable HAP/averaging period (i.e., annual and 24-hour) was compared to the RfCs and TSLs.

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

Pollutant Average Time	Maximum Model Concentration by Source[1] (µg/m³)			Background Concentration (µg/m³)	Total Concentration by Source[1] (µg/m³)			NAAQS (µg/m³)	PSD Increments (µg/m³)
	Compressor Station	Drill Rig[2]	Production Well		Compressor Station	Drill Rig	Production Well		
NO_2									
1-hour[3]	***42.1***	***118.1 (100.4)***	***23.0***	***N/A[4]***	***84.4***	***136.5 (120.1)***	***74.9***	***188***	**--**
Annual[5]	2.53	***0.5 (0.3)***	1.58	***9.0***	***11.5***	***9.5 (9.3)***	***10.6***	100	25
CO									
1-hour	***13***	***329***	***22***	6,325	6,33***8***	***6,654***	6,34***7***	40,000	--
8-hour	***7***	***240***	***17***	3,910	3,91***7***	4,***150***	3,92***7***	10,000	--
SO_2									
1-hour[6]	***0.55***	***0.6***	***0.87***	***21.7***	***22.3***	***22.3***	***22.6***	***196***	**--**
3-hour	0.***62***	0.***6***	0.85	***16.7***	***17.3***	***17.3***	***17.6***	1,300	512
24-hour	0.25	0.***2***	0.39	***5.9***	***6.1***	***6.1***	***6.3***	365	91
Annual	0.02	0.***001***	0.05	***1.5***	***1.5***	***1.5***	***1.6***	80	20
PM_{10}									
24-hour	2.87	***4.5 (0.7)***	***0.89***	18	20.***9***	***22.5 (18.7)***	***18.9***	150	30
$PM_{2.5}$									
24-hour	2.87	***4.5 (0.7)***	***0.89***	***21.6***	***24.5***	***26.1 (22.3)***	***22.5***	35	--
Annual	0.21	***0.0 (0.0)***	***0.27***	***12.3***	***12.5***	***12.3 (12.3)***	***12.6***	15	--

[1] Modeled results are based on Tier 2 engine emission factors unless otherwise noted.

[2] Results in parentheses reflect Tier 4 engine emission factors.

[3] Modeled impacts are the 5-year average 98th percentile daily maximum.

[4] 1-hour NO_2 modeling used background concentrations that vary by season and hour of day.

[5] For annual averaging period, predicted concentration does not include a reduction from NO_X to NO_2. All NO_X is presumed to be NO_2.

[6] Modeled impacts are the 5-year average 99th percentile daily maximum.

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

Pollutant	Averaging Time	Maximum Modeled Concentration[1] (µg/m^3)	Background Concentration (µg/m^3)	Total Impact[1] (µg/m3)	NAAQS (µg/m^3)	PSD Increment (µg/m^3)	Distance (m)	Direction (deg)
10-Acre Spacing Well Production								
NO_2	***1-hour[2]***	***63.9***	***N/A[3]***	***111.1***	***188***	***--***	***943***	***122***
	Annual[4]	5.7	***9.0***	***14.7***	100	25	224	63
CO	1-hour	***69***	6,325	6,39***4***	40,000	--	806	***97***
	8-hour	3***4***	3,910	3,94***4***	10,000	--	80***6***	***83***
SO_2	***1-hour[5]***	***2.6***	***21.7***	***24.3***	***196***	***--***	***854***	***111***
	3-hour	1.9	***16.7***	***18.6***	1,300	512	***854***	***111***
	24-hour	0.9	***5.9***	***6.8***	365	91	***854***	***69***
	Annual	0.1	***1.5***	***1.6***	80	20	224	63
PM_{10}	24-hour	***2.9***	18	***20.9***	150	30	***224***	***207***
$PM_{2.5}$	24-hour	***2.9***	***21.6***	***24.5***	35	--	***854***	***69***
	Annual	***0.8***	***12.3***	***13.1***	15	--	224	63
20-Acre Spacing Well Production								
NO_2	***1-hour[2]***	***48.6***	***N/A[3]***	***96.5***	***188***	***--***	***447***	***153***
	Annual[4]	***4.2***	***9.0***	***13.2***	100	25	***224***	***333***
CO	1-hour	***51***	6,325	6,37***6***	40,000	--	***640***	***129***
	8-hour	***27***	3,910	3,93***7***	10,000	--	***1,714***	***13***
SO_2	***1-hour[5]***	***2.6***	***21.7***	***24.3***	***196***	***--***	***854***	***111***
	3-hour	1.***4***	***16.7***	***18.1***	1,300	512	***447***	***27***
	24-hour	***0.7***	***5.9***	***6.6***	365	91	***447***	***27***
	Annual	***0.1***	***1.5***	***1.6***	80	20	***447***	***27***
PM_{10}	24-hour	***2.7***	18	***20.7***	150	30	***224***	***207***
$PM_{2.5}$	24-hour	***2.7***	***21.6***	***24.3***	35	--	***854***	***69***
	Annual	***0.6***	***12.3***	***12.9***	15	--	***447***	***27***
40-Acre Spacing Well Production								
NO_2	***1-hour[2]***	***45.2***	***N/A[3]***	***86.9***	***188***	***--***	***728***	***106***
	Annual[4]	3.7	***9.0***	***12.7***	100	25	224	333
CO	1-hour	***40***	6,325	6,36***5***	40,000	--	728	106
	8-hour	***20***	3,910	3,93***0***	10,000	--	***1,679***	***7***
SO_2	***1-hour[5]***	***1.5***	***21.7***	***23.2***	***196***	***--***	***728***	***106***
	3-hour	1.***1***	***16.7***	***17.8***	1,300	512	***728***	***74***
	24-hour	0.5	***5.9***	***6.4***	365	91	***922***	***49***
	Annual	0.***1***	***1.5***	***1.6***	80	20	224	333
PM_{10}	24-hour	***2.7***	18	***20.7***	150	30	***224***	***207***
$PM_{2.5}$	24-hour	***2.7***	***21.6***	***24.3***	35	--	***854***	***69***
	Annual	***0.4***	***12.3***	***12.7***	15	--	224	333

[1] Modeled results are based on Tier 2 engine emission factors unless otherwise noted.
[2] Modeled impacts are the 5-year average 98th percentile daily maximum.
[3] 1-hour NO_2 modeling used background concentrations that vary by season and hour of day.
[4] For annual averaging period, predicted concentration does not include a reduction from NO_X to NO_2. All NO_X is presumed to be NO_2.
[5] Modeled impacts are the 5-year average 99th percentile daily maximum.

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

Pollutant	*Averaging Time*	*Maximum Modeled Concentration[1] ($\mu g/m^3$)*	*Background Concentration ($\mu g/m^3$)*	*Total Impact[1] ($\mu g/m^3$)*	*NAAQS ($\mu g/m^3$)*	*PSD Increment ($\mu g/m^3$)*	*Distance (m)*	*Direction (deg)*
NO_2[2]	*1-hour[3]*	*137.1 (106.9)*	*N/A[4]*	*157.2 (125.6)*	*188*	*--*	*361*	*146*
	Annual[5]	*7.7 (2.0)*	*9.0*	*16.7 (11.0)*	*100*	*25*	*510*	*79*
CO	*1-hour*	*399*	*6,325*	*6724*	*40,000*	*--*	*361*	*214*
	8-hour	*251*	*3,910*	*4,161*	*10,000*	*--*	*361*	*326*
SO_2	*1-hour[6]*	*0.7*	*21.7*	*22.4*	*196*	*8*	*361*	*214*
	3-hour	*0.8*	*16.7*	*17.5*	*1,300*	*512*	*361*	*214*
	24-hour	*0.2*	*5.9*	*6.1*	*365*	*91*	*424*	*225*
	Annual	*0.0*	*1.5*	*1.5*	*80*	*20*	*728*	*106*
PM_{10}	*24-hour*	*3.6 (0.9)*	*18*	*21.6 (18.9)*	*150*	*30*	*424*	*225*
$PM_{2.5}$	*24-hour*	*3.6 (0.9)*	*21.6*	*25.2 (22.5)*	*35*	*--*	*806*	*97*
	Annual	*0.1 (0.0)*	*12.3*	*12.4 (12.3)*	*15*	*--*	*728*	*106*

[1] Modeled results are based on Tier 2 engine emission factors unless otherwise noted.
[2] Results in parentheses reflect Tier 4 engine emission factors.
[3] Modeled impacts are the 5-year average 98th percentile daily maximum.
[4] 1-hour NO_2 modeling used background concentrations that vary by season and hour of day.
[5] For annual averaging period, predicted concentration does not include a reduction from NO_X to NO_2. All NO_X is presumed to be NO_2.
[6] Modeled impacts are the 5-year average 99th percentile daily maximum.

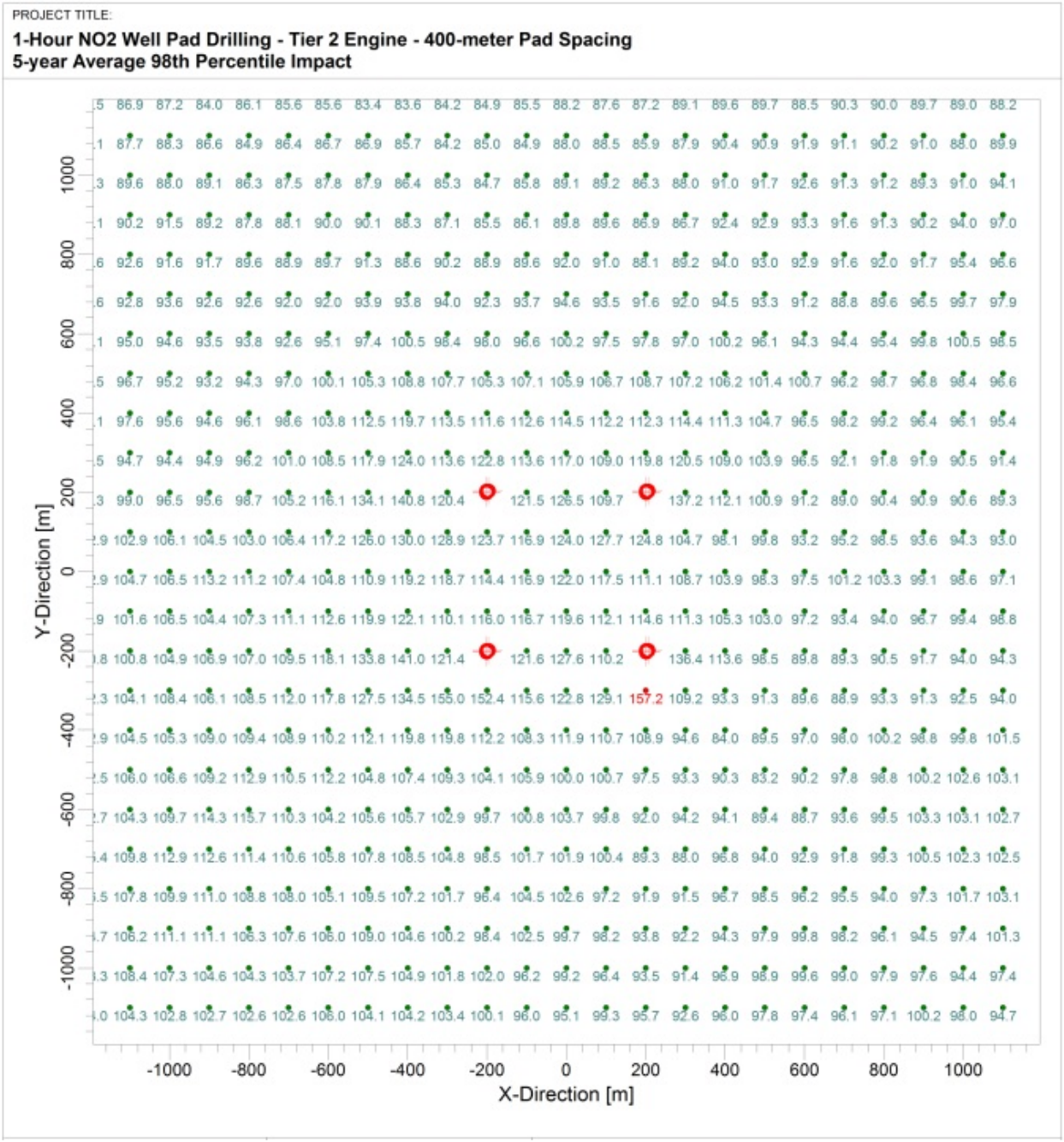


Figure 5-17 1-hour NO_2 Impacts from Well Drilling with Tier 2 Engines (400-m spacing)

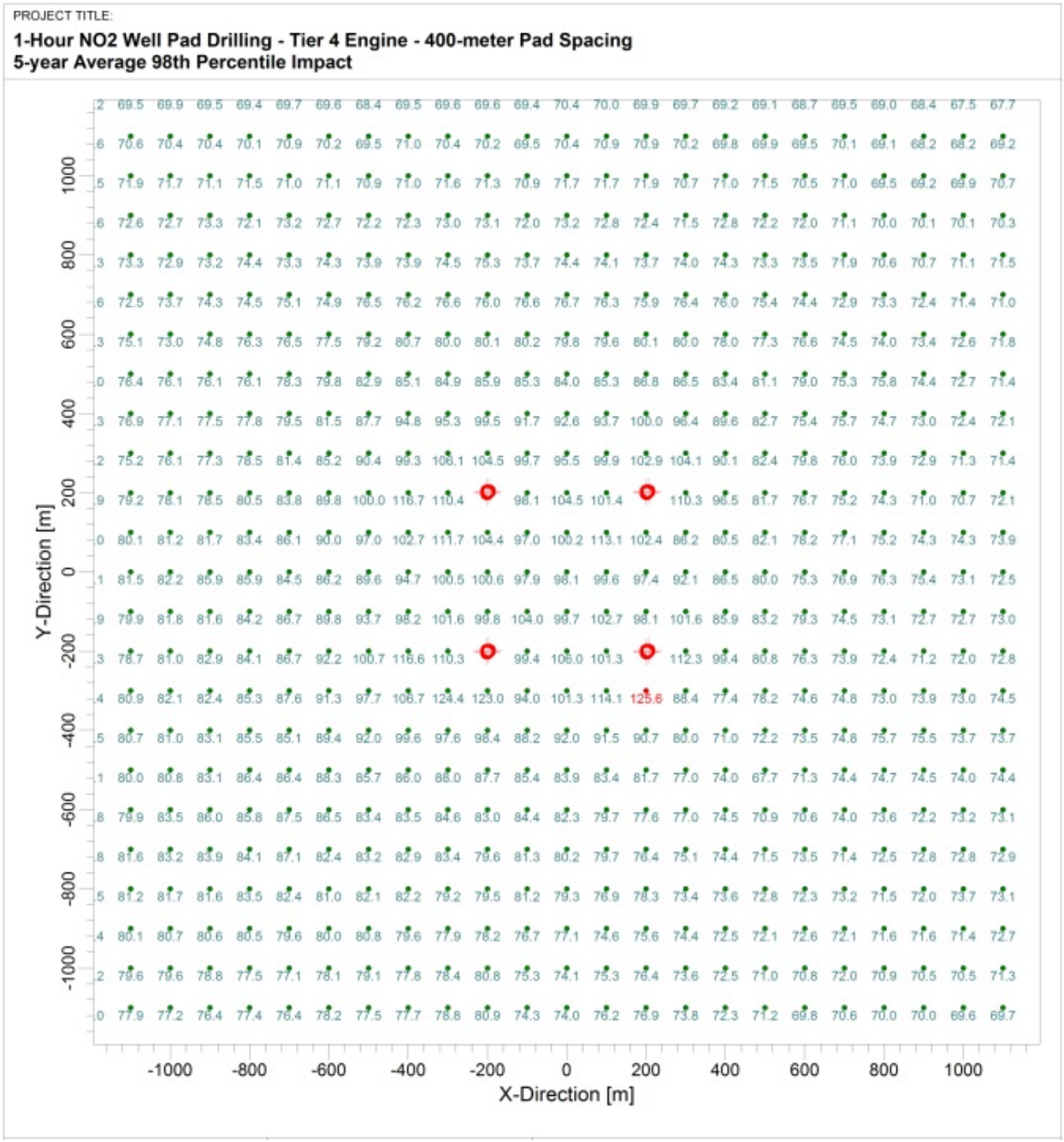


Figure 5-18 1-hour NO_2 Impacts from Well Drilling with Tier 4 Engines (400-m spacing)

Table 5-14 provides a summary of maximum modeled impacts of HAPs for three separate point source types. Table 5-15 provides similar summaries for well pad production operations at three different well densities: 10-, 20-, and 40-acre spacing. Table 5-16 provides a summary of annualized and short-term impacts for well drilling. The results in Tables 5-14 through 5-16 show that maximum concentrations for all source types for all HAPs are below the applicable RfCs and TSLs.

Table 5-14 AERMOD HAPs Near-field Assessment Modeling Result Summary – Single Source Impact Analysis

Pollutant/Averaging Period	Concentration by Source Type (µg/m^3)			Non-Carcinogenic RfC[1] (µg/m^3)	TSL[2] (µg/m^3)
	Compressor Station	Drill Rigs	Production Well		
Benzene					
24-hour	0.03	0.08	2.26	-	53.3
Annual	0.002	0.0003	0.60	30	-
Ethylbenzene					
24-hour	0.003	0.01	0.14	-	14,473
Annual	0.0002	0.00005	0.07	1,000	-
Formaldehyde					
24-hour	3.94	0.47	0.95	-	37
Annual	0.28	0.002	0.26	9.8	-
n-Hexane					
24-hour	0.08	0.006	6.41	-	5,875
Annual	0.006	0.00002	1.73	700	-
Toluene					
24-hour	0.03	0.06	5.26	-	2,512
Annual	0.002	0.0002	1.41	5,000	-
Xylene					
24-hour	0.01	0.04	3.91	-	14,473
Annual	0.001	0.0002	1.04	100	-

[1] USEPA Air Toxics Database, Table 1 (USEPA 2010b).
[2] UDAQ Air Toxic Modeling Guidance for TSLs (UDAQ 2010).

Table 5-15 AERMOD HAPs Near-field Modeling Results – Well Pad Production Analysis

Pollutant/Averaging Period	Concentration per Production Well Density ($\mu g/m^3$)			Non-Carcinogenic RfC[1] ($\mu g/m^3$)	TSL[2] ($\mu g/m^3$)
	10-Acre Spacing	20-Acre Spacing	40-Acre Spacing		
Benzene					
24-hour	5.25	4.14	2.99	-	53.3
Annual	1.55	1.22	0.71	30	-
Ethylbenzene					
24-hour	0.32	0.26	0.18	-	14,473
Annual	0.17	0.13	0.08	1,000	-
Formaldehyde					
24-hour	3.89	3.76	3.76	-	37
Annual	0.85	0.64	0.50	9.8	-
n-Hexane					
24-hour	14.85	11.70	8.45	-	5,875
Annual	4.47	3.52	2.05	700	-
Toluene					
24-hour	12.17	9.59	6.93	-	2,512
Annual	3.63	2.86	1.67	5,000	-
Xylene					
24-hour	9.08	7.15	5.16	-	14,473
Annual	2.68	2.11	1.23	100	-

[1] USEPA Air Toxics Database, Table 1 (USEPA 2010b).
[2] UDAQ Air Toxic Modeling Guidance for TSLs (UDAQ 2010).

Table 5-16 AERMOD HAPs Near-field Modeling Results – Well Drilling Analysis

Pollutant / Averaging Period	Maximum Modeled AERMOD Results ($\mu g/m^3$)	Non-Carcinogenic RfC[1] ($\mu g/m^3$)	TSL[2] ($\mu g/m^3$)
Benzene			
24-hour	0.06	-	53.3
Annual	0.002	30	-
Ethylbenzene			
24-hour	0.01	-	14,473
Annual	0.0003	1,000	-
Formaldehyde			
24-hour	0.3	-	37
Annual	0.01	9.8	-
n-Hexane			
24-hour	0.005	-	5,875
Annual	0.0002	700	-
Toluene			
24-hour	0.04	-	2,512
Annual	0.002	5,000	-
Xylene			
24-hour	0.03	-	14,473
Annual	0.001	100	-

[1] USEPA Air Toxics Database, Table 1 (USEPA 2010b).

[2] UDAQ Air Toxic Modeling Guidance for TSLs (UDAQ 2010).

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, CH_4, and N_2O as well as the global warming potential (GWP) in 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 ***CH_4*** 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

The GHG emissions presented in Table 6-23 were calculated based on implementation of the applicant-committed environmental protection measures quantified in the modeling analysis (see Table 1-1). Implementation of these measures is intended to reduce criteria air pollutants and HAPs; some measures also may reduce GHG emissions (e.g., the use of low-emission dehydrators, low-bleed pneumatics, and green completion techniques to control emissions of CH_4), while others may increase GHG emissions (e.g., the use of electric compression and lean-burn natural gas-fired engines). The net effect of the applicant-committed environmental protection measures is a 4 percent increase in GHG emissions (as CO_2e) for the both the Proposed Action and Optimal Recovery alternatives. This primarily is due to the use of electric compression, which uses mostly coal-fired sources of electricity, and the increased emission of CH_4 and N_2O from lean-burn natural gas-fired engines. The implementation of the applicant-committed environmental protection measures represents a trade-off of air quality improvements in the GNBPA for an increase in GHG emissions locally and at distant coal-fired power plants.

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 *Annual* 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 *Annual* 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.

As stated in Section 3.7, the regional inventory for the action alternatives was revised for the analysis conducted for the SDEIS due to one additional rig needed to drill slightly more wells per year. While this would result in almost no change in VOCs, the project-related NO_X emissions would increase by 6.8 percent for the Proposed Action. This project-related NO_X emissions increase could result in project-specific impacts to ambient ozone levels slightly different than those modeled for the scenario that assumed one less drill rig.

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.

Using background data from AQS, the localized impacts on ambient air quality for criteria pollutants of single sources plus background were all less than the NAAQS. The impacts of all multiple production well scenarios also were below the NAAQS. Near-field modeling showed that simultaneous operation

of drill rigs on adjacent pads would not cause an exceedance of the NAAQS for 1-hour NO_2. The modeled ambient air concentrations of HAPs do not exceed USEPA RfCs or TSLs for any scenario or pollutant.

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.

8.0 References

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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 NBU 920 - 25F		

FIELD DATA		SAMPLE TEMP. :	78
SAMPLE PRES. :	140	AMBIENT TEMP.:	
VAPOR PRES. :		GRAVITY :	
COMMENTS :	GAS VOLUME: 1,061 MCF 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 NBU 920 - 25F		
FIELD DATA		SAMPLE TEMP. :	78
SAMPLE PRES. :	140	AMBIENT TEMP.:	
VAPOR PRES. :		GRAVITY :	
COMMENTS :	GAS VOLUME: 1,061 MCF 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 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 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 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 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:	0.3845
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):	0.0600
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):	0.6800
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):	4.0662
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:	0.2965
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.):	10,256,400.0000

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	5.0688	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)

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):	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 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):	4.0662
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 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)

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):	0.0600
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):	0.6800
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):	4.0662
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:	0.2965
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 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):	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 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):	4.0662
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):	36,497.3814
Vapor Molecular Weight (lb/lb-mole):	36.2400
Vapor Pressure at Daily Average Liquid Surface 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

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	0.29	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

TECHNICAL DATA

G3608 LE Gas Petroleum Engine — 1000 rpm

		DM5561-03	DM5562-03	DM5136-03	DM8606-02
Engine Power					
@ 100% Load	bkW (bhp)	1767 (2370)	1879 (2520)	1823 (2445)	1767 (2370)
@ 75% Load	bkW (bhp)	1326 (1778)	1409 (1890)	1367 (1834)	1326 (1778)
Engine Speed	rpm	**1000**	**1000**	**1000**	**1000**
Max Altitude @ Rated Torque and 38°C (100°F)	m (ft)	1219.2 (4000)	1219.2 (4000)	1219.2 (4000)	914.4 (3000)
Speed Turndown @ Max Altitude, Rated Torque, and 38°C (100°F)	%	20	20	20	20
SCAC Temperature	°C (°F)	54 (130)	32 (90)	43 (110)	54 (130)
Emissions*					
NOx	g/bkW-hr (g/bhp-hr)	.94 (0.7)	.94 (0.7)	.94 (0.7)	.67 (0.5)
CO	g/bkW-hr (g/bhp-hr)	3.35 (2.5)	3.4 (2.5)	3.4 (2.5)	3.7 (2.75)
CO_2	g/bkW-hr (g/bhp-hr)	589 (439)	584 (436)	587 (438)	591 (441)
VOC**	g/bkW-hr (g/bhp-hr)	0.81 (0.6)	0.76 (0.57)	0.79 (0.59)	0.85 (0.63)
Fuel Consumption***					
@ 100% Load	MJ/bkW-hr (Btu/bhp-hr)	9.34 (6600)	9.28 (6561)	9.31 (6580)	9.38 (6629)
@ 75% Load	MJ/bkW-hr (Btu/bhp-hr)	9.74 (6883)	9.66 (6829)	9.7 (6856)	9.78 (6914)
Heat Balance					
Heat Rejection to Jacket Water					
@ 100% Load	bkW (Btu/min)	420 (23,918)	449 (25,555)	435 (24,751)	420 (23,911)
@ 75% Load	bkW (Btu/min)	364 (20,697)	388 (22,055)	376 (21,389)	366 (20,824)
Heat Rejection to Aftercooler					
@ 100% Load	bkW (Btu/min)	297 (16,916)	394 (22,403)	344 (19,601)	310 (17,633)
@ 75% Load	bkW (Btu/min)	139 (7898)	207 (11,778)	172 (9794)	145 (8279)
Heat Rejection to Exhaust					
@ 100% Load	bkW (Btu/min)	1783 (101,403)	1792 (101,922)	1789 (101,728)	1790 (101,780)
@ 75% Load	bkW (Btu/min)	1437 (81,695)	1443 (82,061)	1441 (81,932)	1442 (82,023)
Exhaust System					
Exhaust Gas Flow Rate					
@ 100% Load	m^3/min (cfm)	451.80 (15,955)	463.55 (16,370)	457.83 (16,168)	457.15 (16,144)
@ 75% Load	m^3/min (cfm)	359.68 (12,702)	368.23 (13,004)	364.10 (12,858)	363.93 (12,852)
Exhaust Stack Temperature					
@ 100% Load	°C (°F)	470 (878)	450 (841)	460 (859)	459 (857)
@ 75% Load	°C (°F)	492 (918)	469 (877)	480 (897)	480 (897)
Intake System					
Air Inlet Flow Rate					
@ 100% Load	m^3/min (scfm)	170.07 (6006)	179.36 (6334)	174.71 (6170)	174.91 (6177)
@ 75% Load	m^3/min (scfm)	131.36 (4639)	138.58 (4894)	134.99 (4767)	135.13 (4772)
Gas Pressure	kPag (psig)	295-324 (42.8-47)	295-324 (42.8-47)	295-324 (42.8-47)	295-324 (42.8-47)

*at 100% load and speed, all values are listed as not to exceed
**Volatile organic compounds as defined in U.S. EPA 40 CFR 60, subpart JJJJ
***ISO 3046/1

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	3	@	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	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	3	@	1340	(bhp)	9.38	(MMBtu/hr)
	2	@	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	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)

[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	@	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	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)

[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)
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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

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[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)

[4] AP-42 Chapter 3.2

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	2	@	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	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)

[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	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