Preliminary Draft
Technical Support Document

Air Quality Impact Assessment for the Powder River Basin Oil and Gas Development Project

Prepared for

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DEFINITIONS OF ABBREVIATIONS

AACL	acceptable ambient concentration level
ANC	acid neutralizing capacity
APD	application for permit to drill
Argonne	Argonne National Laboratory
AQRV	air-quality-related value
BLM	Bureau of Land Management
CBM	coal-bed methane
CFR	*Code of Federal Regulations*
CO	carbon monoxide
DEQ	Department of Environmental Quality
DM&E	Dakota, Minnesota, and Eastern Railway Corporation
dv	deciview
EIC	ENVIRON International Corporation
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FLAG	Federal Land Managers' Air-Quality-Related Values Workgroup
FLM	federal land manager
FS	USDA-Forest Service
HAP	hazardous air pollutant
HNO_3	nitric acid
IMPROVE	Interagency Monitoring of Protected Visual Environments
IWAQM	Interagency Workgroup on Air Quality Modeling
LAC	limit of acceptable change
LCP	Lambert Conformal Projection
IR	Indian Reservation
MDEQ	Montana Department of Environmental Quality
MEI	maximally exposed individual
MLE	most likely exposure
MMCFD	million cubic feet per day
MMTPY	million tons per year
NAAQS	National Ambient Air Quality Standards
NCAR	National Center for Atmospheric Research
NEPA	National Environmental Policy Act
NH_3	ammonia
NH_4NO_3	ammonium nitrate
NHS	National Historic Site
NM	National Monument
NO	nitric oxide
NO_x	nitrogen oxides
NO_2	nitrogen dioxide
NO_3^-	nitrate
NP	National Park
NPRB	North Powder River Basin
NPS	USDI-National Park Service
NRA	National Recreational Area

NWS	National Weather Service
O_3	ozone
Pb	lead
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter equal to or less than 10 µm
$PM_{2.5}$	particulate matter with an aerodynamic diameter equal to or less than 2.5 µm; fine particulate matter
ppb	part(s) per billion
ppm	part(s) per million
PRB	Powder River Basin
PRBO&G	Powder River Basin Oil and Gas (Project)
PSD	Prevention of Significant Deterioration
RFD	reasonably foreseeable development
SAAQS	State Ambient Air Quality Standards
SO_2	sulfur dioxide
$SO_4^{=}$	sulfate
SPRB	South Powder River Basin
TPY	tons per year
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USGS	U.S. Geological Survey
UTM	universal transverse Mercator
VOCs	volatile organic compounds
WA	Wilderness Area
WAAQS	Wyoming Ambient Air Quality Standards
WAQS&R	*Wyoming Air Quality Standards and Regulations*
WDEQ	Wyoming Department of Environmental Quality

1 INTRODUCTION

The Bureau of Land Management, Wyoming State Office (Wyoming BLM), has identified a need to prepare an environmental impact statement (EIS) for future coal-bed methane (CBM) and oil development activities in the Powder River Basin (PRB) in northeastern Wyoming (PRB Oil and Gas [PRBO&G] Project). The estimated amount of reasonably foreseeable development (RFD) within the Project Area includes development and operation of about 39,000 new CBM wells and 3,200 new oil wells over the next 10 years. The Project Area encompasses all of Campbell, Johnson, and Sheridan Counties and a major portion of northern Converse County (Figure 1-1).

The Wyoming BLM requested Argonne National Laboratory (Argonne) to conduct an assessment of potential impacts on ambient air quality and air-quality-related values (AQRVs) associated with such development by using the CALPUFF modeling system. The modeling domain selected for the assessment includes northeastern Wyoming and portions of adjacent Montana, South Dakota, and Nebraska (Figure 1-2). The BLM plans to use the results of this air quality impact assessment as an input to the PRBO&G Project EIS and to use the modeling system in future air quality impact analyses.

This document describes methodologies used in assessing potential impacts on air quality and AQRVs from the PRBO&G Project sources, other new and RFD sources in the surrounding area, and cumulative sources (PRBO&G Project sources and other new and RFD sources combined) and the results of that assessment. The methodologies used in the assessment are based primarily on the air quality modeling guidelines of the U.S. Environmental Protection Agency (EPA), guidelines of the U.S. Department of the Interior (USDI), National Park Service (NPS), and the U.S. Department of Agriculture (USDA), Forest Service (FS), and guidance documents of the Wyoming Department of Environmental Quality (WDEQ).

Before Argonne initiated its study, an Air Quality Assessment Protocol document that describes Argonne's plans for conducting the study was prepared with inputs from stakeholders. The stakeholders include BLM, Federal Land Managers (FLMs) of affected areas, EPA, Departments of Environmental Quality (DEQs) of affected states, industries proposing new development, environmental groups including the Wyoming Outdoor Council, and the Northern Cheyenne Tribal Council. Argonne made its best efforts to follow the protocol as closely as practically possible.

In work done for several recent EISs for various development projects within the PRBO&G Project modeling domain, detailed emission inventories for new and RFD projects were developed. In addition, detailed meteorological data for the modeling domain were prepared by using the MM4 and CALMET meteorological models. The air quality modeling conducted for the Dakota, Minnesota, and Eastern Railway Corporation (DM&E) New Railway Retrofit Project EIS, the most recent of these EISs, used the CALPUFF modeling system for both near-field and far-field analyses. Argonne evaluated appropriate data from these efforts and used them in the PRBO&G Project study to achieve consistency and minimize duplication of efforts.

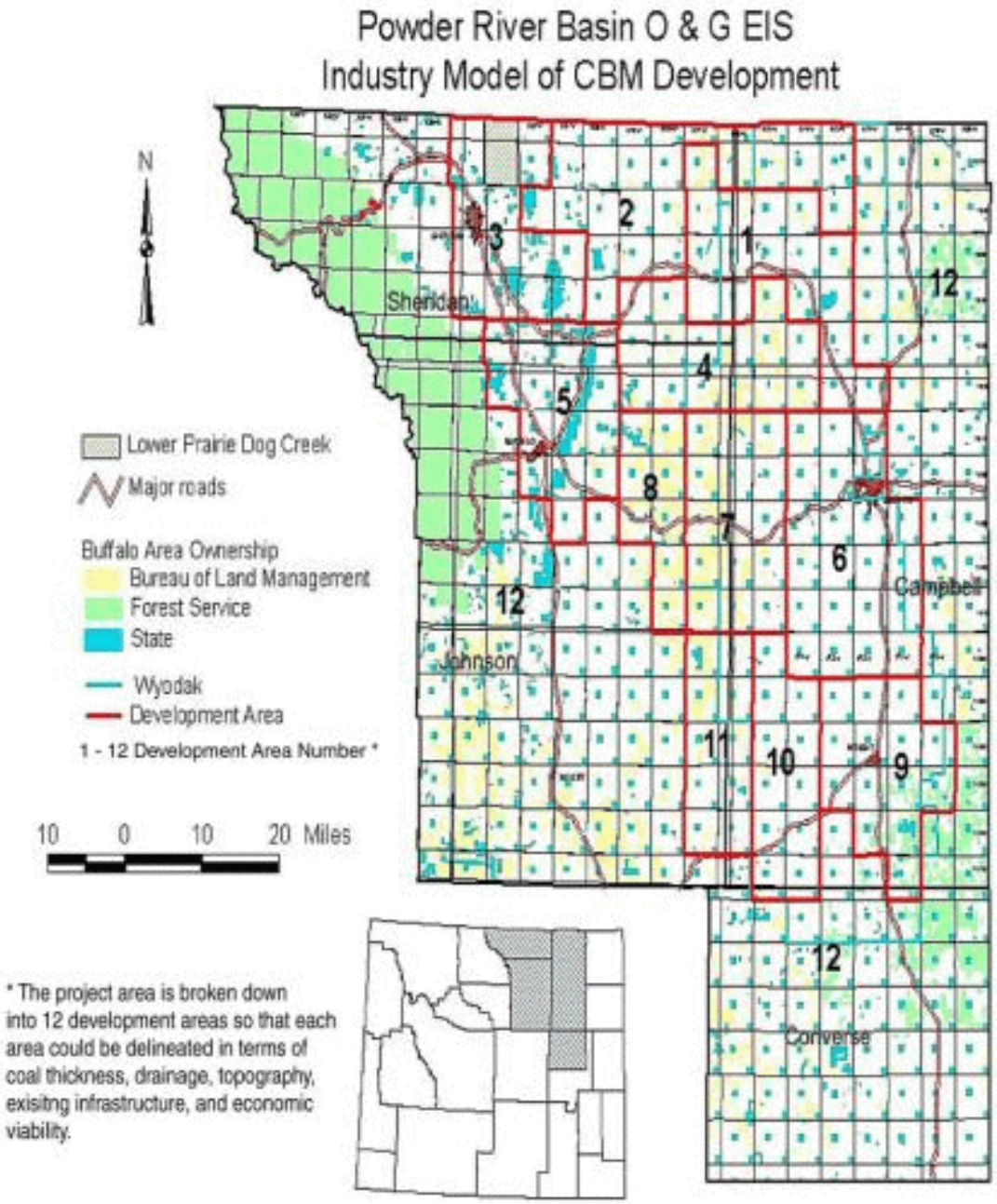


Figure 1-1 Project Area for the Powder River Basin Oil and Gas Project

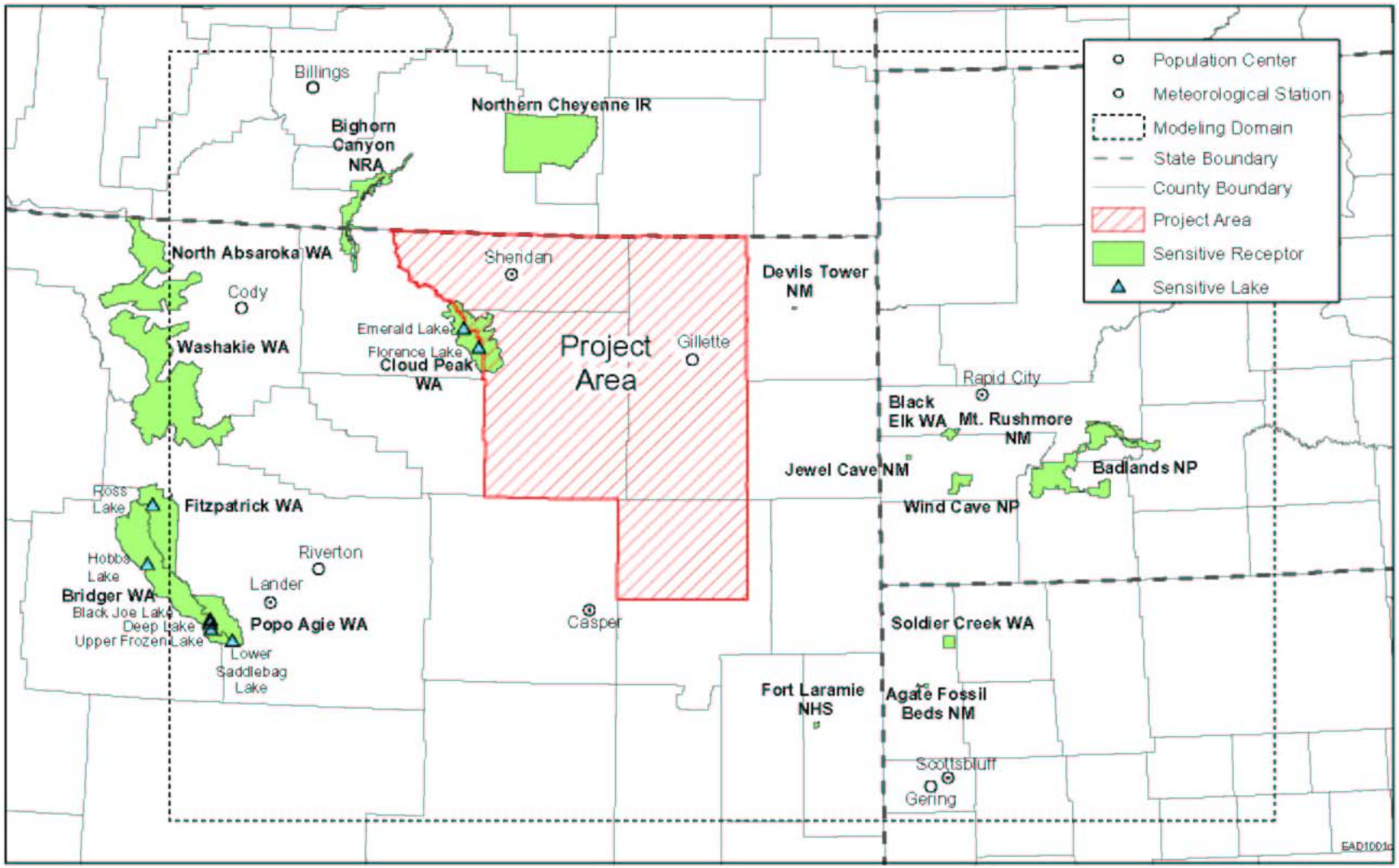


Figure 1-2 Modeling Domain, Project Area, Population Centers, Meteorological Stations, and Sensitive Receptors for the PRBO&G Project

The remainder of this document describes the PRBO&G Project in further detail and provides a list of tasks performed for the current study. Section 2 presents an overview of the assessment approach. Descriptions of the air quality modeling system and modeling domain used in the study are provided in Section 3. Section 4 describes model input data, including emission inventory, meteorological, baseline ambient air quality, and AQRV data. Section 5 describes how air quality modeling and postprocessing of model output data were performed. Section 6 presents the criteria used in the assessments of estimated air quality and AQRV impacts. Section 7 presents the results of CALPUFF modeling and provides assessments of potential impacts on ambient air quality and AQRVs based on the modeling results.

1.1 Project Description

The proposed PRBO&G Project would include the development of CBM wells, conventional oil and gas wells, and ancillary facilities within the Project Area, which encompasses all of Campbell, Johnson, and Sheridan Counties and a major portion of northern Converse County (Figure 1-1). New CBM and oil well locations are proposed for development on the basis of a 80-acre and 40-acre well spacing pattern, respectively. The exact well locations would be determined at a later date during the environmental assessment to be conducted for each well's Application for Permit to Drill (APD), which would be reviewed and approved on a case-by-case basis. The APD process allows Conditions of Approval to be developed for each well on the basis of site-specific monitoring requirements and environmental constraints. In addition to well sites, other facilities such as access roads, tanks and/or pipelines for gas gathering and water transport, electric utilities, and compressors and other associated facilities/equipment would be developed or installed to facilitate gas and oil production and transportation.

The proposed PRBO&G Project Area totals approximately 13,500 square miles (8,636,000 acres). Well density, combined with a preferred approach to locating wells, tends to result in groupings of wells into "pods," depending on the structure of the coal seam and oil-bearing strata. Developed areas may have up to 8 CBM wells per square mile based on 80-acre spacing and 16 oil wells per square mile based on 40-acre spacing within productive portions of the Project Area. The remaining less productive portions of the Project Area may never have any activity. If the total number of anticipated wells were drilled, the average density of new wells would be approximately 3.3 CBM wells and 0.4 oil well per square mile.

A group of oil and gas companies, collectively identified as the PRB Companies (companies), is planning to drill these wells over the next 10-year period. The rate of development would depend on the productivity of the wells and the ability to transport and market the products. The PRBO&G Project would include well development and production from private, state, and federal oil and gas properties. However, CBM and oil well development would likely continue on private and state mineral estates, even if development of federal mineral estates were denied by the BLM.

The PRBO&G Project facilities would be designed to use appropriate control technology on emission sources such as compressors. The specific systems would be determined through a New Source Review analysis conducted as a part of the Wyoming permitting process (*Wyoming Air*

Quality Standards and Regulations [WAQS&R], Chapter 6, Section 2). Preliminary information indicates that the emission control systems for compressors might include the use of lean-burn natural gas reciprocating engines with or without catalytic control and/or catalytic-controlled rich-burn engines to limit emissions of nitrogen oxides (NO_x), carbon monoxide (CO), and formaldehyde.

1.2 Alternatives Evaluated

Four alternatives were analyzed for their potential impacts on air quality and AQRVs: the Proposed Action (Alternative 1), the Proposed Action with certain changes (Alternatives 2a and 2b), and the No Action Alternative (Alternative 3).

Under Alternative 1 (Proposed Action), companies would drill/construct, complete, and operate about 39,367 new CBM wells, about 3,200 conventional oil and gas (non-CBM) wells, and ancillary facilities such as roads, pipelines, power lines, and compressors within the Project Area over a 10-year period (2002-2011). Under this alternative, about 1,060 booster compressors and about 298 reciprocating compressors would be installed and operated, all of which would be gas-fired units.

Alternative 2 would include two options for compression of the CBM, with no other changes from Alternative 1. These options would involve operation of booster compressors by electricity instead of gas. Reciprocating compressors would remain the same. Half of the new 1,060 booster compressors would be electrically powered under the first option (Alternative 2a), while all of the new booster compressors would be electrified under the second option (Alternative 2b). The power for the electrical units would be brought to the compressor stations via the same power lines included in the Proposed Action.

Under Alternative 3 (No Action), development of CBM and non-CBM wells would occur on nonfederal lands within the Project Area, but there would be no additional development of CBM and non-CBM wells on federal leases. As a result, the number of new CBM and non-CBM wells to be drilled would be reduced by about 60% (to about 15,458) and about 56% (to about 1,409), respectively. Construction of ancillary facilities would also be reduced accordingly.

Table 1-1 provides information on the new wells and ancillary facilities (well pads, roads, pipelines, power lines, and compressors) to be developed/installed during the 10-year period under these four alternatives. The year-by-year development plan for CBM wells and compressors and projected annual gas production volume under various alternatives are presented in Table 1-2.

Table 1-1 New CBM Wells and Ancillary Facilities to Be Developed/Installed under Various Alternatives

Wells/Facilities		Unit	Alternative	
			1, 2a, 2b [a]	3
CBM Wells		each	39,367	15,458
Well Pads		each	25,977	10,534
Roads	Improved	mi	6,657	2,170
	Two-track	mi	10,619	4,337
Poly Pipeline	2-3 in.	mi	14,127	5,769
	12 in.	mi	5,311	2,170
Steel Pipeline	12 in.	mi	1,036	396
Electric Line	Overhead	mi	5,311	2,170
Compressors	Booster	each	756	350
		hp	264,600	122,500
	Reciprocating	each	214	97
		hp	353,100	160,050

[a] Half of the booster compressors would be operated by electricity under Alternative 2a, and all of the booster compressors would be operated by electricity under Alternative 2b.

Table 1-2 Development Plan for CBM Wells and Compressors, and Projected Annual Gas Production under Various Alternatives

Year	CBM Wells		Well Pads		Compressors				Annual Gas Volume (MMCFD) [a]	
					Booster		Reciprocating			
	Alt. 1, 2a, 2b	Alt. 3	Alt. 1, 2a, 2b	Alt. 3	Alt. 1, 2a, 2b	Alt. 3	Alt. 1, 2a, 2b	Alt. 3	Alt. 1, 2a, 2b	Alt. 3
2002	4,960	1,994	3,590	1,486	304	127	84	24	1,713	1,254
2003	5,037	1,952	3,637	1,454	373	101	106	31	2,654	1,615
2004	5,038	1,899	3,317	1,339	212	60	56	20	3,177	1,795
2005	4,890	1,899	3,205	1,248	133	43	39	16	3,517	1,951
2006	4,907	1,830	3,294	1,229	31	13	8	4	3,588	1,938
2007	4,899	1,905	3,151	1,244	4	4	1	0	3,578	1,977
2008	4,296	1,566	2,649	1,067	3	2	4	2	3,495	1,882
2009	1,853	841	1,107	511	0	0	0	0	3,086	1,925
2010	1,774	792	1,141	496	0	0	0	0	2,296	1,554
2011	1,713	830	906	468	0	0	0	0	1,620	1,279
Total	39,369	15,458	25,997	10,542	1,060	350	298	97	28,724	17,170

[a] MMCFD = million cubic feet per day

1.3 Study Tasks

The following eight tasks were performed for the PRBO&G Project air quality and AQRV impact assessment:

1. Development of an air pollutant emission inventory for the PRBO&G Project, including the Proposed Action, Alternatives, and other new and RFD activities directly associated with the PRBO&G Project but not represented by the baseline air quality measurements.

2. Updating of the emission inventory database used in the DM&E New Railway Retrofit Project air quality modeling study by (a) adding data for additional new and RFD sources within the modeling domain identified or proposed since the cutoff date for the DM&E emission inventory database and (b) revising the database as needed.

3. Assessment of the reasonable but conservative near-field air quality impacts of various activities of the PRBO&G Project.

4. Assessment of the reasonably foreseeable near-field cumulative air quality impacts of the PRBO&G Project and other new and RFD sources.

5. Assessment of the far-field air quality impacts of the PRBO&G Project at Class I areas and specified Class II areas of concern within the modeling domain.

6. Assessment of the far-field cumulative air quality impacts of the PRBO&G Project and other new and RFD sources.

7. Assessment of the impacts of the PRBO&G Project on visibility and acid deposition at the Class I areas and specified Class II areas of concern.

8. Assessment of the cumulative impacts of the PRBO&G Project and other new and RFD sources on visibility and acid deposition at the federal Class I areas and specified Class II areas of concern.

2 OVERVIEW OF ASSESSMENT APPROACH

As requested by Wyoming BLM, Argonne estimated and assessed the potential impacts of air pollutant emissions from the PRBO&G Project (current project) sources, other new and RFD sources in the surrounding area, and cumulative sources (PRBO&G Project sources and other new and RFD sources combined) under the Proposed Action and three Alternatives. Potential impacts assessed included near-field impacts on criteria and hazardous air pollutants (HAPs) and far-field impacts on criteria air pollutants and AQRVs (visibility and acid deposition).

For predicting potential impacts on air quality and AQRVs, Argonne used the latest version of the CALPUFF modeling system (Version V). For the CALPUFF modeling domain for the PRBO&G Project study (current study), Argonne selected the modeling domain used in the DM&E New Railway Retrofit Project analysis (Figure 1-2). Near-field receptor locations were arranged to identify the maximum estimated concentrations that would result from the Proposed Action and Alternative emission sources. Receptors were located along the boundaries and within each of the Class I areas and specified Class II areas of concern within the modeling domain (e.g., National Parks and Monuments, Wilderness Areas, the Northern Cheyenne Indian Reservation).

The DM&E CALPUFF cumulative emission inventory database was used in air quality modeling for the current study with a few exceptions, including (1) emissions data for the proposed sources of the current project; (2) emissions data for additional new sources since the DM&E emission inventory database cutoff date, identified by the state DEQs; and (3) selected DM&E emission inventory database revisions, reviewed by the state DEQs, revised by Argonne, and approved by BLM, as needed.

The DM&E CALMET Version V meteorological database was used without modification in the CALPUFF modeling for the current study. It is based on the output from 1990 MM4 prognostic meteorological model and on the 1990 surface wind and precipitation data from selected National Weather Service (NWS) stations in the modeling domain.

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 (1) by comparing potential air quality impacts predicted to result from the Proposed Action (and Alternatives) emissions alone, all other new and RFD sources emissions alone, and all sources emissions combined (cumulative) to the applicable Prevention of Significant Deterioration (PSD) increments (Class I or Class II depending on receptor location) and (2) by comparing the potential total concentrations (direct cumulative air quality impacts plus the existing baseline concentration) to the applicable National Ambient Air Quality Standards (NAAQS) and applicable State Ambient Air Quality Standards (SAAQS).

Near-field impacts of fugitive dust emissions from construction sites and operational emissions from compressor stations were assessed by comparing them with NAAQS and SAAQS. Near-field impacts of HAPs from compressor stations were evaluated by comparing them with acceptable ambient concentration levels (AACL) adopted by states and by calculating the distances from the source beyond which potential cancer risks for a maximally exposed

individual (MEI) and most likely exposure (MLE) condition would decrease to the levels of 1×10^{-4} and 1×10^{-6}.

AQRVs evaluated included visibility and acid deposition. Potential visibility impacts were assessed at the far-field receptors located in sensitive receptor areas by using the procedure drafted by the FLMs' Air-Quality-Related Values Workgroup (FLAG). This procedure uses an assumed natural background visibility reference level and visibility parameter equations recommended by FLAG. Estimated potential visibility degradation levels were compared with the limit of acceptable change (LAC) thresholds. Assessments of potential visibility impairment were also made on the basis of background reference levels (visibility conditions) established by the State of Wyoming. For those receptors for which the potential visibility impairment predicted by using the FLAG procedure was equal to or exceeded the LAC thresholds, an assessment of daily visibility impairment was made on the basis of available daily visibility data in order to determine the magnitude, frequency, and duration of such a potential impairment.

Acid deposition impacts were assessed by comparing annual total acid deposition fluxes to sensitive lakes in terms of their acid neutralizing capacity (ANC) predicted by FS-recommended prediction methods (FS Rocky Mountain Region 2000) with the LAC threshold. These lakes include Black Joe, Deep, and Hobbs Lakes in the Class I Bridger Wilderness Area, Ross Lake in the Class I Fitzpatrick Wilderness Area, Emerald Lake and Florence Lake in the Class II Cloud Peak Wilderness Area, and Lower Saddlebag Lake in the Class II Popo Agie Wilderness Area.

3 AIR QUALITY MODELING SYSTEM AND MODELING DOMAIN

An air quality modeling analysis was conducted for the current study to assess potential impacts on ambient air quality and AQRVs due to the current project and other new and RFD sources in the modeling domain. The CALPUFF modeling system (Scire et al. 1999a) recommended by the Interagency Workgroup on Air Quality Modeling (IWAQM) was used as the basis of the modeling analysis for both near- and far-field impact assessments. The CALPUFF modeling system is recommended for a refined modeling analysis (as opposed to a screening-type analysis) to address the air quality impacts of pollutants transported over relatively long distances (EPA 1998).

The CALPUFF modeling system has three main components: CALMET (a diagnostic three-dimensional meteorological model), CALPUFF (the transport and dispersion model), and CALPOST (a postprocessing package). The CALPUFF modeling system is designed to (1) treat time-varying point and area sources, (2) model domains from tens of meters to hundreds of kilometers from a source, (3) predict averaging times ranging from one hour to one year, (4) be applied to inert pollutants and those subject to linear removal and chemical conversion mechanisms, and (5) be applied to rough or complex terrain situations. 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. 1999a).

The CALPUFF model not only enables the prediction of direct concentrations that result from new and RFD sources but also the prediction of total cumulative ambient concentrations by summing up the observed background concentrations (due to existing sources) and the direct impact due to new and RFD sources.

In order to be able to easily evaluate impacts due to a specific source group or groups, the air quality modeling program for the current project was designed so that impact contributions from various source group(s) could be readily separated from overall impacts due to all source groups. Source groups were defined at two hierarchical levels. At the first level, emission sources were divided into three groups: (1) emission sources for the Proposed Action (or Alternatives), (2) sources with permits to construct or operate, and (3) all other potential new sources, reasonably foreseeable but without permits to construct. At the second level, each first-level source group was classified into subgroups by industry category (power plant, surface coal mine, locomotive, gas/oil production site, compressor station, petroleum refinery, petroleum storage tank, gas processing plant, etc.). The program was also designed to allow emission inventory information for specific emission sources to be easily added or removed, so that additional model runs could be performed with minimal effort.

The modeling domain proposed for the current study is identical to that used in the CALMET/CALPUFF modeling conducted for the DM&E New Railway Retrofit Project, which is an area in northeastern Wyoming, southeastern Montana, southwestern South Dakota, and northwestern Nebraska. The modeling domain is defined in the Lambert Conformal Projection (LCP) grid system as follows:

- Central reference LCP point (longitude, latitude) = (-105.0°, 44.0°)
- Standard latitude parallels at 30° and 60°
- Grid origin offset from central reference point = (-350 km, -250 km)

For the near-field impact assessment, the air quality modeling was limited to an area extending 50 km in all directions beyond the locations of stationary emission sources of the current project that are closest to the boundaries of the PRBO&G Project Area.

4 MODEL INPUT DATA

4.1 Emissions Inventory Data

The reasonably foreseeable emissions from the PRBO&G Project were estimated by using appropriate EPA emission factors, equations, and data for anticipated levels of construction and operational activities. Emissions from new and RFD sources within the modeling domain of the PRBO&G Project are based on the emission database used in the DM&E New Railway Retrofit Project modeling analysis (ENVIRON International Corporation [EIC] 2000), which was an enhancement of the Horse Creek EIS modeling analysis (McVehil-Monnett Associates, Inc. 1999). The DM&E database was updated by (1) adding data for any known and quantifiable new (permitted) and RFD sources that were not included in the DM&E database; (2) updating data for any known and quantifiable changes in operating levels of existing sources that affect emissions, including facility shutdowns; and (3) revising data in the DM&E database where necessary. The DM&E database includes data on emissions from surface coal mining and train operations in addition to emissions related to CBM production.

The emission inventory database developed for current study was submitted to interested stakeholders, including state DEQs, for their review. Stakeholders' comments were reflected as appropriate in the final emission inventory database, including the data on emissions associated with the proposed PRBO&G Project and other new and RFD sources within the modeling domain. A map depicting the distribution of the emission sources is provided in Figure 4-1.

4.1.1 PRBO&G Project Sources

Activities associated with the PRBO&G Project that would result in emissions of air pollutants would include construction/installation, operation, and/or maintenance of wells, well pads, compressors, roads, pipelines, electric power lines, and other ancillary facilities. These activities would increase in their spatial extent as more wells were drilled and ancillary facilities were developed or installed. Then, as some of the wells drilled early in the project period reached the end of their productive periods, reclamation activities for these wells and associated facilities would begin to take place. Consequently, air pollutant emissions would gradually increase to their peak, followed by a gradual decrease as fewer new wells were drilled and more wells reached the end of their productive periods.

Emissions of air pollutants from each of these activities were first estimated for the entire 10-year project period, then allocated to each year of the project period according to the development plan presented in Table 1-2. Then the year of peak emissions was identified. In order to minimize the air quality impact assessment effort, CALPUFF modeling was performed for the peak-emission year. Because air quality impacts during other years of the project period would be less than those during the peak-emission year, CALPUFF modeling was performed only for the peak-emission year.

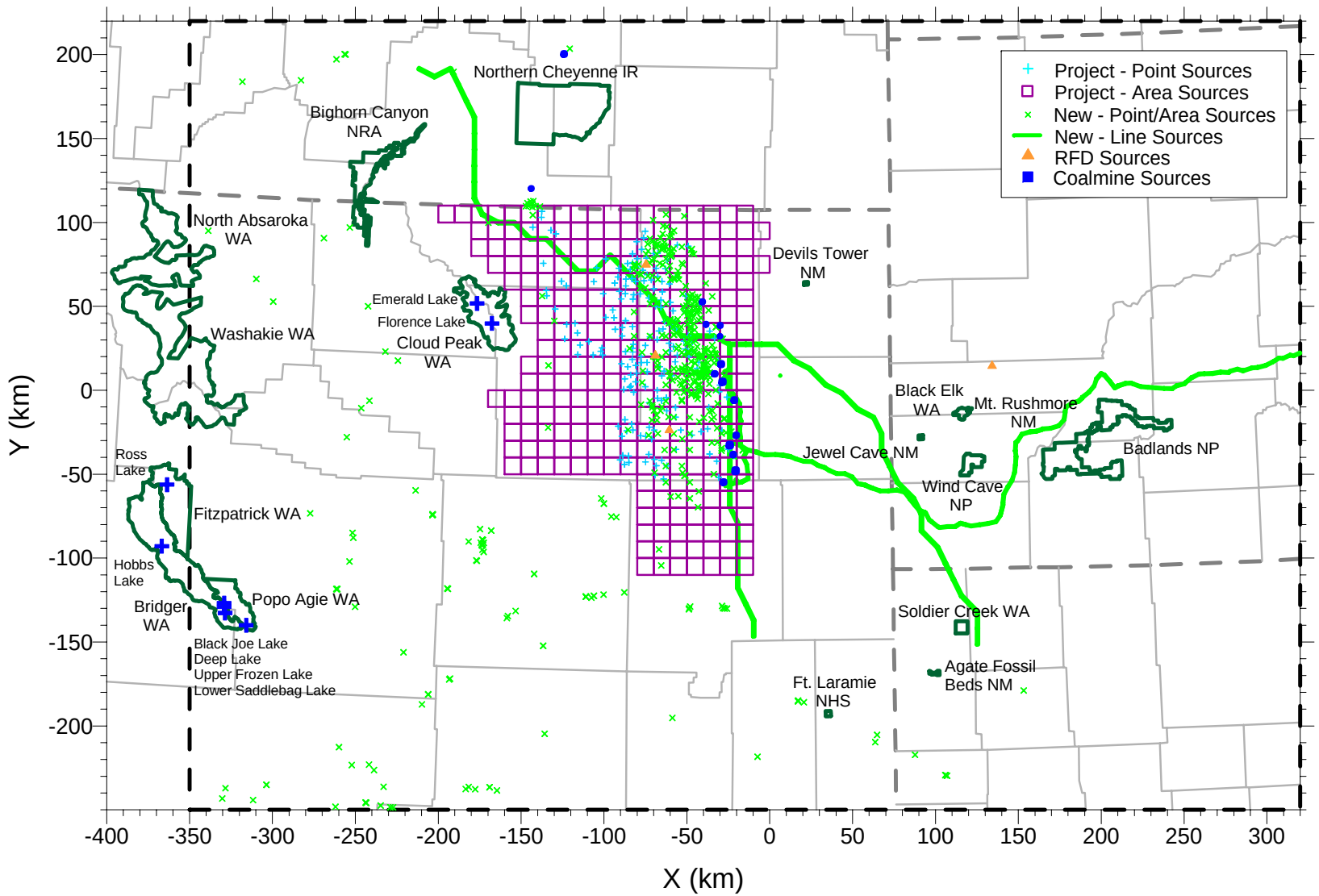


Figure 4-1 Locations of Emission Sources within the PRBO&G Project Modeling Domain

Details of the estimated emissions and the basic data used in emission calculations for the CBM project activities are provided in Appendix A. Those for the conventional oil and gas project activities are provided in Appendix B.

4.1.1.1 Construction-Related Emissions

Estimates of construction-related emissions focused on emissions of particulate matter (PM) with aerodynamic diameters equal to or less than 10 and 2.5 µm (PM_{10} and $PM_{2.5}$, respectively). However, emissions of other criteria pollutants, their precursors, and certain HAPs released from construction equipment and vehicles were also estimated. Fugitive PM emissions from the construction of wells, associated facilities, and roads were computed on the basis of an EPA emission factor for construction activity (EPA 2000a). Emissions of road dust generated from construction vehicles were estimated by using the EPA unpaved road emission factor equation (EPA 2000a) and anticipated volume of project traffic. Exhaust emissions from construction equipment and vehicles were computed by using applicable EPA emission factors (EPA 2000a) and estimated usage levels of construction equipment and vehicles. Construction site emissions were treated as area sources. Exhaust emissions and road dust emissions were also treated similarly because exact locations of roads to be built are not known.

4.1.1.2 Operational Emissions

For the operational phase, emissions of criteria pollutants (NO_x, sulfur dioxide [SO_2], CO, PM_{10}, and $PM_{2.5}$), their precursors (e.g., volatile organic compounds [VOCs]), and HAPs were estimated for compressors (including booster compressors and field compressors), other equipment, road traffic, and road-maintenance activities. Emission estimates for HAPs were made for benzene, n-hexane, toluene, ethylbenzene, xylene, and formaldehyde. The emission factors and stack parameters were obtained from equipment manufacturers with state DEQ review.

Emission rates were computed on the basis of the emission factors and anticipated level of operational activities (e.g., load factors and hours of operation per year). The reasonably foreseeable emissions for compressors and dehydrators at compressor stations were estimated by using conservatively high estimates of compressor hp requirements to move a unit volume of produced CBM (160 hp/10^6 ft^3/d for booster compressors and 183 hp/10^6 ft^3/d for reciprocating compressors) and dehydrator heat input rate to process a unit volume of produced CBM (250×10^6 Btu/h) (Keanini 2001d). For modeling near- and far-field impact analyses, similar emissions from individual stacks at a given facility were aggregated into emissions from a single stack.

Emissions of road dust from vehicles traveling on access roads were estimated by using the EPA unpaved road emission factor equation (EPA 2000a) and anticipated volume of project traffic. Fugitive dust emissions from access-road maintenance activities were estimated on the basis of the EPA emissions for construction activity (EPA 2000a) and the anticipated level of road-maintenance activity.

The estimated total emissions of criteria pollutants and VOCs from various project activities throughout the entire 10-year project period are summarized in Table 4-1a through 4-1c.

Table 4-1a Estimated Total Emissions of Criteria Pollutants and VOCs from CBM Project Activities during the 10-Year Project Period

Project Activity		Emission Source	Total Project Emissions (tons)						
			NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOCs	Total
Construction	Construction Sites (roads, wells, pads, pods, pipelines, compressor stations)	Heavy Equipment							
		Fugitive Dust	0	647	97	0	0	0	743
		Exhaust	37,333	2,660	2,660	2,490	8,167	3,035	56,344
		Commuting Vehicles							
		Road Dust	0	9,737	1,423	0	0	0	11,160
		Exhaust	111	26	24	22	290	67	538
	Subtotal		37,443	13,069	4,204	2,511	8,457	3,102	68,786
Operation	Compressor Stations	Compressors							
		Reciprocating	35,529	1,692	1,692	68	40,604	33,837	113,421
		Booster	29,584	1,954	1,954	59	51,772	22,188	107,511
		Dehydrators	206	16	16	1	173	11	422
		Inspection Visits							
		Road Dust	0	226	33	0	0	0	259
		Exhaust	1	0	0	0	8	1	10
	Wells	Workover							
		Road Dust	0	1,378	201	0	0	0	1,580
		Exhaust							
		On-site	2,441		173	161	526	200	3,675
		On-road	18	4	4	4	37	10	77
	Wells & Pipelines	Inspection Visits							
		Road Dust	0	579	85	0	0	0	664
		Exhaust	2	0	0	0	21	1	25
	Subtotal		67,779	6,022	4,158	293	93,142	56,249	227,642
Maintenance	Roads	Heavy Equipment							
		Fugitive Dust	0	804	73	0	0	0	876
		Exhaust	446	39	39	55	96	23	698
		Commuting Vehicles							
		Road Dust	0	147	21	0	0	0	168
		Exhaust	0	0	0	0	5	0	6
	Compressor Stations	Maintenance Visits							
		Road Dust	0	89	13	0	0	0	102
		Exhaust	0	0	0	0	3	0	4
	Subtotal		447	1,079	146	55	105	23	1,855
Reclamation	Roads	Heavy Equipment							
		Fugitive Dust	0	18	2	0	0	0	20
		Exhaust	6	1	1	1	1	0	9
		Commuting Vehicles							
		Road Dust	0	3	0	0	0	0	4
		Exhaust	0	0	0	0	0	0	0
	Wells	Heavy Equipment							
		Fugitive Dust	0	173	16	0	0	0	188
		Exhaust	71	6	6	9	15	4	111
		Commuting Vehicles							
		Road Dust	0	31	5	0	0	0	36
		Exhaust	0	0	0	0	1	0	1
	Subtotal		77	232	29	9	18	4	370
Total			105,747	20,402	8,537	2,869	101,721	59,377	298,653

Table 4-1b Estimated Total Emissions of Criteria Pollutants and VOCs from Conventional Oil and Gas Project Activities during the 10-Year Project Period

Project Activity		Emission Source	Total Project Emissions (tons)						
			NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOCs	Total
Construction	Construction Sites (roads, wells, pads, pods, pipelines, compressor stations)	Heavy Equipment							
		Fugitive Dust	0	280	42	0	0	0	322
		Exhaust	37,421	1,370	1,370	4,604	9,224	1,468	55,457
		Commuting Vehicles							
		Road Dust	0	1,965	287	0	0	0	2,252
		Exhaust	20	5	4	4	50	12	94
	Subtotal		37,441	3,620	1,703	4,607	9,274	1,480	58,125
Operation	Wells	Workover							
		Road Dust	0	19	3	0	0	0	22
		Exhaust							
		On-site	893	63	63	59	192	73	1,344
		On-road	0	0	0	0	0	0	1
	Wells & Pipelines	Inspection Visits							
		Road Dust	0	147	22	0	0	0	169
		Exhaust	0	0	0	0	5	0	6
	Subtotal		893	230	88	59	198	74	1,542
Maintenance	Roads	Heavy Equipment							
		Fugitive Dust	0	108	10	0	0	0	117
		Exhaust	60	5	5	7	13	3	94
		Commuting Vehicles							
		Road Dust	0	20	3	0	0	0	23
		Exhaust	0	0	0	0	1	0	1
	Subtotal		60	133	18	7	14	3	234
Total			38,394	3,982	1,809	4,674	9,486	1,557	59,902

Table 4-1c Estimated Total Emissions of Criteria Pollutants and VOCs from CBM and Conventional Oil and Gas Project Activities during the 10-Year Project Period

Project Activity		Emission Source	Total Project Emissions (tons)						
			NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOCs	Total
Construction	Construction Sites (roads, wells, pads, pods, pipelines, compressor stations)	Heavy Equipment							
		Fugitive Dust	0	927	139	0	0	0	1,066
		Exhaust	74,754	4,030	4,030	7,093	17,391	4,503	111,801
		Commuting Vehicles							
		Road Dust	0	11,701	1,710	0	0	0	13,412
		Exhaust	130	30	28	25	340	78	633
	Subtotal		74,884	16,689	5,907	7,119	17,731	4,581	126,911
Operation	Compressor Stations	Compressors							
		Reciprocating	35,529	1,692	1,692	68	40,604	33,837	113,421
		Booster	29,584	1,954	1,954	59	51,772	22,188	107,511
		Dehydrators	206	16	16	1	173	11	422
		Inspection Visits							
		Road Dust	0	226	33	0	0	0	259
		Exhaust	1	0	0	0	8	1	10
	Wells	Workover							
		Road Dust	0	1,397	204	0	0	0	1,601
		Exhaust							
		On-site	3,334	237	237	220	718	274	5,019
		On-road	18	4	4	4	38	11	78
	Wells & Pipelines	Inspection Visits							
		Road Dust	0	726	106	0	0	0	832
		Exhaust	2	0	0	0	27	2	31
	Subtotal		68,673	6,251	4,245	352	93,340	56,323	229,184
Maintenance	Roads	Heavy Equipment							
		Fugitive Dust	0	911	83	0	0	0	994
		Exhaust	506	44	44	62	109	26	792
		Commuting Vehicles							
		Road Dust	0	166	24	0	0	0	190
		Exhaust	1	0	0	0	6	0	7
	Compressor Stations	Maintenance Visits							
		Road Dust	0	89	13	0	0	0	102
		Exhaust	0	0	0	0	3	0	4
	Subtotal		507	1,211	164	62	119	26	2,089
Reclamation	Roads	Heavy Equipment							
		Fugitive Dust	0	18	2	0	0	0	20
		Exhaust	6	1	1	1	1	0	9
		Commuting Vehicles							
		Road Dust	0	3	0	0	0	0	4
		Exhaust	0	0	0	0	0	0	0
	Wells	Heavy Equipment							
		Fugitive Dust	0	173	16	0	0	0	188
		Exhaust	71	6	6	9	15	4	111
		Commuting Vehicles							
		Road Dust	0	31	5	0	0	0	36
		Exhaust	0	0	0	0	1	0	1
	Subtotal		77	232	29	9	18	4	370
Total			144,141	24,384	10,346	7,543	111,207	60,934	358,555

Estimated emissions for the CBM project activities are provided in Table 4-1a, and those for the conventional oil and gas project activities are provided in Table 4-1b. Estimated combined total emissions for the two types of projects are presented in Table 4-1c. Table 4-2 presents the estimated year-by-year emissions of criteria pollutants and VOCs from various project activities. The year 2006 is estimated to be the year with the highest level of project-related emissions, as shown in Table 4-2.

4.1.2 Other New and RFD Sources

An updated emission inventory database for the new (permitted) and RFD sources that are not represented by the background air quality measurements was prepared. Electronic files of emission inventory data for criteria pollutants and HAPs that were used in the recent EIS projects in the modeling domain were obtained through the BLM (e.g., EIC 2000).

Emission inventory data for additional new sources and RFD sources were obtained from state DEQs and the industries proposing such sources. Argonne reviewed these data sets and reorganized them into an appropriate format. The review was conducted with care to ensure that no source was counted more than once. For example, emission sources that were identified as RFD sources in the emission inventories for the previous modeling studies but have obtained permits to construct since that time were included in the new source group (with permits to construct or operate) but eliminated from the previous RFD source group. Emission inventory data were revised on the basis of information available in the permits issued.

Any revision or updating of data in the existing emission inventory databases that became necessary because of changes in design or operation (including facility shutdowns), or because more appropriate emission factors became available, were performed following the guidance provided by BLM and state DEQs.

Emissions from CBM sources that were aggregated into one large source in the previous air quality modeling studies were disaggregated as necessary to the extent possible.

The new NO_x emission sources whose impacts are not reflected in the baseline ambient concentrations were included in the updated emission inventory database. The impacts of new sources that received permits to construct from state DEQs from September 1, 1994, through August 31, 2000, would not have been reflected in baseline ambient concentrations measured between March 1996 and April 1997, provided that the construction period for new sources is assumed to be approximately 18 months. This monitoring period (March 1996 through April 1997) was selected for the updated emission inventory database because it is the period when the most recent background nitrogen dioxide (NO_2, as the most significant pollutant emitted from the PRBO&G Project) data are available for this analysis (at Gillette, Wyoming [see Table 4-6 later in this section]). The permit cutoff date for new sources to be included in the updated emission inventory database (August 31, 2000) was selected at the stakeholders meeting held in Buffalo, Wyoming, on August 3, 2000. Similarly, the RFD projects are those clearly defined as of August 31, 2000, as the sources reasonably expected to be in operation within the next 10 years.

Table 4-2 Estimated Annual Emissions of Criteria Pollutants and VOCs from CBM and Conventional Oil and Gas Project Activities during the 10-Year Project Period

Project	Pollutant	Annual Emissions (tons/yr)										Total Emissions (tons)
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
CBM Project	NO_x	7,632	10,925	12,716	13,723	13,995	13,962	13,071	9,220	6,440	4,063	105,747
	PM_{10}	2,114	2,392	2,468	2,479	2,508	2,517	2,305	1,400	1,206	1,014	20,402
	$PM_{2.5}$	741	940	1,036	1,083	1,099	1,098	1,016	664	502	359	8,537
	SO_2	345	358	361	354	357	357	317	151	139	129	2,869
	CO	4,803	9,364	11,900	13,497	13,851	13,807	13,265	10,732	6,892	3,611	101,721
	VOCs	2,633	5,389	6,925	7,900	8,113	8,086	7,791	6,388	4,067	2,086	59,377
	Total	18,269	29,368	35,405	39,036	39,922	39,827	37,764	28,554	19,245	11,263	298,653
Conventional Oil & Gas Project	NO_x	3,834	3,836	3,837	3,838	3,839	3,840	3,841	3,842	3,843	3,844	38,394
	PM_{10}	375	380	385	391	396	401	406	411	416	421	3,982
	$PM_{2.5}$	178	178	179	180	181	181	182	183	183	184	1,809
	SO_2	467	467	467	467	467	467	468	468	468	468	4,674
	CO	947	947	948	948	948	949	949	949	950	950	9,486
	VOCs	155	155	156	156	156	156	156	156	156	156	1,557
	Total	5,957	5,964	5,972	5,979	5,986	5,994	6,001	6,009	6,016	6,024	59,902
CBM Project and Conventional Oil & Gas Project	NO_x	11,467	14,761	16,553	17,560	17,834	17,802	16,912	13,063	10,283	7,907	144,141
	PM_{10}	2,489	2,773	2,853	2,869	2,904	2,918	2,711	1,811	1,622	1,435	24,384
	$PM_{2.5}$	919	1,118	1,215	1,262	1,280	1,279	1,198	846	685	543	10,346
	SO_2	812	825	829	822	825	825	784	618	607	597	7,543
	CO	5,750	10,311	12,847	14,445	14,799	14,756	14,215	11,682	7,841	4,562	111,207
	VOCs	2,789	5,544	7,081	8,056	8,268	8,242	7,946	6,544	4,223	2,242	60,934
	Total	24,225	35,332	41,377	45,015	45,909	45,821	43,765	34,563	25,261	17,286	358,555

Although available data on ambient baseline concentrations are more recent for certain criteria pollutants than data for NO_2 (March 1996 through April 1997), the updated emission inventory database was used in CALPUFF modeling without further modification so that conservatively high impact estimates would be obtained. For example, PM_{10} ambient concentration data within the Project Area are available for the period from January 1, 1999, through December 31, 1999 (at Gillette and Sheridan, Wyoming [see Table 4-6]). In this case, the new sources with a construction permit receipt date from September 1, 1994 until July 1, 1997 (18 months before January 1, 1999) were assumed to not be reflected in the ambient concentration monitored during the period from January 1, 1999, through December 31, 1999.

The updated new and RFD source emission inventories are presented in Appendix C and summarized in Table 4-3.

4.1.3 Coal Mine Sources

Currently, 19 coal mines (13 in Wyoming and 6 in Montana) are operating within the PRBO&G Project modeling domain. At a given mine, the annual coal production volume, and consequently the activities associated with mining, vary from year to year depending on demand. Coal mining locations change gradually as coal mining progresses. Therefore, potential emissions from coal mining activities at each mine within the modeling domain were estimated for 2006, the projected peak emission year for the PRBO&G Project, on the basis of the projected 2006 annual coal production volume (Doelger 2001; Giovanini 2001) and the reported emission rates per unit coal production volume at each mine (WDEQ 2000; Montana Department of Environmental Quality [MDEQ] 2001). The projected locations of the mines anticipated to operate in 2006 were also obtained from BLM (Doelger 2001; Giovanini 2001). Estimated emissions of criteria pollutants and VOCs from coal mines in the PRBO&G Project modeling domain are provided in Table 4-4.

Table 4-3 Annual Emissions of Criteria Pollutants and VOCs from New and RFD Sources within the PRBO&G Project Modeling Domain

Source Category		Annual Emissions (tons/year)					
		NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO	VOCs
New Sources	DM&E New Railway Retrofit Project Sources	4,591	551	221	221	878	324
	DM&E Permitted New Sources	13,234	5,282	1,015	72	- [a]	-
	CDWII [b] Permitted New Sources	1,588	624	379	-	-	-
	Wyoming Permitted New Sources	4,264	1,460	345	251	8,511	2,460
	Montana Permitted New Sources	234	142	82	79	366	115
	Nebraska Permitted New Sources	27	3	41	12	39	4
	Subtotal	23,938	8,063	2,083	635	9,795	2,903
RFD Sources	Wyoming Sources	266	9	19	19	323	92
	South Dakota Sources	289	35	53	53	175	71
	Subtotal	555	44	72	72	498	163
Total		24,492	8,107	2,155	706	10,293	3,066

[a] A hyphen indicates that no data are available.
[b] Continental Divide/Wamsutter II and South Baggs Natural Gas Development Projects (BLM 1999a).

Table 4-4 Estimated 2006 Emissions of Criteria Pollutants and VOCs from Coal Mines within the PRBO&G Project Modeling Domain

River Basin	Mine Name	Projected Mine Location in 2006 [a]				Annual Coal Production (MMTPY) [a,b]				Emission Increase from Base Year [c] to 2006 (TPY) [b]				
		Pit Area	Section	Town-ship	Range	Actual in Base Year [c]	2000 Air Quality Permit [d]	2006 Market Share [e]	Increase from Base Year [c] to 2006	NO_x	PM_{10}	SO_2	CO	VOCs
SPRB [b] South Pod	Antelope	North	23, 25, 26, 27	41	71	23.0	35.0	28.3	5.3	154.3	73.1	16.4	319.6	16.8
		West	34	41	71									
		South	3, 10, 15	40	71									
	Black Thunder	South	30, 31	43	70	60.1	100.0	74.0	13.9	372.5	274.7	45.5	838.1	43.9
		Center	7, 18, 19, 30	43	70									
		Thunder Cloud	1, 5, 6	43	70, 71									
	Jacobs Ranch	Main	33, 34	44	70	28.3	50.0	34.8	6.5	123.0	165.9	15.0	391.9	20.6
	North Antelope-Rochelle	West	17, 18, 19, 20	41	70	70.7	105.0	87.0	16.3	436.2	430.6	45.8	982.9	51.5
		Middle	32, 33, 34, 35	42	70									
		East	1, 6, 7, 36	41, 42	69, 70									
	North Rochelle	West	5, 32	42, 43	70	24.8	35.0	30.5	5.7	51.8	178.0	6.4	343.7	18.0
		Middle	9	42	70									
	South Pod Total					206.9	325.0	254.6	47.7	1,137.7	1,122.3	129.1	2,876.2	150.8
SPRB Middle Pod	Belle Ayr	Main	31	48	71	15.0	45.0	18.5	3.5	268.2	138.1	29.8	211.0	11.1
	Caballo-North, Caballo	Main	9, 10, 15, 16	48	71	25.7	40.0	31.6	5.9	299.9	208.2	31.6	355.8	18.7
	Coal Creek	Main	19, 20, 21, 22, 27, 28, 29	46	70	4.2	18.0	5.2	1.0	55.9	39.6	6.2	60.3	3.2
	Cordero Rojo	South	2, 3	46	71	38.6	65.0	47.5	8.9	392.9	325.1	44.6	536.6	28.1
		South Center	27, 34	47	71									
		North Center	15, 22	47	71									
		North	2, 11	47	71									
		West	8, 9, 10, 16	47	71									
		East	11, 12	47	71									
	Middle Pod Total					83.5	168.0	102.8	19.3	1,016.9	710.9	112.1	1,163.7	61.0

Table 4-4 Estimated 2006 Emissions of Criteria Pollutants and VOCs from Coal Mines within the PRBO&G Project Modeling Domain (Continued)

River Basin	Mine Name	Projected Mine Location in 2006 [a]				Annual Coal Production (MMTPY) [a,b]				Emission Increase from Base Year [c] to 2006 (TPY) [b]				
		Pit Area	Section	Town-ship	Range	Actual in Base Year [c]	2000 Air Quality Permit [d]	2006 Market Share [e]	Increase from Base Year [c] to 2006	NO_x	PM_{10}	SO_2	CO	VOCs
SPRB North Pod	Buckskin	Main	16, 17	52	72	15.8	22.0	19.5	3.7	161.6	67.9	16.8	223.1	11.7
	Dry Fork	South	31	51	71	2.2	15.0	2.7	0.5	21.8	11.3	2.3	30.2	1.6
		East	36	51	71									
	Eagle Butte	Main	27, 34	51	72	18.6	35.0	22.9	4.3	226.9	95.8	23.6	259.3	13.6
	Wyodak	Main	21, 22	50	71	3.0	10.0	3.7	0.7	30.6	13.7	3.2	42.2	2.2
	Clovis Point	NA [b]					4.0							
	Rawhide	Main	8, 9	51	72		24.0							
	Fort Union/ Kennecott	NA					9.4							
	North Pod Total					39.6	119.4	48.8	9.2	440.9	188.8	45.8	554.7	29.1
Wyoming Total						330.0	612.4	406.2	76.2	2,595.6	2,022.0	286.9	4,594.7	240.9
NPRB [b]	Savage	NA	21	20	57	0.3	0.5	0.3	0.1	2.1	3.0	0.2	3.0	0.2
	Absaroka	NA	32	1	38	7.0	11.0	4.0						
	Big Sky	NA	24	1	40	4.3	6.5	1.5						
	Rosebud	NA	8	1	41	8.9	20.5	10.0	1.1	44.1	87.3	4.8	71.9	3.5
	Decker	NA	17	9	40	11.9	16.0	9.5						
	Spring Creek	NA	25	8	39	8.3	15.0	11.0	2.7	102.1	116.5	9.0	101.9	7.4
Montana Total						40.7	69.5	36.3	3.8	148.3	206.8	14.0	176.8	11.1
Wyoming and Montana Total						370.7	681.9	442.5	80	2,743.9	2,228.8	300.9	4,771.5	252.0

[a] Data for Wyoming and Montana are provided by Doelger (2001) and Giovanini (2001), respectively.
[b] MMTPY = million tons per year; TPY = tons per year; SPRB = South Powder River Basin; NPRB = North Powder River Basin; NA = not available.
[c] The base years for Wyoming and Montana mines are 2000 and 1997, respectively.
[d] Maximum annual coal production volumes allowed under the state air quality permits.
[e] Projected values.

4.2 Meteorological Data

Hourly three-dimensional meteorological data fields for 1990 were recently developed for the project domain by EIC by using Version V of CALMET (Scire et al. 1999b), a diagnostic meteorological model (EIC 2000). The meteorological database with local wind variations at a 5- by 5-km resolution, which was developed for the DM&E New Railway Retrofit Project EIS, was used without modification as input to the CALPUFF model for the PRBO&G EIS analysis.

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 in order to generate three-dimensional wind fields (Scire et al. 1999b). 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 (80-km) resolution simulation of a prognostic meteorological model (e.g., Pennsylvania State University/National Center for Atmospheric Research (NCAR) mesoscale meteorological model [MM4] [Bullock 1993]) and then better characterizes the local wind variations at a finer scale (e.g., 5 km) by using its diagnostic wind algorithms and local surface observations. The detailed meteorological database for the project domain was developed by using surface meteorological data and upper-air meteorological data at the following sites within the modeling domain (see Figure 1-2 for locations):

- Casper, Wyoming (surface wind and precipitation data);
- Lander, Wyoming (surface wind, precipitation, and upper-air data);
- Rapid City, South Dakota (surface wind, precipitation, and upper-air data);
- Scottsbluff, Nebraska (surface wind and precipitation data); and
- Sheridan, Wyoming (surface wind data only).

For the CALMET modeling performed for the DM&E New Railway Retrofit Project EIS, terrain and land use data from the U.S. Geological Survey (USGS 2000a,b) were processed to obtain average terrain elevation and predominant land use type for each of the 134 by 94 grid cells (5-km by 5-km) in the modeling domain. Figure 4-2 displays the topography of the modeling domain based on the average terrain elevation data.

Annual wind roses at 10 m level based on the hourly CALMET V output described above are presented in Figure 4-3 for Sheridan, Casper, and Lander in Wyoming; Rapid City in South Dakota; and Scottsbluff in Nebraska.

4.3 Receptor Data

Near-field receptor locations were arranged to obtain the maximum estimated concentrations that would result from the proposed new sources identified in the PRBO&G Project. The near-field

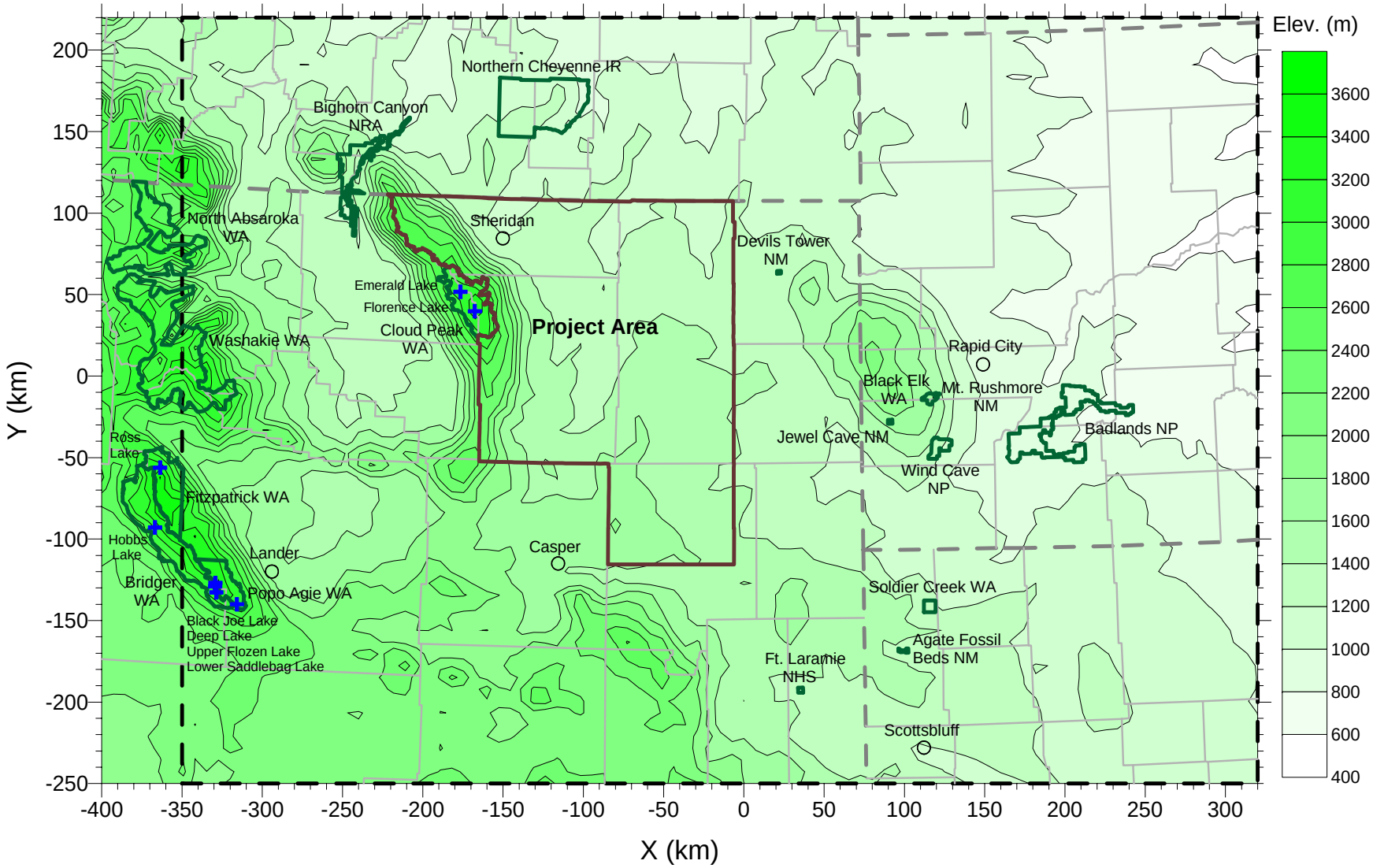
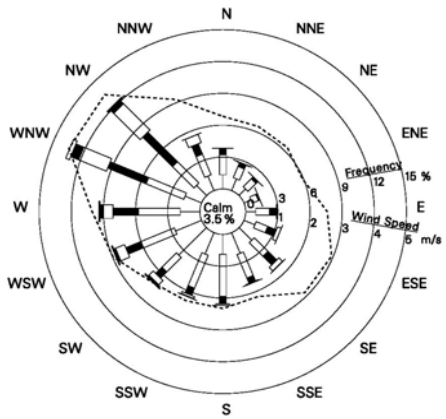
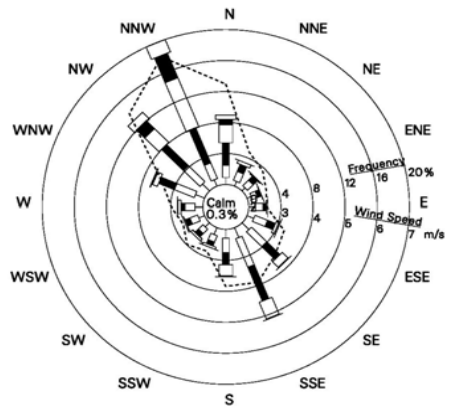


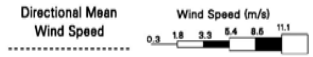
Figure 4-2 Topography of the PRBO&G Project Modeling Domain, Meteorological Stations, and Sensitive Receptors

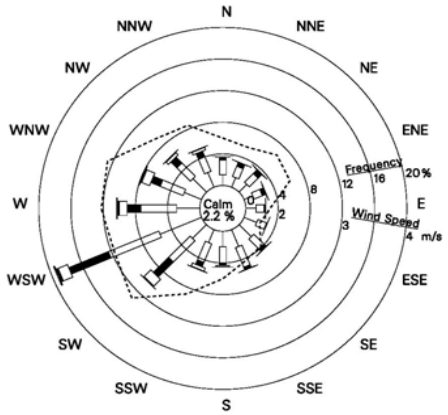


(a) Sheridan, WY

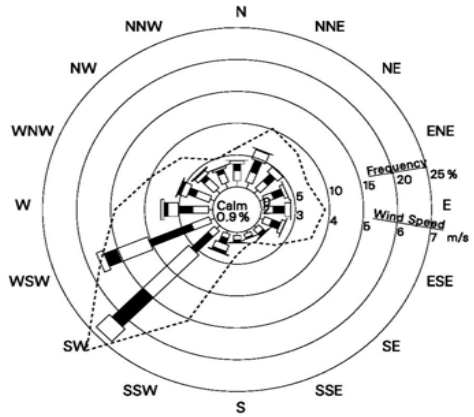


(b) Rapid City, SD

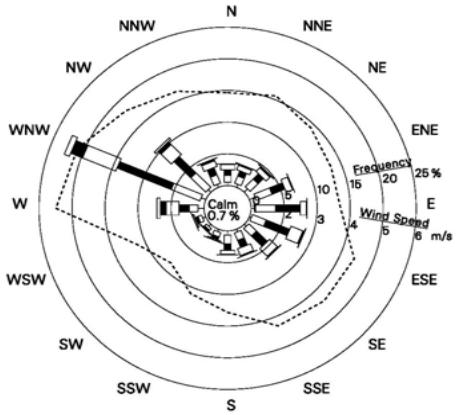




(c) Lander, WY



(d) Casper, WY



(e) Scottsbluff, NE

Figure 4-3 Annual Wind Roses at 10-m Level in 1990 at Sheridan, Lander, and Casper, Wyoming; Rapid City, South Dakota; and Scottsbluff, Nebraska

receptor grid was initially spaced at 5-km intervals. Subsequent near-field modeling with smaller receptor grid intervals was conducted in an area (30- by 30-km) located in the north-central part of the Project Area, where high impacts were predicted during the initial modeling and where the stationary emission sources of the current project are most densely concentrated. The receptor grid interval for the 30- by 30-km area was reduced to 1 km, except for the area near the boundary of the 30- by 30-km area, where the receptor grid was set at 2-km intervals (Figure 4-4).

Near-field impacts of PM emitted from construction activities of the PRBO&G Project were evaluated by modeling emissions from the construction site for a reciprocating compressor engine (7 acres) and a service road (40 ft wide and 1,575 ft long). Receptors for the near-field fugitive dust impact modeling were located at 100-m intervals within an area extending from 400 to 600 m from the center of the compressor station construction site and from 200 to 600 m from the center of the service road. Operational emissions of criteria pollutants and HAPs from the PRBO&G Project were also evaluated for near-field impacts by modeling emissions from the largest compressor station (with 6 units of reciprocating compressor engines). Receptors for these near-field impact modeling were located at 100-m intervals within an area extending to 3 km from the center of the compressor station.

For far-field impact assessment, receptors were located along the boundaries and within each of the Class I areas and specified Class II areas of concern within the modeling domain (Table 4-5). The locations of these sensitive receptor areas as well as other sensitive areas within the modeling domain are shown in Figures 1-2 and 4-2. The receptors were defined with the density necessary to assure that maximum potential air quality and AQRV impacts are evaluated (i.e., at 4- to 5-km intervals in the interior and along the boundaries of the Class I areas, specified Class II areas of concern, and specified sensitive lakes) (Figure 4-4).

The elevation of each receptor was obtained by using Digital Elevation Model data for the 1:250,000 quads with 30-m horizontal resolution (USGS 2000a).

4.4 Ambient Air Quality and AQRV Data

The existing ambient air quality levels, visibility, and lake chemistry parameters in and around the Project Area are described in several recently published EISs for proposed activities in the modeling domain (e.g., BLM 1999b; EIC 2000). These baseline or background data were used in the current study as follows:

- Data on baseline concentrations for criteria pollutants based on the most recent maximum concentrations measured in the region were combined with the data on predicted maximum cumulative impacts for comparison with ambient standards.
- Data on background ozone (O_3) concentrations were used as input to CALPUFF model. Data on background concentrations of particulate chemical species were combined with data on ambient and CALPUFF-predicted chemical species concentrations for performing the sulfate/nitrate/ammonia equilibrium calculation needed to predict the secondary particulate concentration.

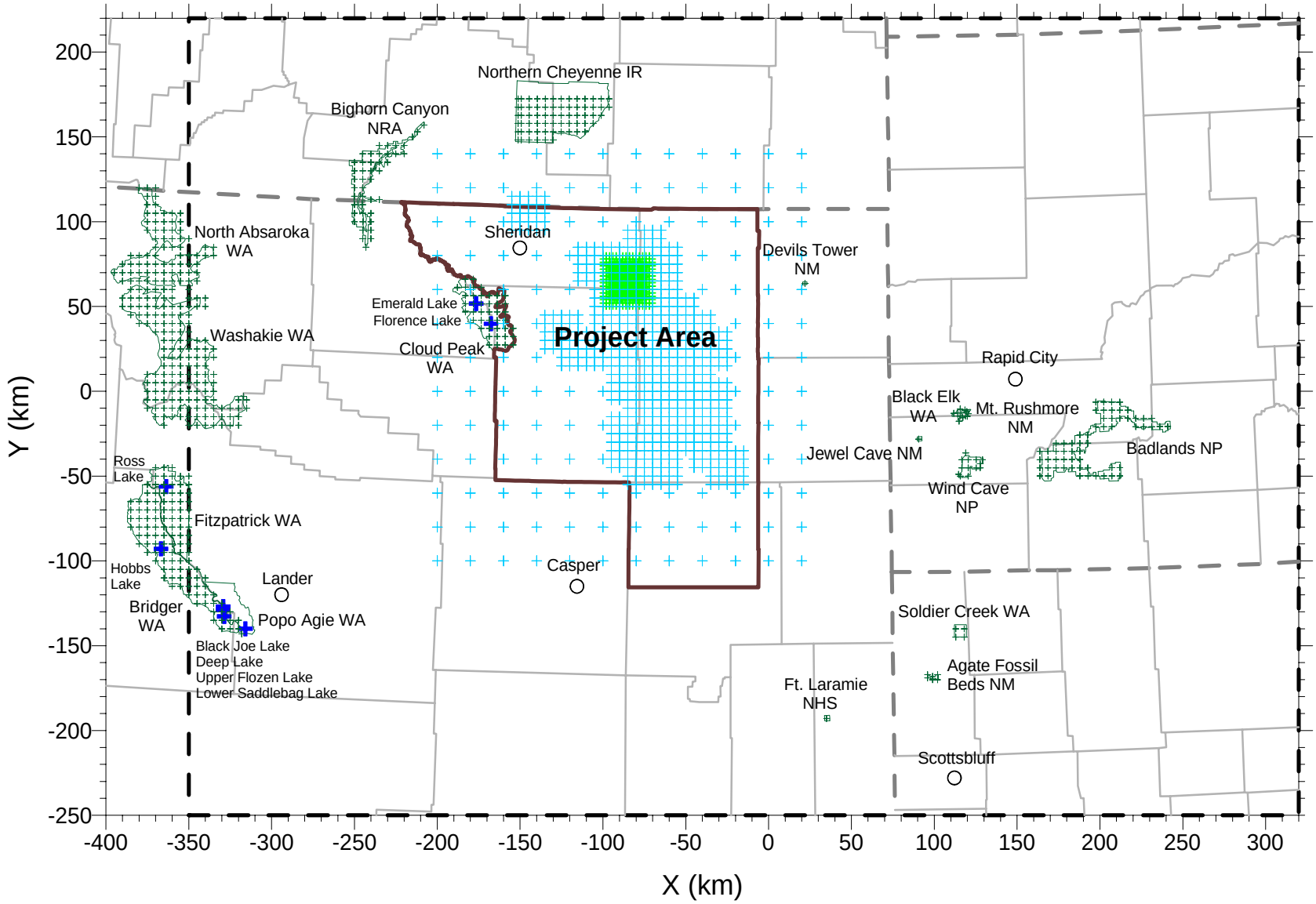


Figure 4-4 Near-Field and Far-Field Receptor Locations Used in CALPUFF Modeling

Table 4-5 Class I Areas and Class II Areas of Concern within the PRBO&G Project Modeling Domain

Mandatory Federal Class I Area or PSD Class II Area of Concern	PSD Class	Responsible Agency	Location [a]	
			Distance (km)	Direction
Badlands Wilderness Area	I	NPS	280	ESE
Wind Cave National Park	I	NPS	213	ESE
Bridger Wilderness Area	I	FS	310	WSW
Fitzpatrick Wilderness Area	I	FS	299	WSW
Washakie Wilderness Area	I	FS	278	W
North Absaroka Wilderness Area	I	FS	293	W
Northern Cheyenne Reservation	I	NCTC [b]	139	NNW
Devils Tower National Monument	II	NPS	104	ENE
Mount Rushmore National Memorial	II	NPS	202	ESE
Jewel Cave National Monument	II	NPS	178	ESE
Agate Fossil Beds National Monument	II	NPS	267	SE
Fort Laramie National Historic Site	II	NPS	252	SSE
Black Elk Wilderness Area	II	FS	199	ESE
Soldier Creek Wilderness Area	II	FS	260	SE
Cloud Peak Wilderness Area	II	FS	93	W
Bighorn Canyon National Recreation Area	II	NPS	185	WNW

[a] Distance and direction are from the center point of the Project Area to the center point of the receptor area.
[b] Northern Cheyenne Tribal Council.

- Data on reference levels of visibility, daily monitored visibility levels, and acid neutralizing capacity (ANC) were used to assess the significance of predicted changes in visibility and acid deposition, respectively.

The baseline or background data selected for use in the PRBO&G Project analysis are described in the following sections. Additional data on ambient air quality, visibility, and ANC that became available since the preparation of the recently published EISs were obtained and evaluated. Valid new data were included in defining the baseline or background ambient air quality and AQRV levels for this analysis.

4.4.1 Criteria Pollutants

Ambient concentrations of criteria pollutants monitored within the modeling domain that are used to define regional baseline air quality levels are listed in Table 4-6. PM data (PM_{10} and $PM_{2.5}$) are presented for two locations: Sheridan and Gillette, Wyoming. Sheridan data were used to represent the baseline concentrations for the population center receptors in the community of Sheridan. Gillette data were used to represent the baseline concentrations for the rest of the Project Area. Because of Gillette's environmental setting and its smaller population, Gillette data are considered more representative of the rest of the Project Area than the data collected in Sheridan.

Table 4-6 Regional Baseline Ambient Air Quality Levels

Pollutant	Ambient Air Quality Level ($\mu g/m^3$)					Source
	Annual	24-hour	8-hour	3-hour	1-hour	
NO_2	16.5	-[a]	-	-	-	Gillette, WY (3/1996-4/1997) [b]
SO_2	3	8	-	8	-	Devil's Tower, WY (1983) [c]
PM_{10}	17	42	-	-	-	Gillette, WY (1999) [d]
	33	105	-	-	-	Sheridan, WY (1999) [d]
$PM_{2.5}$	7.6	19	-	-	-	Gillette, WY (1999) [d,e]
	9.5	33	-	-	-	Sheridan, WY (1999) [d]
CO	-	-	1,500	-	3,500	Riley Ridge EIS [f]
O_3	-	-	130	-	-	Pinedale, WY [g]

[a] A hyphen indicates no standard exists.
[b] NO_2 concentration data collected at Gillette, WY, from 3/27/96 to 4/28/97 (EIC 2000).
[c] SO_2 data collected at Devil's Tower during 1983 (EIC 2000).
[d] Twenty four-hour average data represent 99th percentile (second highest) concentration (WDEQ 2000).
[e] Sheridan annual $PM_{2.5}/PM_{10}$ ratio for 1999 (0.45) applied to Gillette PM_{10} values.
[f] Taken from representative data collected by WDEQ and commercial operators (BLM 1983).
[g] Fourth-highest maximum daily 8-hour average concentration, averaged over 3-year period (1992-1994).

4.4.2 Chemical Species

The regional background ozone concentration value is needed as an input to the CALPUFF model for use in its empirical chemical transformation algorithm. Because of the lack of available data, this analysis used the same constant values as those used in modeling for other recent EIS projects: the values are in the region of 40 parts per billion (ppb) (e.g., EIC 2000).

Chemical species data for ambient aerosols are determined by analyzing PM samples collected twice a week at two Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring sites in the vicinity of the modeling domain, located near Badlands National Park and Bridger Wilderness Area. PM mass concentration data reconstructed from the speciated PM data at the two monitoring sites were processed to generate monthly average PM speciation profiles (EIC 2000). The Badlands and Bridger IMPROVE data were used to define the background concentrations of particulate sulfate, nitrate, and ammonium for those sensitive receptor areas located, respectively, east and west of the eastern boundary of the Project Area (Figure 1-2).

In addition to the chemical species data for airborne PM, background concentration data for gaseous free ammonia and nitric acid are also required. Because there are no measurements of gaseous ammonia or nitric acid in the region, values of 5 and 0.5 ppb, respectively, were used in the PRBO&G Project analysis, as they were used in the previous CALPUFF modeling analyses, in order to provide conservatively high estimates.

4.4.3 Visibility

FLAG has established a recommended procedure for identifying and evaluating potential visibility impairment primarily in mandatory federal Class I areas (FLAG 2000). (See Appendix D for details.) According to the FLAG procedure, predicted changes in visibility in terms of percent change in extinction (or change in deciview [*dv*]; a 10% change in extinction corresponds to 1.0 *dv*) due to emissions from proposed sources would be computed and compared with estimated seasonal natural background reference visibility levels, and the resulting percent change in extinction (or change in *dv*) would be compared with FLAG-prescribed threshold levels for impact assessment. The Class I areas and specified Class II areas of concern within the modeling domain where visibility is an important value are listed in Table 4-5. Estimated natural background visibility reference levels and associated parameter values, including site-specific, seasonal relative humidity adjustment factors, as recommended by FLAG, are provided in Table 4-7 for the Class I and Class II areas of concern (FLAG 2000) located within the PRBO&G Project modeling domain.

In addition, the State of Wyoming DEQ, has established a set of reference levels (visibility conditions) based on the mean of the cleanest 20% from the period winter 1987 to summer 1997. A separate visibility analysis was performed; it used the same procedures as those described in Appendix D but was based on the following reference levels (in Mm^{-1}) provided by the State of Wyoming: (1) for Badlands and Wind Cave National Parks (winter 23.04, spring 26.13, summer 27.35, and fall 23.13); and (2) for Bridger, Fitzpatrick, North Absaroka, and Washakie Wilderness Areas (winter 14.41, spring 17.56, summer 19.05, and fall 16.37).

Table 4-7 Estimated Natural Background Visibility Reference Levels

Mandatory Federal Class I Area [a]	Season [b]	Hygroscopic (Mm^{-1})	Non-hygroscopic (Mm^{-1})	Rayleigh (Mm^{-1})	f(RH) [c]	Particle b_{ext} with f(RH) (Mm^{-1})	Reference Level (Mm^{-1}) [d]
Badlands WA	Winter	0.6	4.5	10.0	3.1	6.4	16.4
	Spring	0.6	4.5	10.0	2.6	6.1	16.1
	Summer	0.6	4.5	10.0	2.2	5.8	15.8
	Fall	0.6	4.5	10.0	2.8	6.2	16.2
Bridger WA	Winter	0.6	4.5	10.0	2.9	6.2	16.2
	Spring	0.6	4.5	10.0	1.9	5.6	15.6
	Summer	0.6	4.5	10.0	1.5	5.4	15.4
	Fall	0.6	4.5	10.0	2.4	5.9	15.9
Fitzpatrick WA	Winter	0.6	4.5	10.0	2.9	6.2	16.2
	Spring	0.6	4.5	10.0	1.9	5.7	15.7
	Summer	0.6	4.5	10.0	1.5	5.4	15.4
	Fall	0.6	4.5	10.0	2.4	6.0	16.0
North Absaroka WA [e]	Winter	0.6	4.5	10.0	2.9	6.2	16.2
	Spring	0.6	4.5	10.0	2.1	5.8	15.8
	Summer	0.6	4.5	10.0	1.7	5.5	15.5
	Fall	0.6	4.5	10.0	2.5	6.0	16.0
Washakie WA	Winter	0.6	4.5	10.0	2.8	6.2	16.2
	Spring	0.6	4.5	10.0	2.0	5.7	15.7
	Summer	0.6	4.5	10.0	1.6	5.5	15.5
	Fall	0.6	4.5	10.0	2.5	6.0	16.0
Wind Cave NP [f]	Winter	0.6	4.5	10.0	2.9	6.2	16.2
	Spring	0.6	4.5	10.0	2.5	6.0	16.0
	Summer	0.6	4.5	10.0	2.1	5.7	15.7
	Fall	0.6	4.5	10.0	2.6	6.1	16.1

[a] WA = Wilderness Area; NP = National Park.
[b] Winter: December, January, and February; Spring: March, April, and May; Summer: June, July, and August; Fall: September, October, and November.
[c] Site-specific, seasonal relative humidity adjustment factor for hygroscopic aerosols.
[d] Calculated values based on procedures summarized in Appendix A.
[e] Values also assumed to be representative of the redesignated Northern Cheyenne Class I Reservation, the Class II Bighorn Canyon National Recreation Area, and the Class II Cloud Peak Wilderness Area.
[f] Values also assumed to be representative of the Class II Agate Fossil Beds, Devils Tower, and Jewel Cave National Monuments, the Class II Black Elk and Soldier Creek Wilderness Areas, the Class II Fort Laramie National Historic Site, and the Class II Mount Rushmore National Memorial.

Source: FLAG (2000).

Except for the winter season at the Fitzpatrick Wilderness Area, all the reference levels established by the WDEQ are higher than the FLAG reference levels listed in Table 4-7.

4.4.4 Lake Chemistry

Acid deposition impacts were assessed by comparing annual total acid deposition fluxes to sensitive lakes in terms of their ANC estimated by using FS-recommended prediction methods with the LAC threshold (FS Rocky Mountain Region 2000). These lakes include Black Joe, Deep, and Hobbs Lakes in the Class I Bridger Wilderness Area, Ross Lake in the Class I Fitzpatrick Wilderness Area, Emerald Lake and Florence Lake in the Class II Cloud Peak Wilderness Area, and Lower Saddlebag Lake in the Class II Popo Agie Wilderness Area. Information on location, size of watershed area, and monitored ANC for these sensitive lakes is presented in Table 4-8.

Table 4-8 Acid Neutralizing Capacities of Sensitive Lakes within the PRBO&G Project Modeling Domain

Sensitive Lake	Wilderness Area Where Lake Is Located	Location		Watershed Area (ha)	10% Most Sensitive ANC (µeq/L)
		Distance (km)	Direction		
Florence	Cloud Peak	91	W	417	32.7
Emerald	Cloud Peak	101	W	293	55.3
Lower Saddlebag	Popo Agie	295	SW	155	55.5
Black Joe	Bridger	298	WSW	890	69.0
Deep	Bridger	300	WSW	205	61.0
Ross	Fitzpatrick	300	WSW	4,455	61.4
Upper Frozen	Bridger	316	WSW	-[a]	-
Hobbs	Bridger	316	WSW	293	68.0

[a] A hyphen indicates no data are available.

5 AIR QUALITY MODELING AND POSTPROCESSING

The air quality modeling analysis described in Section 3 was conducted by using the CALPUFF model with model input data described in Section 4 to assess potential impacts on ambient air quality and AQRVs (visibility and acid deposition) that would result from the proposed new sources of the PRBO&G Project (Proposed Action and Alternatives). Additional model runs were also made to assess potential impacts of other new and RFD sources in the region alone, as defined in Section 4.1.2, as well as to assess cumulative impacts from the combined PRBO&G Project and other new and RFD sources.

The air quality modeling analysis used the daily maximum emission rates for the PRBO&G Project sources and long-term (seasonal maximum) emission estimates for the other new and RFD sources (as defined in the DM&E New Railway Retrofit Project EIS emission inventory database). 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 were selected:

- Turbulence-based dispersion (based on similarity theory)
- Transitional plume rise
- Stack tip downwash
- Transition of horizontal dispersion to time-dependent (Heffter) growth rates, and
- Chemical transformation based on RIVAD/ARM3 scheme, which treats the nitric oxide (NO) and NO_2 conversion processes in addition to the NO_2 to total nitrate (NO_3^-) and SO_2 to sulfate ($SO_4^=$) conversions with equilibrium between gaseous nitric acid (HNO_3) and ammonium nitrate (NH_4NO_3) aerosol.

Other CALPUFF model options and assumptions about background concentrations of chemical species used in the current study were based on those used in the DM&E New Railway Retrofit Project modeling study (EIC 2000). For example, the ambient ratio method, which assumes a conversion rate of 75%, was used for the NO_x to NO_2 conversion rate, according to EPA guidance (*Code of Federal Regulations*, Title 40, Part 51 [40 CFR Part 51], Appendix W).

Potential increases in concentrations of SO_2, NO_2, PM_{10}, $PM_{2.5}$, and sulfur and nitrogen deposition, as well as in visibility impairment (aerosol light extinction), were predicted at selected receptor locations, as described in Section 4. Concentration increases in PM_{10} and $PM_{2.5}$ due to construction activities were also predicted for locations close to a selected construction site, as described in Section 4. Concentrations of HAPs (e.g., formaldehyde) due to emissions from the proposed new sources of the PRBO&G Project (Proposed Action and Alternarives) was predicted at near-field receptors, as described in Section 4.

NO_x would be a major component of the emissions from the PRBO&G Project and other new sources in the region. CALPUFF simulates the oxidation of NO_x to NO_3^- and calculates the equilibrium between $SO_4^=$, NO_3^-, and NH_3 to determine how much of the converted NO_x is particulate NO_3^- and how much is gaseous HNO_3. The latest version of CALPUFF allows the background concentrations of pollutants such as $SO_4^=$ and NO_3^- (representing contributions due

to existing sources) to be input so that the contributions of background concentrations of these species to the overall cumulative impacts would be included.

All air quality outputs from the modeling program are hourly values of direct concentration increases, which were processed to compute 3-hour, 8-hour, 24-hour, and annual average direct concentration increases. Another category of predicted outputs are total ambient concentration values (direct concentration increases plus the background concentrations). Visibility and deposition estimates are daily values, and annual number of days with given level of visibility degradation and annual total sulfur and nitrogen deposition flux increments were derived from the daily values.

6 CRITERIA USED IN ASSESSING POTENTIAL AIR QUALITY AND AQRV IMPACTS

To evaluate the significance of predicted air quality and AQRV impacts, the results of air quality modeling and postprocessing are compared with applicable standards and criteria, as described in the following subsections.

6.1 Significant Deterioration of Air Quality

The potential air quality concentration increases predicted at the Class I areas and Class II areas that result from the contributions from the PRBO&G Project, other new and RFD sources, and cumulative PRBO&G Project and other new and RFD sources, respectively, are compared with the allowable increments under the PSD air quality regulations. (This comparison to the PSD Class I and II increments within the context of the National Environmental Policy Act [NEPA] is intended to provide a general idea of how much of the increments are consumed by a particular project and does not represent a regulatory PSD increment consumption analysis.) The allowable PSD increments for Class I and Class II areas are given in Table 6-1.

Table 6-1 Maximum Allowable PSD Increments for PSD Class I and Class II Areas

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

[a] A hyphen indicates no standard exists.

6.2 Ambient Air Quality

6.2.1 Criteria Pollutants

The potential total concentrations (cumulative concentration contributions due to the emissions from the proposed new sources of the PRBO&G Project, other new sources and RFD sources, plus the background concentrations) of criteria pollutants estimated at near-field receptors are compared with applicable health- and welfare-related NAAQS and SAAQS.

The NAAQS and SAAQS for the states, parts of which are located within the modeling domain (Wyoming, Montana, South Dakota, and Nebraska), are established for NO_2, SO_2, PM_{10}, $PM_{2.5}$, O_3, CO, and lead (Pb). Given the insignificant levels of potential VOCs and Pb emissions, neither the O_3 nor the Pb standard are addressed in this analysis.

New NAAQS for O_3 and $PM_{2.5}$ were promulgated by the EPA on July 18, 1997. However, the procedures for implementing these standards have not been established by the EPA. The existing PM_{10} standard remains applicable throughout the United States, including the states within the modeling domain, and are used for comparison. The NAAQS and SAAQS addressed in this study are listed in Table 6-2.

Table 6-2 Applicable Ambient Air Quality Standards

Pollutant	Ambient Air Quality Standards (μg/m^3) [a]				
	Annual [b]	24-hour [c]	8-hour [c]	3-hour [c]	1-hour [c]
NO_2	100 (0.05)	- [d]	-	-	265 (0.30) [e]
SO_2	60 (0.02) [e, f] 80 (0.03)	260 (0.10) [e, f] 365 (0.14)	-	1,300 (0.50)	1,300 (0.50) [f]
PM_{10}	50 [g]	150 [h]	-	-	-
$PM_{2.5}$	15 [g]	65 [i]	-	-	-
CO	-	-	10,000 (9)	-	26,000 (23) [e] 40,000 (35)

[a] NAAQS unless otherwise noted. Values in parentheses are in parts per million (ppm).
[b] Annual arithmetic mean not to be exceeded, unless otherwise noted.
[c] Not to be exceeded more than once per year, unless otherwise noted.
[d] A hyphen indicates no standard exists.
[e] Montana SAAQS (more stringent than NAAQS).
[f] Wyoming SAAQS (more stringent than NAAQS).
[g] Expected annual arithmetic mean averaged over a 3-year period.
[h] Annual 99th percentile concentration averaged over a 3-year period.
[i] Annual 98th percentile concentration averaged over a 3-year period.

6.2.2 Hazardous Air Pollutants

Since neither the EPA nor the State of Wyoming has established ambient HAP standards, the maximum estimated concentration increases (8-hour average) of HAPs due to the proposed new sources of the PRBO&G Project are compared with a range of state acceptable ambient concentration levels (AACLs) (EPA 1997) (Table 6-3). The distances from a compressor station with the highest HAP emission rates where the potential cancer risks from long-term (70-year) exposures to HAPs would be less than the threshold range of 1×10^{-6} to 1×10^{-4} were estimated under two scenarios: an MEI and an MLE condition. These potential cancer risks were estimated by using the EPA unit risk factors (EPA 2001). For each scenario (MEI or MLE), an adjustment factor was used to account for duration of exposure to HAPs. If exposure of an MEI

is based on 100% of the time for the lifetime of a CBM compressor (i.e., 20 years), the adjustment factor would be 0.29 (20/70×1). If it is assumed that an MLE condition consists of 64% of the time at a receptor location (at the maximum predicted concentration) and 36% of the time at a more distant location (i.e., at 1/4 the maximum predicted concentration) for a total period of 20 years, then the adjustment factor would be 0.21 (i.e., 20/70×[0.64×1+0.36×0.25]). Since there are no regulatory requirements, the above assessments are provided for information purposes only.

Table 6-3 Range of State AACLs for Selected Hazardous Air Pollutants

HAP Species	Range of 8-hour State AACL ($\mu g/m^3$)
n-Hexane	1,800 [a] - 36,000 [b]
Benzene	30 [a] - 714 [c]
Toluene	1,870 [d] - 8,930 [c]
Ethyl benzene	4,340 [e] - 43,500 [f]
Xylene	2,170 [g] - 10,400 [c]
Formaldehyde	4.5 [a] - 71 [c]

[a] Florida, Pinellas County Air Pollution Control Board.
[b] Connecticut Department of Environmental Protection, Air Compliance Unit.
[c] Nevada Division of Environmental Protection, Air Quality Control.
[d] Indiana, Indianapolis Air Pollution Control Division.
[e] North Dakota Department of Health, Division of Environmental Engineering.
[f] Vermont Department of Environmental Conservation, Air Pollution Control Division.
[g] Indiana Department of Environmental Management.

6.3 Air-Quality-Related Values

6.3.1 Visibility

Estimated potential maximum visibility degradation at the Class I areas and specified Class II areas of concern due to the contributions from PRBO&G Project, other new sources and RFD sources, and cumulative sources, respectively, were processed to obtain potential visibility impairment in terms of delta *dv*. These predicted visibility impairments were then compared with the LAC thresholds (5% and 10% of the reference background visibility, or 0.5 and 1.0 *dv*, respectively, for the impairment attributable to the PRBO&G Project sources alone and cumulative sources [including both the PRBO&G Project sources and other new sources and RFD sources]).

Initially, potential visibility impacts were predicted by using the assumed natural background visibility data presented in Table 4-7 and the reference levels established by the State of Wyoming. For those locations where predicted visibility impairment would equal or exceed 10% extinction or 1.0 *dv*, an assessment of potential daily visibility impairment was made by using measured optical conditions in order to determine the magnitude, frequency, and duration of

such impairment. (See Appendix D for the procedures to be used to predict visibility impairment.)

6.3.2 Acid Deposition

Estimated annual wet, dry, and total (wet plus dry) deposition fluxes of total sulfur and nitrogen due to the contributions from the proposed PRBO&G Project alone, other new sources and RFD sources, and cumulative sources combined, respectively, were used to estimate the potential changes in ANC at several specified sensitive lake receptors. The estimates were made by following the procedure developed by the FS Rocky Mountain Region (2000), and predicted changes in ANC were compared with the LAC threshold (10% change in ANC for lakes with background ANC values greater than 25 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).

7 ASSESSMENT OF POTENTIAL AIR QUALITY AND AQRV IMPACTS

This section presents the modeling results of potential air quality and AQRV impacts of the emissions from the PRBO&G Project sources, other new and RFD sources in the modeling domain (non-PRBO&G Project sources), and cumulative sources (PRBO&G Project and non-PRBO&G Project sources combined) under the four alternatives considered for the PRBO&G Project EIS. Estimated potential maximum near-field and far-field air quality impacts are compared with applicable PSD and ambient air quality standards, and potential near-field HAP impacts are compared with a range of AACLs established by states. Estimated potential maximum far-field AQRV (visibility and acid deposition) impacts are compared with relevant LAC thresholds.

For the most part, the estimated potential maximum near-field and far-field air quality impacts and acid deposition impacts are much lower than the applicable standards or LAC thresholds. However, potential maximum far-field visibility impacts estimated by the screening procedures exceeded LAC thresholds except at a few visibility-sensitive receptors for the case of PRBO&G Project emissions under Alternative 3 (No Action Alternative). Thus, potential maximum far-field visibility impacts were estimated by the refined procedure, and the magnitude, frequency, and duration of potential daily visibility impairment are presented.

7.1 Near-Field Impacts

7.1.1 Criteria Pollutants

7.1.1.1 Emissions from PRBO&G Project, Non-PRBO&G Project, and Cumulative Sources

Table 7-1 summarizes the estimated potential maximum near-field impacts of criteria air pollutants due to the emissions from the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources under various alternatives. The potential increases in maximum near-field concentrations of criteria pollutants due to the emissions from the PRBO&G Project sources under all four alternatives are estimated to be about 10 µg/m^3 for annual average NO_2; <1, <1, and 3 µg/m^3 for annual, 24-hour, and 3-hour average SO_2, respectively; 5 and 20 µg/m^3 for annual and 24-hour average PM_{10}, respectively; 4 and 20 µg/m^3 for annual and 24-hour average $PM_{2.5}$, respectively; and 930 and 1,000 µg/m^3 for 8-hour and 1-hour average CO, respectively. Figure 7-1 illustrates the distribution of the estimated concentration increases due to the emissions from the PRBO&G Project sources for the potential increase in annual average NO_2 concentration.

Among the four alternatives, potential air quality impacts due to the emissions from PRBO&G Project emissions are the highest under Alternative 1 (Proposed Action), except for the potential concentration increases in 24-hour average PM_{10} and $PM_{2.5}$ and 8-hour and 1-hour average CO under Alternative 3 (No Action Alternative). Potential maximum near-field criteria pollutant concentration increases due to the emissions from PRBO&G Project emissions are lower than those due to non-PRBO&G Project source emissions for SO_2, but are higher for NO_2, PM_{10}, $PM_{2.5}$, and CO. Under all alternatives, these concentration increases due to the emissions from

Table 7-1 Estimated Potential Maximum Near-Field Air Quality Impacts Due to Emissions from PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources under Various Alternatives

Criteria Pollutant	Averaging Time	Maximum Concentration Increase ($\mu g/m^3$)									PSD Increment for Class II Area ($\mu g/m^3$)
		Non-PRBO&G Sources	PRBO&G Sources				Cumulative Sources				
		All Alt.	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	
NO_2	Annual	6 (25) [a]	10 (39)	9 (35)	7 (30)	7 (28)	14 (57)	13 (53)	12 (49)	9 (36)	25
SO_2	Annual	1 (7)	<1 (2)	<1 (2)	<1 (2)	<1 (1)	2 (9)	2 (9)	2 (9)	1 (7)	20
	24-hour	3 (4)	1 (1)	1 (1)	1 (1)	1 (1)	4 (5)	4 (5)	4 (5)	4 (4)	91
	3-hour	7 (1)	3 (1)	3 (1)	3 (1)	1 (<1)	10 (2)	10 (2)	10 (2)	8 (2)	512
PM_{10}	Annual	2 (14)	5 (27)	4 (21)	3 (20)	4 (21)	6 (35)	6 (33)	6 (32)	4 (24)	17
	24-hour	8 (26)	18 (60)	10 (35)	10 (33)	20 (68)	18 (60)	16 (52)	15 (50)	21 (68)	30
$PM_{2.5}$	Annual	2	4	2	2	3	4	4	4	4	- [b]
	24-hour	7	18	9	6	20	18	11	11	20	-
CO	8-hour	120	800	400	160	930	800	400	160	930	-
	1-hour	130	850	430	230	1,000	850	430	230	1,000	-

[a] Values in parentheses are the predicted maximum concentration increases as percent of maximum allowable PSD increments for Class II area.
[b] A hyphen indicates no standard exists.

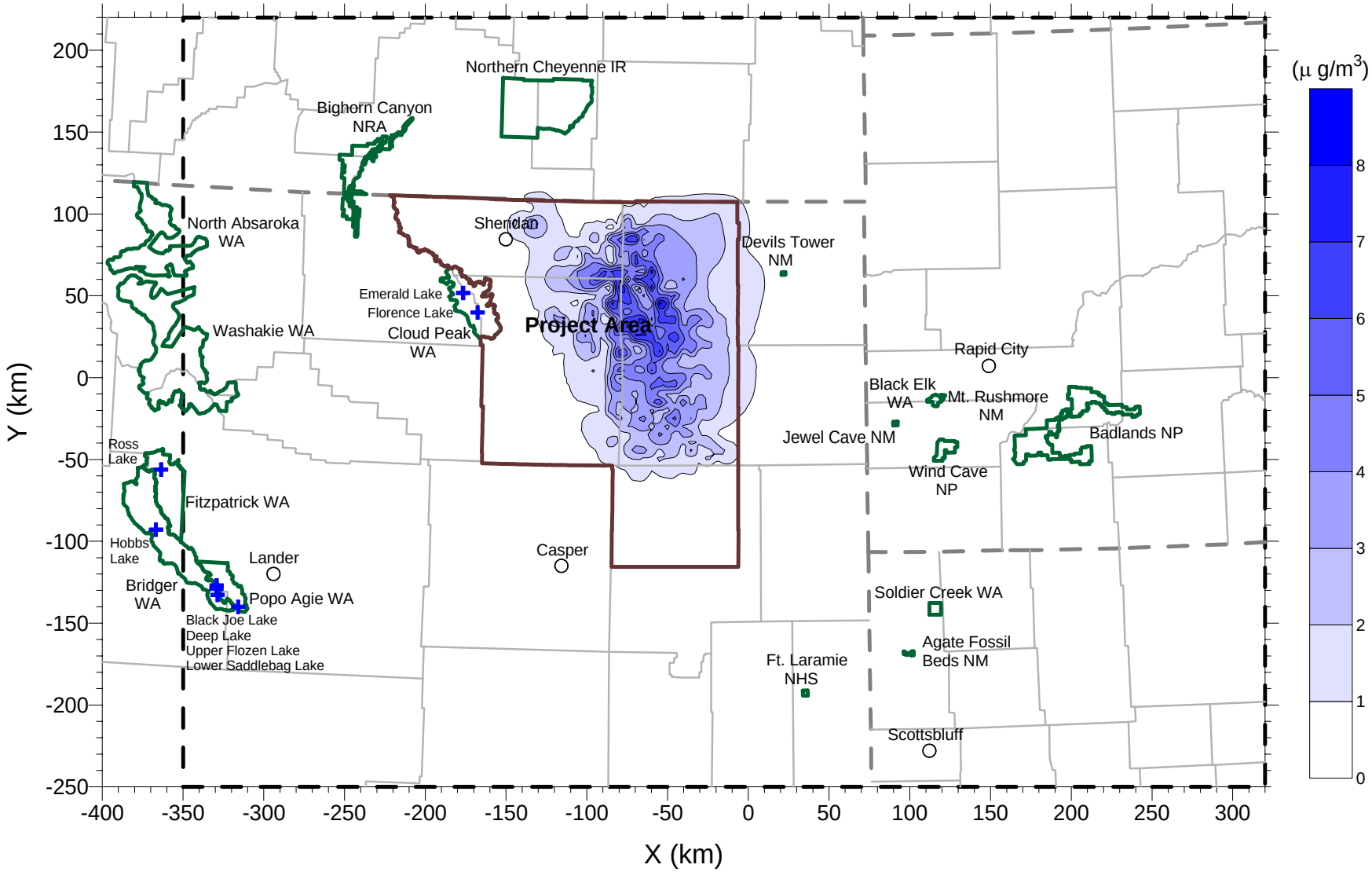


Figure 7-1 Estimated Annual Average NO_2 Concentration Increases Due to PRBO&G Project Emissions under the Proposed Action

the PRBO&G Project are less than the maximum allowable PSD increments for Class II areas, representing percentages equal to or less than about 39, 2, and 68% of the maximum allowable PSD increments for Class II areas for NO_2, SO_2, and PM_{10}, respectively.

The estimated potential maximum near-field total concentrations (concentration increases due to cumulative source emissions plus background concentrations) of criteria pollutants are compared with applicable ambient air quality standards (Wyoming SAAQS [WAAQS] and NAAQS) in Table 7-2. The potential maximum total concentrations are less than applicable WAAQS or NAAQS under all alternatives, representing percentages equal or less than about 31, 8, 46, 80, and 24% of WAAQS for NO_2, SO_2, PM_{10}, $PM_{2.5}$ and CO, respectively.

7.1.1.2 Fugitive Dust Emissions from Construction Sites

The potential maximum 24-hour average PM_{10} concentration impact due to fugitive dust emissions from the largest construction site of the PRBO&G Project (7-acre reciprocating compressor station with a two-track road 480 m long and 12 m wide) was estimated to be about 55 $\mu g/m^3$ occurring about 240 m away from the compressor station site and about 200 m from the road. Although the temporary, short-term impacts of fugitive dust emissions from a construction site are not usually subjected to the requirements of ambient air quality standards, the total PM_{10} concentration, including the contributions from the largest construction site of the PRBO&G Project, was estimated and compared with applicable WAAQS and NAAQS. Adding the estimated potential maximum 24-hour average PM_{10} concentration increase of 55 $\mu g/m^3$ to the background concentration of 42 $\mu g/m^3$ would amount to a total concentration of about 97 $\mu g/m^3$, which is about 65% of WAAQS. Because all other construction sites of the PRBO&G Project would be smaller in size than the 7-acre reciprocating compressor station site, potential PM_{10} concentration impacts at these sites would be less.

7.1.1.3 Operational Emissions from Compressor Stations

Table 7-3 presents the estimated potential maximum near-field impacts of criteria pollutants due to emissions from 6-unit booster and reciprocating compressor stations with compressor engines using various combustion technologies. Among the five combinations of compressor type and combustion technology, the near-field impacts of NO_2, SO_2, and 24-hour average PM_{10} and $PM_{2.5}$ are highest for the reciprocating compressor station with the lean-burn Caterpillar G3516LE model engines; near-field impacts of annual average PM_{10} and $PM_{2.5}$ are highest for the booster compressor station with rich-burn compressor engines; and near-field impacts of CO are highest for the reciprocating compressor station with rich-burn compressor engines.

The estimated potential maximum near-field total concentrations (concentration increases due to compressor station emissions plus background concentrations) of criteria pollutants are compared with applicable ambient air quality standards (WAAQS and NAAQS) in Table 7-3. The potential total concentrations are less than applicable WAAQS or NAAQS for all five compressor type and combustion technology combinations, representing percentages equal or less than about 24, 5, 34, 53, and 17% of WAAQS for NO_2, SO_2, PM_{10}, $PM_{2.5}$ and CO, respectively.

Table 7-2 Estimated Potential Maximum Near-Field Air Quality Concentrations Due to Emissions from PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources under Various Alternatives

Criteria Pollutant	Averaging Time	Maximum Concentration ($\mu g/m^3$)									WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
		Baseline	Increase Due to Cumulative Sources				Total Concentration					
			Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3		
NO_2	Annual	16.5	14	13	12	9	31 (31) [a]	30 (30)	29 (29)	25 (25)	100	100
SO_2	Annual	3	2	2	2	1	5 (8)	5 (8)	5 (8)	4 (7)	60	80
	24-hour	8	4	4	4	4	12 (5)	12 (5)	12 (5)	12 (5)	260	365
	3-hour	8	10	10	10	8	18 (1)	18 (1)	18 (1)	16 (1)	1,300	1,300
PM_{10}	Annual	17	6	6	6	4	23 (46)	23 (46)	23 (46)	21 (42)	50	50
	24-hour	42	18	16	15	21	60 (40)	58 (39)	57 (38)	63 (42)	150	150
$PM_{2.5}$	Annual	7.6	4	4	4	4	12 (80)	11 (73)	11 (73)	11 (73)	15	15
	24-hour	19	18	11	11	20	37 (57)	30 (46)	30 (46)	39 (60)	65	65
CO	8-hour	1,500	800	400	160	930	2,300 (23)	1,900 (19)	1,700 (17)	2,400 (24)	10,000	10,000
	1-hour	3,500	850	430	230	1,000	4,400 (11)	3,900 (10)	3,700 (9)	4,500 (11)	40,000	40,000

[a] Values in parentheses are the predicted maximum total concentrations as percent of Wyoming State Ambient Air Quality Standards.

Table 7-3 Estimated Potential Maximum Near-Field Air Quality Impacts Due to Emissions from 6-Unit Booster and Reciprocating Compressor Stations

Criteria Pollutant	Averaging Time	Maximum Concentration Increase ($\mu g/m^3$) [a, b]						Maximum Concentration ($\mu g/m^3$)			
		Booster Compressor		Reciprocating Compressor			PSD Increment for Class II Area				
		Rich Burn	Lean Burn	Rich Burn	Lean Burn 1 [c]	Lean Burn 2 [d]		Baseline	Total [e]	WAAQS	NAAQS
NO_2	Annual	4.1 (16)	4.0 (16)	3.1 (12)	7.5 (30)	1.9 (8)	25	16.5	24 (24)	100	100
SO_2	Annual	< 0.1 (< 0.1)	< 0.1 (< 0.1)	< 0.1 (< 0.1)	< 0.1 (< 0.1)	< 0.1 (< 0.1)	20	3	3 (5)	60	80
	24-hour	0.1 (0.1)	.1 (0.1)	0.1 (0.1)	0.3 (0.1)	0.1 (0.1)	91	8	8 (3)	260	365
	3-hour	0.2 (< 0.1)	0.2 (< 0.1)	0.3 (0.1)	0.4 (0.1)	0.3 (0.1)	512	8	8 (1)	1,300	1,300
PM_{10}	Annual	0.4 (2)	0.4 (2)	0.3 (2)	0.2 (1)	0.1 (1)	17	17	17 (34)	50	50
	24-hour	3.7 (12)	3.8 (13)	3.8 (13)	5.3 (18)	1.5 (5)	30	42	47 (31)	150	150
$PM_{2.5}$	Annual	0.4	0.4	0.3	0.2	0.1	- [b]	7.6	8 (53)	15	15
	24-hour	3.7	3.8	3.8	5.3	1.5	-	19	24 (37)	65	65
CO	8-hour	170	130	240	82	33	-	1,500	1,700 (17)	10,000	10,000
	1-hour	230	160	400	140	60	-	3,500	3,900 (10)	40,000	40,000

[a] Estimated concentration increases are for a 6-unit compressor station with a total capacity of 2,100 hp and 9,900 hp for booster and reciprocating compressor stations, respectively.
[b] Values in parentheses are the predicted maximum concentration increases as percent of maximum allowable PSD Increments for Class II Area.
[c] Lean-burn Caterpillar G3516LE model.
[d] Lean-burn Caterpillar G3608 model.
[e] Values in parentheses are the predicted maximum total concentrations as percent of Wyoming State Ambient Air Quality Standards.

7.1.2 Hazardous Air Pollutants

Table 7-4 lists the emission factors, emission rates, estimated potential maximum 8-hour average ground-level concentrations, state-established AACL ranges, and estimated cancer-risk-related data for various HAPs emitted from a 6-unit reciprocating compressor station. The HAP emission rates of the 6-unit reciprocating compressor station are the highest among all compressor stations proposed for the PRBO&G Project. As shown in the table, the estimated potential maximum 8-hour average ground-level concentrations of benzene, ethyl benzene, n-hexane, toluene, and xylene represent very small fractions of the state-established AACL ranges. Only the estimated potential maximum 8-hour average ground-level concentration of formaldehyde (11.5 $\mu g/m^3$) lies within the range of state-established AACLs (4.5 to 71 $\mu g/m^3$).

Among the HAPs listed in Table 7-4, the inhalation cancer unit risk factors from the EPA's IRIS database are available only for benzene and formaldehyde (EPA 2001). The estimated potential maximum long-term concentrations of these HAPs due to emissions from the 6-unit reciprocating compressor station are so low that there are no receptors in the vicinity of the station with potential cancer risk from the long-term (70-year) exposure of 1×10^{-6} and 1×10^{-4} for benzene and formaldehyde, respectively. The estimated distance from the 6-unit reciprocating compressor station beyond which the potential maximum cancer risk from the long-term (70-year) exposure to formaldehyde would be less than the threshold of 1×10^{-6} is 0.4 km and less than 0.4 km from the compressor station for MEI and MLE cases, respectively.

Table 7-4 Estimated Potential Maximum Near-Field HAP Impacts Due to Emissions from 6-Unit Reciprocating Compressor Station

Parameter	Hazardous Air Pollutant Species					
	Benzene	Form-aldehyde	Ethyl Benzene	n-Hexane	Toluene	Xylene
Emission Factor (10^{-3}g/bhp-h) [a]	4.3 [b]	70 [c]	0.3 [b]	3.2 [c]	27 [b]	1.3 [c]
Emission Rate (10^{-3}g/s) [d]	12	193	0.9	8.9	74	3.5
Max. 8-h Ground-Level Concentration (μg/m^3) [e]	0.7	11.5	0.1	0.5	4.4	0.2
Range of 8-h State AACL (μg/m^3) [f]	30 - 714	4.5 -71	4,340 - 43,500	1,800 - 36,000	1,870 - 8,930	2,170 - 10,400
Inhalation Cancer Unit Risk (10^{-6}/μg/m^3) [g]	7.8	13	NA [h]	NA	NA	NA
Concentration (μg/m^3) to Be at Risk of: 10^{-4}	13	7.7	NA	NA	NA	NA
10^{-6}	0.1	0.08	NA	NA	NA	NA
Max. Distance from the Station (km) for an MEI to Be at Risk of: 10^{-4}	-	-	NA	NA	NA	NA
10^{-6}	-	0.40	NA	NA	NA	NA
Max. Distance from the Station (km) for an MLE to Be at Risk of: 10^{-4}	-	-	NA	NA	NA	NA
10^{-6}	-	0.35	NA	NA	NA	NA

[a] For a reciprocating compressor with a four-stroke, lean-burn engine. bhp = brake horsepower.
[b] GRI-HAPCalc 3.0 (Gas Research Institute [GRI] 2001).
[c] Bailey (2001).
[d] For a 6-unit reciprocating compressor station with a total capacity of 9,900 hp operating at full load.
[e] Estimated by using the CALPUFF model with 1990 MM-4 meteorological data and flat terrain.
[f] See Table 6-3.
[g] IRIS database (EPA 2001).
[h] NA = Data not available.

7.2 Far-Field Impacts

7.2.1 Criteria Pollutants

The estimated potential far-field air quality impacts at each of the Class I and II sensitive receptors (Table 4-5) due to the emissions from each category of emission sources under each of the Alternatives evaluated are presented in Appendix E for the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources. Table 7-5 summarizes the estimated potential maximum far-field impacts of criteria air pollutants at Class I sensitive receptors identified in the modeling domain that are due to the emissions from the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources under various alternatives. Among the four Alternatives, estimated potential maximum air quality impacts due to the PRBO&G Project emissions are highest under Alternative 1 (Proposed Action) for all criteria pollutants. The estimated potential maximum far-field impacts of criteria air pollutants at the Class I sensitive receptors occur at the Northern Cheyenne Indian Reservation, the sensitive receptor closest to the PRBO&G Project Area among all of the Class I sensitive receptors listed in Table 4-5.

The estimated potential maximum far-field criteria pollutant concentration increases due to the emissions from PRBO&G Project emissions are lower than those due to non-PRBO&G Project source emissions for all criteria pollutants. These concentration increases due to the PRBO&G Project emissions are substantially less than the maximum allowable PSD increments for Class I areas under all alternatives, representing percentages equal to or less than about 9, 3, and 26% of the maximum allowable PSD increments for Class I areas for NO_2, SO_2, and PM_{10}, respectively.

The estimated potential maximum far-field impacts of criteria air pollutants at the Class II sensitive receptors identified in the modeling domain that are due to the emissions from the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources are summarized in Table 7-6 for various alternatives. Among the four Alternatives, the estimated potential maximum air quality impacts due to PRBO&G Project emissions are highest under Alternative 1 (Proposed Action) for all criteria pollutants. The estimated potential maximum far-field impacts of criteria air pollutants at the Class II sensitive receptors occur at Devil's Tower National Monument, the sensitive receptor closest to the PRBO&G Project Area downwind of the prevailing winds among all of the Class II sensitive receptors listed in Table 4-5.

The estimated potential maximum far-field criteria pollutant concentration increases due to PRBO&G Project emissions are lower than those due to non-PRBO&G Project source emissions for all criteria pollutants, except for the 8-hour average CO concentration. These concentration increases due to PRBO&G Project emissions are only small fractions of the maximum allowable PSD increments for Class II areas under all alternatives, representing percentages equal to or less than about 3, 0.4, and 7% of the maximum allowable PSD increments for Class II areas for NO_2, SO_2, and PM_{10}, respectively.

Table 7-5 Estimated Potential Maximum Far-Field Air Quality Impacts at Class I Areas Due to Emissions from PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources under Various Alternatives

Criteria Pollutant	Averaging Time	Maximum Concentration Increase ($\mu g/m^3$)									PSD Increment for Class I Area ($\mu g/m^3$)
		Non-PRBO&G Sources	PRBO&G Sources				Cumulative Sources				
		All Alt.	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	
NO_2	Annual	0.4 (15; WC) [a]	0.2 (9)	0.2 (8)	0.2 (7)	0.1 (5)	0.5 (20; WC)	0.5 (20; WC)	0.5 (19; WC)	0.4 (17; WC)	2.5
SO_2	Annual	0.1 (6; WC)	0.01 (1)	0.01 (1)	0.01 (1)	0.0 (1)	0.1 (7; WC)	0. (7; WC)	0.1 (7; WC)	0.1 (6; WC)	2
	24-hour	1.2 (24)	0.2 (3)	0.2 (3)	0.2 (3)	0.1 (2)	1.4 (28)	1.4 (28)	1.4 (28)	1.3 (26)	5
	3-hour	3.2 (13)	0.8 (3)	0.8 (3)	0.8 (3)	0.4 (2)	3.7 (15)	3.7 (15)	3.7 (15)	3.3 (13;	25
PM_{10}	Annual	0.2 (6; WC)	0.1 (3)	0.1 (3)	0.1 (3)	0.1 (2)	0.3 (8; WC)	0.3 (8; WC)	0.3 (7; WC)	0.3 (6; WC)	4
	24-hour	2.8 (35)	2.1 (26)	1.8 (23)	1.7 (21)	0.9 (11)	4.9 (61)	4.6 (58)	4.4 (55)	3.5 (44)	8
$PM_{2.5}$	Annual	0.2 (WC)	0.1	0.1	0.1	0.1	0.2 (WC)	0.2 (WC)	0.2 (WC)	0.2 (WC)	- [b]
	24-hour	2.1	1.6	1.3	1.1	0.6	3.6	3.4	3.2	2.6	-
CO	8-hour	12	15	11	8	6	27	23	19	17	-
	1-hour	40	31	23	16	12	54	47	47	43	-

[a] Values in parentheses are the predicted maximum concentration increases as percent of maximum allowable PSD increments for Class I area. Abbreviations in parentheses indicate the locations where the potential maximum concentration increases were predicted to occur. WC = Wind Cave National Park. All other concentration increases for which no location is indicated were predicted to occur at the Northern Cheyenne Indian Reservation.

[b] A hyphen indicates no standard exists.

Table 7-6 Estimated Potential Maximum Far-Field Air Quality Impacts at Class II Areas Due to Emissions from PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources under Various Alternatives

Criteria Pollutant	Averaging Time	Maximum Concentration Increase ($\mu g/m^3$)									PSD Increment for Class II Area ($\mu g/m^3$)
		Non-PRBO&G Sources	PRBO&G Sources				Cumulative Sources				
		All Alt.	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	
NO_2	Annual	0.8 (3) [a]	0.7 (3)	0.6 (2)	0.5 (2)	0.3 (1)	1.4 (6)	1.4 (5)	1.3 (5)	1.0 (4)	25
SO_2	Annual	0.2 (1; JC) [b]	0.04 (0.2)	0.04 (0.2)	0.04 (0.2)	0.02 (0.1)	0.2 (1)	0.2 (1)	0.2 (1)	0.2 (1; JC)	20
	24-hour	1.5 (2; JC)	0.3 (0.4)	0.3 (0.4)	0.3 (0.4)	0.1 (0.1)	1.5 (2; JC)	1.5 (2; JC)	1.5 (2; JC)	1.5 (2; JC)	91
	3-hour	4.6 (1; JC)	1.2 (0.2)	1.2 (0.2)	1.2 (0.2)	0.4 (0.1)	4.6 (1; JC)	4.6 (1; JC)	4.6 (1; JC)	4.6 (1; JC)	512
PM_{10}	Annual	0.4 (2)	0.3 (1)	0.2 (1)	0.2 (1)	0.1 (0.5)	0.6 (4)	0.6 (4)	0.6 (3)	0.5 (3)	17
	24-hour	2.7 (9)	2.1 (7)	1.9 (6)	1.8 (6)	0.7 (2)	4.0 (13)	3.8 (13)	3.7 (12)	3.2 (11)	30
$PM_{2.5}$	Annual	0.3	0.2	0.2	0.1	0.1	0.4	0.4	0.4	0.3	- [c]
	24-hour	2.2	1.3 (BH)	1.2 (BH)	1.0	0.5	3.4	3.2	3.1	2.7	-
CO	8-hour	11	14	11	8	4	25	22	19	16	-
	1-hour	43 (JC)	21	17	13	6	46 (JC)	33	45 (JC)	44 (JC)	-

[a] Values in parentheses are the predicted maximum concentration increases as percent of maximum allowable PSD increments for Class II area.

[b] Abbreviations in parentheses indicate the locations where the potential maximum concentration increases were predicted to occur, JC = Jewel Cave National Monument; and BH = Bighorn Canyon National Recreational Area. All other concentration increases for which no locations are indicated were predicted to occur at Devil's Tower National Monument

[c] A hyphen indicates no standard exists.

The estimated potential maximum far-field total concentrations (concentration increases due to cumulative source emissions plus baseline concentrations) of criteria pollutants are compared with applicable ambient air quality standards (WAAQS and NAAQS) in Table 7-7. The estimated potential maximum total concentrations are less than the applicable WAAQS or NAAQS under all alternatives, representing percentages equal to or less than about 31, 8, 46, 80, and 24% of WAAQS for NO_2, SO_2, PM_{10}, $PM_{2.5}$ and CO, respectively.

7.2.2 Visibility

7.2.2.1 Screening Analysis

The potential far-field visibility impacts due to the emissions from each category of emission sources under each of the Alternatives evaluated, estimated by the screening procedures at each of the Class I and II sensitive receptors (Table 4-5), are presented in Appendix F for the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources. Tables 7-8 and 7-9 summarize the potential annual number of days with visibility degradation exceeding 0.5 *dv* and 1.0 *dv*, respectively, estimated for the current study by the screening procedures at the visibility-sensitive receptors listed in Table 4-5. Estimates of these potential visibility impacts were made for the cases of emissions from the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources under various alternatives.

The estimated potential annual number of days with visibility degradation exceeding 0.5 *dv* due to emissions from the PRBO&G Project sources estimated by the WDEQ screening procedure ranges from less than 1 day at Washakie Wilderness Area (WA), North Absaroka WA, and Fitzpatrick WA under Alternative 3 to 32 days at Wind Cave National Park (NP) under Alternative 1. The annual number of days exceeding 1.0 *dv* due to emissions from the PRBO&G Project sources ranges from less than 1 at all of all six sensitive receptors under one or more Alternatives to 8 days at the Wind Cave NP under Alternative 1.

The estimated potential annual number of days with visibility degradation exceeding 0.5 *dv* and 1.0 *dv* due to emissions from all categories of sources estimated by the FLAG screening procedure is substantially larger than the number estimated by the WDEQ screening procedure. The estimated potential annual number of days with visibility degradation exceeding 0.5 *dv* due to emissions from the PRBO&G Project sources estimated by the FLAG screening procedure ranges from less than 1 day at Fitzpatrick WA under Alternative 3 to 105 days at Devil's Tower National Monument (NM) under Alternative 1. The number exceeding 1.0 *dv* due to emissions from the PRBO&G Project sources ranges from less than 1 day at all of visibility-sensitive receptors evaluated under one or more Alternatives to 45 days at Devil's Tower NM under Alternative 1.

Among the four Alternatives, potential visibility impacts due to PRBO&G Project emissions are highest under Alternative 1 (Proposed Action). According to the estimates made by the WDEQ screening procedure, potential maximum visibility impacts at the PSD Class I sensitive receptors occur at Wind Cave NP, the PSD Class I area closest to the PRBO&G Project Area among all of the PSD Class I areas evaluated. According to the estimates made by the FLAG screening procedure, potential maximum visibility impacts at the Class I and II sensitive receptors occur at Devil's Tower NM, the receptor closest to the PRBO&G Project Area downwind of the

Table 7-7 Estimated Potential Maximum Far-Field Air Quality Concentrations Due to Emissions from PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources under Various Alternatives

Criteria Pollutant	Averaging Time	Maximum Concentration ($\mu g/m^3$)									WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
		Baseline	Increase due to Cumulative Sources				Total Concentration					
			Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3		
NO_2	Annual	16.5	1.4	1.4	1.3	1.0	18 (18) [a]	18 (18)	18 (18)	18 (18)	100	100
SO_2	Annual	3	0.2	0.2	0.2	0.2	3 (5)	3 (5)	3 (5)	3 (5)	60	80
	24-hour	8	1.5	1.5	1.5	1.5	10 (4)	10 (4)	10 (4)	9 (4)	260	365
	3-hour	8	4.6	4.6	4.6	4.6	13 (1)	13 (1)	13 (1)	13 (1)	1,300	1,300
PM_{10}	Annual	17 [33] [b]	0.6	0.6	0.6	0.5	18 (35)	18 (35)	18 (35)	17 (35)	50	50
	24-hour	42 [105]	4.9	4.6	4.4	3.5	47 (31)	47 (31)	46 (31)	46 (30)	150	150
$PM_{2.5}$	Annual	7.6 [9.5]	0.4	0.4	0.4	0.3	8 (53)	8 (53)	8 (53)	8 (53)	15	15
	24-hour	19 [33]	3.6	3.4	3.2	2.7	23 (35)	22 (34)	22 (34)	22 (33)	65	65
CO	8-hour	1,500	27	23	19	17	1,500 (15)	1,500 (15)	1,500 (15)	1,500 (15)	10,000	10,000
	1-hour	3,500	54	47	47	44	3,600 (9)	3,500 (9)	3,500 (9)	3,500 (9)	40,000	40,000

[a] Values in parentheses are the predicted maximum total concentrations as percent of Wyoming State Ambient Air Quality Standards.
[b] Values in brackets are the baseline concentrations at Sheridan, Wyoming.

Table 7-8 Estimated Potential Visibility Impairment ($\Delta dv > 0.5$) Due to Emissions from PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources Predicted by Screening Procedures under Various Alternatives

	Visibility-Sensitive Receptor				Number of Days with $\Delta dv > 0.5$								
			Location [a]		Non-PRBO&G Sources	PRBO&G Sources				Cumulative Sources			
Screening Procedure	Name	PSD Class	Distance (km)	Direc-tion	All Alt.	Alt. 1	Alt. 2a	Alt. 2b	Alt.3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3
WDEQ	Wind Cave NP	I	213	ESE	92	32	23	17	5	115	112	111	99
	Washakie WA	I	278	W	2	2	2	2	0	5	5	5	3
	Badlands NP	I	280	ESE	62	22	17	11	3	92	88	84	76
	N. Absaroka WA	I	293	W	2	1	1	1	0	2	2	2	2
	Fitzpatrick WA	I	299	WSW	1	1	1	1	0	4	4	3	2
	Bridger WA	I	310	WSW	9	7	6	6	1	11	11	11	11
FLAG	Cloud Peak WA	II	93	W	38	32	30	29	16	52	50	47	47
	Devil's Tower NM	II	104	ENE	161	105	96	81	23	206	205	205	188
	N. Cheyenne IR	I	139	NNW	77	49	40	35	17	108	107	105	105
	Jewel Cave NM	II	178	ESE	146	52	44	37	12	177	175	171	158
	Bighorn Canyon NRA	II	185	WNW	16	14	13	13	7	24	23	23	20
	Black Elk WA	II	199	ESE	136	42	37	31	7	166	166	162	146
	Mt. Rushmore NM	II	202	ESE	127	39	33	27	6	154	151	147	138
	Wind Cave NP	I	213	ESE	124	44	40	32	8	153	152	146	136
	Fort Laramie NHS	II	252	SSE	64	34	27	18	4	87	87	87	71
	Soldier Creek WA	II	260	SE	102	45	40	30	7	136	134	132	118
	Agate Fossil Beds NM	II	267	SE	91	41	35	26	9	115	111	110	102
	Washakie WA	I	278	W	3	2	2	2	2	6	6	5	4
	Badlands NP	I	280	ESE	98	38	32	28	9	134	129	124	112
	N. Absaroka WA	I	293	W	2	1	1	1	1	3	3	3	2
	Fitzpatrick WA	I	299	WSW	2	1	1	1	0	4	3	3	2
	Bridger WA	I	310	WSW	10	7	7	6	1	11	11	11	11

[a] Distance and direction are from the center point of the Project Area to the center point of the receptor area.

Table 7-9 Estimated Potential Visibility Impairment (Δdv > 1.0) Due to Emissions from PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources Predicted by Screening Procedure under Various Alternatives

	Visibility-Sensitive Receptor				Number of Days with Δdv > 1.0								
			Location [a]		Non-PRBO&G Sources	PRBO&G Sources				Cumulative Sources			
Screening Procedure	Name	PSD Class	Distance (km)	Direc-tion	All Alt.	Alt. 1	Alt. 2a	Alt. 2b	Alt.3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3
WDEQ	Wind Cave NP	I	213	ESE	41	8	6	3	0	63	63	60	52
	Washakie WA	I	278	W	2	2	2	0	0	2	2	2	2
	Badlands NP	I	280	ESE	26	7	4	2	0	39	37	37	31
	N. Absaroka WA	I	293	W	1	1	1	0	0	1	1	1	1
	Fitzpatrick WA	I	299	WSW	1	0	0	0	0	1	1	1	1
	Bridger WA	I	310	WSW	3	1	1	1	0	9	7	7	5
FLAG	Cloud Peak WA	II	93	W	18	17	13	11	3	39	35	34	26
	Devil's Tower NM	II	104	ENE	97	45	37	30	2	139	130	127	117
	N. Cheyenne IR	I	139	NNW	27	21	16	13	6	54	49	47	45
	Jewel Cave NM	II	178	ESE	81	17	16	11	1	98	97	96	90
	Bighorn Canyon NRA	II	185	WNW	8	7	7	6	1	15	15	15	14
	Black Elk WA	II	199	ESE	74	12	9	7	1	97	96	94	83
	Mt. Rushmore NM	II	202	ESE	61	12	8	6	1	87	85	81	73
	Wind Cave NP	I	213	ESE	68	18	14	8	0	85	83	82	73
	Fort Laramie NHS	II	252	SSE	27	10	7	3	0	47	46	46	41
	Soldier Creek WA	II	260	SE	44	15	11	7	0	72	70	68	58
	Agate Fossil Beds NM	II	267	SE	40	16	10	8	1	66	65	60	49
	Washakie WA	I	278	W	2	2	2	2	0	2	2	2	2
	Badlands NP	I	280	ESE	42	13	9	9	2	69	67	65	53
	N. Absaroka WA	I	293	W	1	1	1	1	0	2	2	2	1
	Fitzpatrick WA	I	299	WSW	1	0	0	0	0	2	1	1	1
	Bridger WA	I	310	WSW	3	1	1	1	0	9	8	8	5

[a] Distance and direction are from the center point of the Project Area to the center point of the receptor area.

prevailing winds among all visibility-sensitive receptors evaluated. In general, estimated potential visibility impacts decrease as the distance between the Project Area and the receptor area increases and as the direction from the Project Area to the receptor area changes from downwind to upwind of the prevailing winds. The potential visibility impacts due to PRBO&G Project emissions estimated by the screening procedures are lower than those due to non-PRBO&G Project source emissions at all visibility-sensitive receptors under all alternatives evaluated.

The estimated potential annual number of days with visibility degradation exceeding 0.5 *dv* due to emissions from cumulative sources estimated by the WDEQ screening procedure ranges from about 2 days at North Absaroka WA and Fitzpatrick WA under Alternative 3 to 115 days at Wind Cave NP under Alternative 1. The estimated potential annual number of days with visibility degradation exceeding 1.0 *dv* due to emissions from cumulative sources ranges from about 1 day at North Absaroka WA and Fitzpatrick WA under all alternatives evaluated to 63 days at Wind Cave NP under Alternatives 1 and 2a.

The estimated potential annual number of days with visibility degradation exceeding 0.5 *dv* due to emissions from cumulative sources estimated by the FLAG screening procedure ranges from about 2 days at North Absaroka WA and Fitzpatrick WA under Alternative 3 to 206 days at Devil's Tower NM under Alternative 1. The estimated potential annual number of days with visibility degradation exceeding 1.0 *dv* due to emissions from cumulative sources ranges from about 1 day at North Absaroka WA and Fitzpatrick WA under one or more Alternatives to 139 days at Devil's Tower NM under Alternative 1.

7.2.2.2 Refined Analysis

The potential far-field visibility impacts due to the emissions from each category of emission sources under each of the Alternatives evaluated, estimated by the refined procedures at each of the Class I and II sensitive receptors (Table 4-5), are presented in Appendix G for the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources. Tables 7-10 summarizes the potential annual number of days with visibility degradation exceeding 1.0 *dv*, estimated for the current study by the refined procedure described in Appendix D at the visibility-sensitive receptors listed in Table 4-5. The potential daily visibility degradation was calculated on the basis of direct total optical monitoring (transmissometer) data collected at Badlands WA during a 12-year period (1988-1999) and at Bridger WA during an 11-year period (1989 - 1999). The Badlands data were also used for Agate Fossil Beds NM, Black Elk WA, Devils Tower NM, Fort Laramie National Historic Site (NHS), Jewel Cave NM, Mount Rushmore National Memorial, Soldier Creek WA, and Wind Cave NP, and the Bridger data were also used for Bighorn Canyon National Recreational Area (NRA), Cloud Peak WA, Fitzpatrick WA, North Absaroka WA, Northern Cheyenne Indian Reservation (IR), and Washakie WA. The potential number of days with visibility degradation exceeding 1.0 *dv* was calculated for each year, and an annual average number of days with such visibility degradation was computed. Estimates of these potential visibility impacts were made for the cases of emissions from the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources under various alternatives.

Table 7-10 Estimated Potential Visibility Impairment (Δdv > 1.0) Due to Emissions from Various Categories of Sources Predicted by Refined Procedures under Various Alternatives

Visibility-Sensitive Receptor				Number of Days with Δdv > 1.0 [b]								
		Location [a]		Non-PRBO&G Sources	PRBO&G Sources				Cumulative Sources			
Name	PSD Class	Distance (km)	Direc-tion	All Alt.	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3
Cloud Peak WA	II	93	W	2	2	1	< 1	0	7	6	6	4
Devil's Tower NM	II	104	ENE	4	1	< 1	< 1	0	12	10	10	7
N. Cheyenne IR	I	139	NNW	3	2	1	1	0	10	10	9	6
Jewel Cave NM	II	178	ESE	2	< 1	< 1	0	0	5	5	4	3
Bighorn Canyon NRA	II	185	WNW	1	1	1	1	0	4	4	4	3
Black Elk WA	II	199	ESE	1	< 1	0	0	0	4	3	3	2
Mt. Rushmore NM	II	202	ESE	1	< 1	0	0	0	3	3	3	2
Wind Cave NP	I	213	ESE	1	< 1	0	0	0	4	3	3	2
Fort Laramie NHS	II	252	SSE	<1	0	0	0	0	1	1	1	1
Soldier Creek WA	II	260	SE	<1	0	0	0	0	2	2	2	1
Agate Fossil Beds NM	II	267	SE	<1	< 1	0	0	0	3	3	2	1
Washakie WA	I	278	W	0.0	0	0	0	0	1	1	1	<1
Badlands NP	I	280	ESE	1	0	0	0	0	3	3	3	2
N. Absaroka WA	I	293	W	0.0	0	0	0	0	1	1	<1	<1
Fitzpatrick WA	I	299	WSW	0.0	0	0	0	0	0	0	0	0
Bridger WA	I	310	WSW	<1	0	0	0	0	<1	<1	<1	<1

[a] Distance and direction are from the center point of the PRBO&G Project Area to the center point of the receptor area.
[b] Number of days is rounded-up or rounded-down figure. < 1 means a predicted number between 0.1 and 0.9; and 0 means a predicted number less than 0.1.

The estimated potential annual number of days with visibility degradation exceeding 1.0 *dv* due to emissions from the PRBO&G Project sources estimated by the refined procedure ranges from less than 1 day at all visibility-sensitive receptors evaluated under one or more alternatives to about 2 days at the Northern Cheyenne IR and Cloud Peak WA under Alternative 1.

Visibility degradation trends indicated in the result of the visibility impact analysis conducted by using the refined procedure are similar to those of the analysis conducted by using the screening procedures described in Section 7.2.2.1 with respect to the following parameters: (a) relative significance of the PRBO&G Project sources and non-PRBO&G Project sources; (b) effect of the distance between the Project Area and receptor area; and (c) direction from the Project Area to the receptor area relative to the prevailing wind direction.

The estimated potential annual number of days with visibility degradation exceeding 1.0 *dv* due to emissions from cumulative sources estimated by the refined procedure ranges from less than 1 day at Washakie WA, North Absaroka WA, and Fitzpatrick WA under one or more alternatives to 12 days at Devil's Tower NM under Alternative 1.

7.2.3 Acid Deposition

The potential far-field acid deposition impacts due to the emissions from each category of emission sources under each of the Alternatives evaluated, estimated at each of the sensitive lakes (Table 4-8), are presented in Appendix H for the PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources. Table 7-11 presents the potential changes in ANC at the sensitive lakes listed in Table 4-8 estimated for emissions from PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources under various alternatives. As shown in the table, the estimated potential changes in ANC due to emissions from PRBO&G Project sources, non-PRBO&G Project sources, and cumulative sources under all alternatives evaluated are less than 10%, the LAC threshold for lakes with background ANC values greater than 25 µeq/L (see Table 4-8 for the 10% most sensitive ANC values of the sensitive lakes evaluated). In general, potential acid deposition impacts decrease as the distance between the Project Area and sensitive lake increases.

The estimated potential changes in ANC due to emissions from the PRBO&G Project sources range from about 0.1% at Black Joe Lake, Deep Lake, and Hobbs Lake in Bridger WA and Ross Lake in Fitzpatrick WA under one or more alternatives to about 3.1% at Florence Lake in Cloud Peak WA under Alternative 1. ANC changes due to emissions from non-PRBO&G Project sources are higher than those due to emissions from PRBO&G Project sources under all alternatives, ranging from about 0.2% at Hobbs Lake in Bridger WA and Ross Lake in Fitzpatrick WA to about 4.7% at Florence Lake in Cloud Peak WA. ANC changes due to emissions from cumulative sources range from about 0.3% at Hobbs Lake in Bridger WA and Ross Lake in the Fitzpatrick WA to about 4.7% at Florence Lake in Cloud Peak WA.

Table 7-11 Estimated Potential Changes in ANC at Sensitive Lakes Due to Emissions from the PRBO&G Project Sources, Non-PRBO&G Project Sources, and Cumulative Sources under Various Alternatives

Sensitive Lake				Potential ANC Change (%)								
		Location [a]		Non-PRBO&G Sources	PRBO&G Sources				Cumulative Sources			
Name	Wilderness Area Where Lake is Located	Distance (km)	Direction	All Alt.	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3	Alt. 1	Alt. 2a	Alt. 2b	Alt. 3
Florence	Cloud Peak	91	W	4.7	3.1	2.8	2.5	1.4	7.8	7.5	7.2	6.1
Emerald	Cloud Peak	101	W	2.5	1.6	1.5	1.3	0.7	4.1	3.9	3.8	3.2
Lower Saddlebag	Popo Agie	295	SW	0.9	0.4	0.4	0.3	0.2	1.4	1.3	1.3	1.1
Black Joe	Bridger	298	WSW	0.5	0.3	0.2	0.2	0.1	0.8	0.8	0.7	0.6
Deep	Bridger	300	WSW	0.6	0.3	0.3	0.2	0.1	0.9	0.9	0.8	0.7
Ross	Fitzpatrick	300	WSW	0.2	0.2	0.1	0.1	0.1	0.4	0.4	0.4	0.3
Hobbs	Bridger	316	WSW	0.2	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3

[a] Direction and distance are from the center of the PRBO&G Project area to the center of each sensitive lake.

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Appendix A:

CBM Project Emission Inventory

A.1 Construction Activities

A.2 Operational Activities

A.3 Maintenance Activities

A.4 Reclamation Activities

APPENDIX A: CBM Project Emission Inventory

A.1 Construction Activities

A.1.1 Heavy Equipment

A.1.1.1 Fugitive Dust Emissions

Emission Factors for Construction Activities:

		Source
E =	1.2 tons of TSP/acre/month	EPA, *AP-42* , Volume I, Section 13.2.3 Heavy Construction Operations (1/95)
PM_{10} =	26 % of TSP	Muleski (2001)
$PM_{2.5}$ =	15 % of PM_{10}	Muleski (2001)
CE = control efficiency for watering	50 %	EPA, *Control of Open Fugitive Dust Sources* , Section 5.3.1 Watering of Unpaved Surfaces (1988)

Emissions Estimation for Construction Activities:

Area Disturbed for CBM Wells	Emission Estimation Basis	Average Value				Total # of Well Pads or Stations [b]	Total Area (acre)	Emissions (lb/well pad, lb/stn, or lb/project)			Emissions (ton/project)		
		Length [a] (mi)	Width [a] (ft)	Area (acre)	Av. # of Days to Complete			TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Improved Road	per Well Pad	0.35	40	1.69	1	25,997	43,879	68	18	3	878	228	34
Two-track Road	per Well Pad	0.55	10	0.67	1	25,997	17,330	27	7	1	347	90	14
Well Pad	per Well Pad			0.48	0.5	25,997	12,548	10	3	0	125	33	5
Pod (15 pads/pod)	per Pod			0.48	3	1,733	836	58	15	2	50	13	2
Poly Pipeline, < 3"	per Well Pad	0.73	10 [c]	0.89	1 [d]	25,997	23,050	35	9	1	461	120	18
Poly Pipeline, 12"	per Well Pad	0.27	20 [c]	0.67	1 [d]	25,997	17,331	27	7	1	347	90	14
Steel Pipeline, 12"	per Recip Station	9.83	30 [c]	36	1 [d]	61	2,180	1,430	372	56	44	11	2
Intrastate Pipeline [e]	per Project	150 [f]	50		1 [d]		909	36,364	9,455	1,418	18	5	1
Electric Line	per Well Pad	0.27	10	0.33	1 [d]	25,997	8,665	13	3	1	173	45	7
Booster Compressor Station	per Booster Station			4 [g]	2	184	736	320	83	12	29	8	1
Recip. Compressor Station	per Recip Station			6 [g]	2	61	366	480	125	19	15	4	1
						Total	**127,830**				**2,487**	**647**	**97**

[a] Beels (2000).
[b] Beels (2001), Cameron (2001), and Keanini (2001c).
[c] Martinez (2001a).
[d] Duration of disturbance (clearing, digging, layout, and covering) for a given segment of pipeline or electric line construction is assumed to be one day.
[e] To be installed in 2004.
[f] Total miles.
[g] Martinez (2001b).

A.1.1.2 Exhaust Emissions

Emission Factors for Construction Equipment:

Equipment	Emission Factors (g/hp-hr)					Equipment Category in AP-42 [a]
	NO_x	PM_{10}	SO_2	CO	VOCs	
Backhoe	8.81	0.81	0.86	2.71	0.97	Wheeled Loader
Dozer	7.81	0.69	0.85	2.15	0.75	Track-Type Tractor
Blade	7.14	0.63	0.87	1.54	0.36	Motor Grader
Trencher	11.01	0.90	0.93	4.60	1.01	Miscellaneous
Trackhoe	9.30	0.66	0.85	2.26	1.11	Track-Type Loader

[a] Emission factors for the listed equipment category were assumed for equipment used in PRBO&G project construction.

Source: EPA, *AP-42*, Volume II, Section II-7 Heavy-Duty Construction Equipment (9/85).

Emissions Estimation for Construction Equipment:

Construction Site	Equipment Type	Capacity (hp)	# of Units	Av. Load Factor (%)	# of Oper. Hrs per Day	# of Oper. Days per Well Pad or per Station	# of Oper. Hrs per Well Pad or per Station	# of Well Pads or Stations	Emissions (lb/well pad, lb/station, or lb/project)					Emissions (ton/equipment type)					Emissions (ton/construction site)				
									NO_x	PM_{10} [a]	SO_2	CO	VOC	NO_x	PM_{10} [a]	SO_2	CO	VOC	NO_x	PM_{10} [a]	SO_2	CO	VOC
Improved & Two-Track Road	Blade	100	1	80	10	0.2	2	25,997	3	0.2	0.3	0.5	0.1	33	3	4	7	2	48	4	5	12	3
	Backhoe	80	1	75	10	0.1	1	25,997	1.2	0.1	0.1	0.4	0.1	15	1	1	5	2					
Well Pad	Backhoe	80	1	75	10	0.5	5	25,997	6	0.5	0.6	2	0.6	76	7	7	23	8	76	7	7	23	8
Pod (15 pads/pod)	Backhoe	80	1	75	10	0.1	1	1,733	1.2	0.1	0.1	0.4	0.1	1	0.1	0.1	0.3	0.1	1	0.1	0.1	0.3	0.1
Poly Pipeline, < 3"	Blade	100	1	80	10	0.25	2.5	25,997	3	0.3	0.4	0.7	0.2	41	4	5	9	2	520	43	46	205	47
	Trencher	175	1	80	10	1	10	25,997	34	3	3	14	3	442	36	37	185	41					
	Backhoe	80	1	75	10	0.25	2.5	25,997	3	0.3	0.3	0.9	0.3	38	3	4	12	4					
Poly Pipeline, 12"	Blade	100	1	80	10	0.2	2	25,997	3	0.2	0.3	0.5	0.1	33	3	4	7	2	136	11	13	48	12
	Trencher	175	1	80	10	0.2	2	25,997	7	0.6	0.6	3	0.6	88	7	7	37	8					
	Trackhoe	75	1	75	10	0.1	1	25,997	1.2	0.1	0.1	0.3	0.1	15	1	1	4	2					
Steel Pipeline, bstr to recip [b]	Blade	100	1	80	10	5	50	61	63	6	8	14	3	2	0.2	0.2	0.4	0.1	11	0.8	1.0	3	1.0
	Trencher	175	1	80	10	5	50	61	170	14	14	71	16	5	0.4	0.4	2	0.5					
	Trackhoe	75	1	75	10	10	100	61	115	8	11	28	14	4	0.2	0.3	0.9	0.4					
Intrastate Pipeline, 36" X 150 miles	Blade	100	1	80	10	60	600		756	67	92	163	38	0.4	0.0	0.0	0.1	0.0	2	0.2	0.2	0.6	0.2
	Trencher	175	1	80	10	60	600		2,039	167	172	852	187	1.0	0.1	0.1	0.4	0.1					
	Trackhoe	75	1	75	10	90	900		1,038	74	95	252	124	0.5	0.0	0.0	0.1	0.1					
Booster Compressor Station	Dozer	350	1	80	8	2	16	184	77	7	8	21	7	7	0.6	0.8	2	0.7	13	1.1	1	4	1
	Backhoe	80	2	80	8	3	24	184	60	5	6	18	7	5	0.5	0.5	2	0.6					
Recip Compressor Station	Dozer	350	1	80	8	2	16	61	77	7	8	21	7	2.4	0.2	0.3	0.6	0.2	4	0.4	0.4	1.2	0.4
	Backhoe	80	2	80	8	3	24	61	60	5	6	18	7	1.8	0.2	0.2	0.6	0.2					
									Subtotal					**810**	**68**	**75**	**297**	**73**	**810**	**68**	**75**	**297**	**73**

[a] Emisison factor for $PM_{2.5}$ was assumed to be the same as that for PM_{10}.

[b] Per recip compressor station.

Emission Factors for Industrial Engines:

Fuel Type	Emission Factors (lb/hp-hr)				
	NO_x	PM_{10}	SO_x	CO	VOC
Diesel	3.10E-02	2.20E-03	2.05E-03	6.68E-03	2.51E-03

Source: EPA, *AP-42*, Volume I, Section 3.3 Gasoline and Diesel Industrial Engines (10/96).

Emissions Estimation for Industrial Engines:

Construction Site Activity	Equipment Type	Capacity (hp)	# of Units	Av. Load Factor (%)	# of Operating Hours per Day	# of Operating Days per Well	# of Operating Hours per Well	# of Wells	Emissions (lb/well)					Emissions (ton/equipment type)					Emissions (ton/project activity)				
									NO_x	PM_{10} [a]	SO_2	CO	VOC	NO_x	PM_{10} [a]	SO_x	CO	VOC	NO_x	PM_{10} [a]	SO_x	CO	VOC
Rig-up, Drilling, and Rig-down	Main Deck	400	1	60	11	3	33	39,367	246	17	16	53	20	4,833	343	320	1,041	392	7,029	499	465	1,515	570
	Auxiliary Pump	200	1	90	10	2	20	39,367	112	8	7	24	9	2,197	156	145	473	178					
Well Completion & Testing	Main Deck	400	1	60	10	1	10	39,367	74	5	5	16	6	1,464	104	97	316	119	29,493	2,093	1,950	6,355	2,392
	Auxiliary Pump	125	1	90	6	1	6	39,367	21	1	1	5	2	412	29	27	89	33					
	Equipment Type	**Capacity [b] (kw)**	**Av. # of Wells Served**	**Av. Load Factor [b] (%)**	**# of Operating Hours per Day**	**Av. # of Operating Days**	**# of Opearating Hours per Well**	**# of Wells**															
	Field Generators for Pumps & Lighting	125	8	75	24	120	360	39,367	1,403	100	93	302	114	27,616	1,960	1,826	5,951	2,240					
									Subtotal					**36,522**	**2,592**	**2,415**	**7,870**	**2,962**	**36,522**	**2,592**	**2,415**	**7,870**	**2,962**
									Total					**37,333**	**2,660**	**2,490**	**8,167**	**3,035**	**37,333**	**2,660**	**2,490**	**8,167**	**3,035**

[a] Emisison factor for $PM_{2.5}$ was assumed to be the same as that for PM_{10}.

[b] Gomendi (2001).

A.1.2 Commuting Vehicles

A.1.2.1 Road Dust Emissions

Emission Factors for Road Traffic:

$$E\ (lb/VMT) = \frac{k\ (s/12)^{a}\ (W/3)^{b}}{(M/0.2)^{c}}$$

Parameter	PM_{10}	$PM_{2.5}$
k	2.6	0.38
a	0.8	0.8
b	0.4	0.4
c	0.3	0.3

Source: EPA, *AP-42*, Volume I, Section 13.2.2 Unpaved Roads (9/98)

Function/Variable Description	Assumed Value	Source
E = size-specific emission factor (lb/VMT)		
s = surface material silt content (%)	5.1	EPA, *AP-42*, Volume I, Section 13.2.2 Unpaved Roads (9/98)
W = mean vehicle weight (tons)	Listed in the table below	
M = surface material moisture content (%)	0.2	Default value in EPA, *AP-42*, Volume I, Section 13.2.2 Unpaved Roads (9/98)
CE = control efficiency for watering (%)	50	EPA, *Control of Open Fugitive Dust Sources*, Section 5.3.1 Watering of Unpaved Surfaces (1988)

Emissions Estimation for Road Traffic:

Construction Site Destination	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi)	# of Round Trips per Well Pad or per Station	Miles Traveled per Well Pad or per Station	Total # of Well Pads or Stations	PM_{10}				$PM_{2.5}$			
							Controlled Em. Factor (lb/VMT)	Emissions (lb/well pad, lb/stn, or lb/proj.)	Emissions (ton/veh. type)	Emissions (ton/const. site)	Controlled Em. Factor (lb/VMT)	Emissions (lb/well pad, lb/stn, or lb/proj.)	Emissions (ton/veh. type)	Emissions (ton/const. site)
Improved & two-track road	Semi Trucks	60,000	6	2.6	16	25,997	1.65	26	334	334	0.24	4	49	49
Well Pad	Haul Trucks	45,000	6	2	12	25,997	1.47	18	229	338	0.21	3	33	49
	Pickup Trucks	7,000	6	2	12	25,997	0.70	8	109		0.10	1	16	
Pod (15 pads/pod)	Semi Trucks	60,000	6	1	6	1,733	1.65	10	9	27	0.24	1	1	4
	Haul Trucks	45,000	6	1	6	1,733	1.47	9	8		0.21	1	1	
	Pickup Trucks	7,000	6	3	18	1,733	0.70	13	11		0.10	2	2	
Poly Pipeline, < 3"	Haul Trucks	45,000	6	4	24	25,997	1.47	35	458	675	0.21	5	67	99
	Pickup Trucks	7,000	6	4	24	25,997	0.70	17	218		0.10	2	32	
Poly Pipeline, 12"	Haul Trucks	45,000	6	0.3	2	25,997	1.47	3	34	72	0.21	0	5	11
	Pickup Trucks	7,000	6	0.7	4	25,997	0.70	3	38		0.10	0	6	
Steel Pipeline, bstr to recip [a]	Semi Trucks	60,000	6	4	24	61	1.65	40	1	32	0.24	6	0	5
	Haul Trucks	45,000	6	40	240	61	1.47	352	11		0.21	51	2	
	Pickup Trucks	7,000	6	160	960	61	0.70	669	20		0.10	98	3	
Intrastate Pipeline, 36" diam. X 150 miles [b]	Semi Trucks	60,000	35 [c]	130 [d]	4,550 [e]		1.65	7,493	4	9	0.24	1,095	1	1
	Haul Trucks	45,000	35 [c]	130 [d]	4,550 [e]		1.47	6,679	3		0.21	976	0	
	Pickup Trucks	7,000	50 [c]	130 [d]	6,500 [e]		0.70	4,533	2		0.10	662	0	
Electric Line	Haul Trucks	45,000	6	1	6	25,997	1.47	9	114	223	0.21	1	17	33
	Pickup Trucks	7,000	6	2	12	25,997	0.70	8	109		0.10	1	16	
Booster Compressor Station	Semi Trucks	60,000	10	15	150	184	1.65	247	23	211	0.24	36	3	31
	Haul Trucks	45,000	10	48	480	184	1.47	705	65		0.21	103	9	
	Pickup Trucks	7,000	10	192	1,920	184	0.70	1,339	123		0.10	196	18	
Recip. Compressor Station	Semi Trucks	60,000	10	18.5	185	61	1.65	305	9	72	0.24	45	1	10
	Haul Trucks	45,000	10	48	480	61	1.47	705	21		0.21	103	3	
	Pickup Trucks	7,000	10	192	1,920	61	0.70	1,339	41		0.10	196	6	
								Subtotal	**1,994**	**1,994**			**291**	**291**

[a] Per reciprocating compressor station. [b] To be installed in 2004. [c] Per day. [d] Number of days. [e] Total miles.

A.1.2.1 Road Dust Emissions (Continued)

Construction Site Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi)	# of Round Trips per Well or per Station	Miles Traveled per Well or per Station	Total # of Wells or Stations	PM_{10} Controlled Em. Factor (lb/VMT)	PM_{10} Emissions (lb/well)	PM_{10} Emissions (ton/veh. type)	PM_{10} Emissions (ton/proj. activity)	$PM_{2.5}$ Controlled Em. Factor (lb/VMT)	$PM_{2.5}$ Emissions (lb/well)	$PM_{2.5}$ Emissions (ton/veh. type)	$PM_{2.5}$ Emissions (ton/proj. activity)
Rig-up, Drilling, and Rig-down	Semi Rig Transport, Drill Rig	80,000	6	1	6	39,367	1.85	11	218	3,429	0.27	2	32	501
	Fuel Haul Truck	45,000	6	2	12	39,367	1.47	18	347		0.21	3	51	
	Mud Haul Truck, Water Hauling	60,000	6	7	42	39,367	1.65	69	1,361		0.24	10	199	
	Rig Crew	7,000	6	3	18	39,367	0.70	13	247		0.10	2	36	
	Co. Supervisor	7,000	6	8	48	39,367	0.70	33	659		0.10	5	96	
	Tool Pusher	7,000	6	6	36	39,367	0.70	25	494		0.10	4	72	
	Logger, Engr Truck	12,000	6	1	6	39,367	0.87	5	102		0.13	1	15	
Well Completion & Testing	Semi Casing	45,000	6	1	6	39,367	1.47	9	173	4,314	0.21	1	25	631
	Semi Completion, Unit Rig	80,000	6	1	6	39,367	1.85	11	218		0.27	2	32	
	Semi Fracing, Blender	20,000	6	1	6	39,367	1.06	6	125		0.16	1	18	
	Tubing Truck	45,000	6	1	6	39,367	1.47	9	173		0.21	1	25	
	Haul Cementer, Pump Truck	80,000	6	1	6	39,367	1.85	11	218		0.27	2	32	
	Haul Cementer, Cement Truck	60,000	6	1	6	39,367	1.65	10	194		0.24	1	28	
	Haul Completion, Equip Truck	20,000	6	1	6	39,367	1.06	6	125		0.16	1	18	
	Haul Perforators Logging Truck	12,000	6	1	6	39,367	0.87	5	102		0.13	1	15	
	Haul Fracing, Tank	45,000	6	2	12	39,367	1.47	18	347		0.21	3	51	
	Haul Fracing, Pump	20,000	6	2	12	39,367	1.06	13	251		0.16	2	37	
	Haul Welders	12,000	6	1	6	39,367	0.87	5	102		0.13	1	15	
	Haul Water Truck	60,000	6	9	54	39,367	1.65	89	1,750		0.24	13	256	
	Pickup Cementer, Engineer	7,000	6	1	6	39,367	0.70	4	82		0.10	1	12	
	Pickup Co. Supervisor	7,000	6	2	12	39,367	0.70	8	165		0.10	1	24	
	Pickup Miscellaneous Supplies	7,000	6	1	6	39,367	0.70	4	82		0.10	1	12	
	Pickup Roustabout Crew	12,000	6	2	12	39,367	0.87	10	204		0.13	2	30	
								Subtotal	**7,743**	**7,743**			**1,132**	**1,132**
								Total	**9,737**	**9,737**			**1,423**	**1,423**

A.1.2.2 Exhaust Emissions

Emisison Factors for Road Traffic:

Vehicle		Emission Factors (g/mi)					
Type	Class	NO_x	PM_{10} [a,b]	$PM_{2.5}$ [a,b]	SO_x [a]	CO	VOC
Light-Duty Gasoline Truck	LDGT2	1.01	0.10	0.08	0.11	11.64	0.75
Heavy-Duty Diesel Truck	HDDV	8.13	1.96	1.81	1.63	17.09	4.83

[a] Estimated using the EPA PART5 model (1995).
[b] Including tire and brake wear emissions.

Source: EPA, *AP-42*, Volume II, Appendix H-117, Table 3.1A.2 Light Duty Gasoline Powered Trucks II and
Appendix H-259, Table 7.1.2 Heavy Duty Diesel Powered Vehicles (High Altitude; Model Year 1991-1997; 50,000 mileage) (6/30/95).

Emisisons Estimation for Road Traffic:

Construction Site Destination	Vehicle		Round Trip Distance (mi)	# of Round Trips per Well Pad or per Station	Miles Traveled per Well Pad or per Station	Total # of Well Pads or Stations	Emissions																	
							(lb/well pad, lb/station, or lb/project)						(ton/vehicle type)						(ton/construction site)					
	Type	Class					NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC
Improved & Two-Track Road	Semi Trucks	HDDV	6	2.6	15.6	25,997	0.28	0.07	0.06	0.06	0.59	0.17	3.6	0.9	0.8	0.7	7.6	2.2	3.6	0.9	0.8	0.7	7.6	2.2
Well Pad	Haul Trucks	HDDV	6	2	12	25,997	0.22	0.05	0.05	0.04	0.45	0.13	2.8	0.7	0.6	0.6	5.9	1.7	3.1	0.7	0.6	0.6	9.9	1.9
	Pickup Trucks	LDGT2	6	2	12	25,997	0.03	0.00	0.00	0.00	0.31	0.02	0.3	0.0	0.0	0.0	4.0	0.3						
Pod (15 pads/pod)	Semi Trucks	HDDV	6	1	6	1,733	0.11	0.03	0.02	0.02	0.23	0.06	0.1	0.0	0.0	0.0	0.2	0.1	0.2	0.0	0.0	0.0	0.8	0.1
	Haul Trucks	HDDV	6	1	6	1,733	0.11	0.03	0.02	0.02	0.23	0.06	0.1	0.0	0.0	0.0	0.2	0.1						
	Pickup Trucks	LDGT2	6	3	18	1,733	0.04	0.00	0.00	0.00	0.46	0.03	0.0	0.0	0.0	0.0	0.4	0.0						
Poly Pipeline, < 3"	Haul Trucks	HDDV	6	4	24	25,997	0.43	0.10	0.10	0.09	0.90	0.26	5.6	1.3	1.2	1.1	11.8	3.3	6.3	1.4	1.3	1.2	19.8	3.8
	Pickup Trucks	LDGT2	6	4	24	25,997	0.05	0.01	0.00	0.01	0.62	0.04	0.7	0.1	0.1	0.1	8.0	0.5						
Poly Pipeline, 12"	Haul Trucks	HDDV	6	0.3	1.8	25,997	0.03	0.01	0.01	0.01	0.07	0.02	0.4	0.1	0.1	0.1	0.9	0.2	0.5	0.1	0.1	0.1	2.3	0.3
	Pickup Trucks	LDGT2	6	0.7	4.2	25,997	0.01	0.00	0.00	0.00	0.11	0.01	0.1	0.0	0.0	0.0	1.4	0.1						
Steel Pipeline, Recip Compressor to Pipeline [a]	Semi Trucks	HDDV	6	4	24	61	0.43	0.10	0.10	0.09	0.90	0.26	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.1	0.1
	Haul Trucks	HDDV	6	40	240	61	4.30	1.04	0.96	0.86	9.04	2.56	0.1	0.0	0.0	0.0	0.3	0.1						
	Pickup Trucks	LDGT2	6	160	960	61	2.14	0.21	0.16	0.24	24.63	1.58	0.1	0.0	0.0	0.0	0.8	0.0						
Intrastate Pipeline, 36" X 150 miles [b]	Semi Trucks	HDDV	35 [c]	130 [d]	4,550 [e]		81.55	19.67	18.13	16.34	171.43	81.55	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.3	0.1
	Haul Trucks	HDDV	35 [c]	130 [d]	4,550 [e]		81.55	19.67	18.13	16.34	171.43	81.55	0.0	0.0	0.0	0.0	0.1	0.0						
	Pickup Trucks	LDGT2	35 [c]	130 [d]	6,500 [e]		14.47	1.41	1.08	1.61	166.78	14.47	0.0	0.0	0.0	0.0	0.1	0.0						
Electric Line	Haul Trucks	HDDV	6	1	6	25,997	0.11	0.03	0.02	0.02	0.23	0.06	1.4	0.3	0.3	0.3	2.9	0.8	1.7	0.4	0.3	0.3	6.9	1.1
	Pickup Trucks	LDGT2	6	2	12	25,997	0.03	0.00	0.00	0.00	0.31	0.02	0.3	0.0	0.0	0.0	4.0	0.3						
Booster Compressor Station	Semi Trucks	HDDV	10	15	150	184	2.69	0.65	0.60	0.54	5.65	1.60	0.2	0.1	0.1	0.0	0.5	0.1	1.4	0.3	0.3	0.3	6.7	0.9
	Haul Trucks	HDDV	10	48	480	184	8.60	2.08	1.91	1.72	18.08	5.11	0.8	0.2	0.2	0.2	1.7	0.5						
	Pickup Trucks	LDGT2	10	192	1920	184	4.28	0.42	0.32	0.48	49.26	3.17	0.4	0.0	0.0	0.0	4.5	0.3						
Recip Compressor Station	Semi Trucks	HDDV	10	18.5	185	61	3.32	0.80	0.74	0.66	6.97	1.97	0.1	0.0	0.0	0.0	0.2	0.1	0.5	0.1	0.1	0.1	2.3	0.3
	Haul Trucks	HDDV	10	48	480	61	8.60	2.08	1.91	1.72	18.08	5.11	0.3	0.1	0.1	0.1	0.6	0.2						
	Pickup Trucks	LDGT2	10	192	1920	61	4.28	0.42	0.32	0.48	49.26	3.17	0.1	0.0	0.0	0.0	1.5	0.1						
												Subtotal	**18**	**4**	**4**	**3**	**58**	**11**	**18**	**4**	**4**	**3**	**58**	**11**

[a] Per reciprocating compressor station. [b] To be installed in 2004. [c] Per day. [d] Number of days. [e] Total miles.

A.1.2.2 Exhaust Emissions (Continued)

Construction Site Activity	Vehicle Type	Vehicle Class	Round Trip Distance (mi)	# of Round Trips per Well or per Station	Miles Traveled per Well or per Station	Total # of Wells or Stations	Emissions (lb/well)						Emissions (ton/vehicle type)						Emissions (ton/project activity)					
							NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOCs	NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOCs	NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOCs
Rig-up, Drilling, and Rig-down	Semi Rig Transport	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3	38.9	9.0	8.2	7.5	109.0	23.5
	Fuel Haul Truck	HDDV	6	2	12	39,367	0.22	0.05	0.05	0.04	0.45	0.13	4.2	1.0	0.9	0.8	8.9	2.5						
	Mud Haul Truck, Water	HDDV	6	7	42	39,367	0.75	0.18	0.17	0.15	1.58	0.45	14.8	3.6	3.3	3.0	31.1	8.8						
	Rig Crew	LDGT2	6	3	18	39,367	0.04	0.00	0.00	0.00	0.46	0.03	0.8	0.1	0.1	0.1	9.1	0.6						
	Co. Supervisor	LDGT2	6	8	48	39,367	0.11	0.01	0.01	0.01	1.23	0.08	2.1	0.2	0.2	0.2	24.2	1.6						
	Tool Pusher	HDDV	6	6	36	39,367	0.65	0.16	0.14	0.13	1.36	0.38	12.7	3.1	2.8	2.5	26.7	7.5						
	Logger, Engr Truck	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
Well Completion & Testing	Semi Casing Haulers	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3	54.0	12.9	11.8	10.7	123.4	32.2
	Semi Completion, Unit Rig	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Semi Fracing, Blender	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Tubing Truck	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Cementer, Pump Truck	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Cementer, Cement Truck	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Completion, Equip Truck	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Service Tools	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Perforators Logging Truck	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Fracing, Tank	HDDV	6	2	12	39,367	0.22	0.05	0.05	0.04	0.45	0.13	4.2	1.0	0.9	0.8	8.9	2.5						
	Haul Fracing, Pump	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Welders	HDDV	6	1	6	39,367	0.11	0.03	0.02	0.02	0.23	0.06	2.1	0.5	0.5	0.4	4.4	1.3						
	Haul Water Truck	HDDV	6	10	60	39,367	1.08	0.26	0.24	0.22	2.26	0.64	21.2	5.1	4.7	4.2	44.5	12.6						
	Pickup Cementer, Engineer	LDGT2	6	1	6	39,367	0.01	0.00	0.00	0.00	0.15	0.01	0.3	0.0	0.0	0.0	3.0	0.2						
	Pickup Co. Supervisor	LDGT2	6	2	12	39,367	0.03	0.00	0.00	0.00	0.31	0.02	0.5	0.1	0.0	0.1	6.1	0.4						
	Pickup Miscellaneous Supplies	LDGT2	6	1	6	39,367	0.01	0.00	0.00	0.00	0.15	0.01	0.3	0.0	0.0	0.0	3.0	0.2						
	Pickup Roustabout Crew	HDDV	6	2	12	39,367	0.22	0.05	0.05	0.04	0.45	0.13	4.2	1.0	0.9	0.8	8.9	2.5						
												Subtotal	**93**	**22**	**20**	**18**	**232**	**56**	**93**	**22**	**20**	**18**	**232**	**56**
												Total	**111**	**26**	**24**	**22**	**290**	**67**	**111**	**26**	**24**	**22**	**290**	**67**

A.2 Operational Activities

A.2.1 Compressors - Natural Gas Fired

Emission Factors for Compressors:

Compressor			Make	Model	Capacity (hp)	Emission Factors (g/hp-hr)					
						NOx [a]	PM_{10} [b,c]	SO_2 [b]	CO [a]	VOCs [a]	HCHO [a]
Booster	Rich Burn	50%	Caterpillar	G3408	400	1.00	6.6E-02	2.0E-03	2.00	1.00	0.05
	Lean Burn	50%	Waukesha	F18GL	400	1.00	6.6E-02	2.0E-03	1.50	0.50	0.20
Recip	Rich Burn	50%	Waukesha	7044GSI	1680	1.00	6.6E-02	2.0E-03	2.00	1.00	0.05
	Lean Burn	25%	Caterpillar	G3516LE	1340	1.50	3.4E-02	2.0E-03	0.50	1.00	0.07
		25%	Caterpillar	G3608	2225	0.70	3.4E-02	2.0E-03	0.30	1.00	0.07

[a] Dailey (2001) and Martinez (2001b).
[b] Source: EPA, *AP-42*, Volume I, Section 3.2 Natural Gas-Fired Reciprocating Engines, Table 3.2-2 & 3.2-3 (7/00).
Assumed a fuel consumption rate of 7,500 Btu/bhp-hr (Martinez [2001b]).
[c] Emission factor for $PM_{2.5}$ was assumed to be the same as that for PM_{10}.

Emissions Estimation for Compressors:

Compressor Station	Capacity Required [a] (hp/MMCFD)	Total Gas Production Volume [b] (MMCFD/ project)	Operating Hours per Year	Total Emissions (ton/project)				
				NOx	PM_{10}	SO_2	CO	VOCs
Booster	160	19,149	8,760	29,584	1,954	59	51,772	22,188
Recip	183	19,149	8,760	35,529	1,692	68	40,604	33,837
			Total	**65,113**	**3,646**	**127**	**92,376**	**56,025**

[a] Compressor engine capacity required to transport unit volume of CBM (Keanini [2001d]).
[b] Keanini (2001c).

A.2.2 Dehydrators

Emission Factors for Dehydrators:

Unit	NO_x	PM_{10} [a]	SO_2	CO	VOCs
lb/MMscf	100	7.6	0.6	84	5.5
lb/MMBtu [b]	9.80E-02	7.45E-03	5.88E-04	8.24E-02	5.39E-03

[a] Emission factor for $PM_{2.5}$ was assumed to be the same as that for PM_{10}.

[b] Assumed a fuel heating value of 1,020 Btu/scf.

Source: EPA, *AP-42*, Volume I, Section 1.4 Natutal Gas Combustion (7/98).

Emissions Estimation for Dehydrators:

Compressor Station	Total Gas Production Rate (MMCFD-yr)	Firing Rate [a] (Btu/hr/MMCFD)	Operating Hours per Year [b]	Total Emissions (ton/project)				
				NOx	PM_{10} [c]	SO_2	CO	VOCs
Recip	19,149	25,000	8,760	206	16	1	173	11

[a] Keanini (2001a).

[b] Assumed conservatively that a dehydrator operates year-round.

[c] Emisisons of $PM_{2.5}$ were assumed to be the same as those for PM_{10}.

A.2.3 Compressor Station Visits for Inspection and Repair

A.2.3.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section A.1.2.1.

Emissions Estimation for Road Traffic:

Activity	Compressor Station	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi/day)	# of Stations Visited per Day	# of Visits per Station per Year [a]	Miles Traveled per Station per Year	Total # of Operating Station-Yr	PM_{10}			$PM_{2.5}$		
									Em. Factor (lb/VMT)	Emissions		Em. Factor (lb/VMT)	Emissions	
										(lb/stn-yr)	(ton/proj.)		(lb/stn-yr)	(ton/proj.)
Inspection Visits for Compressor Stations	Booster	Pickup Truck	7,000	20	15	182.5	243	1,604	0.70	169.7	136	0.10	24.8	20
	Recip	Pickup Truck	7,000	20	15	365	487	529	0.70	339.4	90	0.10	49.6	13
								Total			226			33

[a] Booster and reciprocating compressor stations are visited using a 200-hp pickup truck (4 wheels) every other day and every day, respectively (Keanini [2001a]).

A.2.3.2 Exhaust Emissions

Emisison Factors for Road Traffic: See Section A.1.2.2.

Emisisons Estimation for Road Traffic:

Activity	Compressor Station	Vehicle		Round Trip Distance (mi/day)	# of Stations Visited per Day [a]	# of Visits per Station per Year [a]	Miles Traveled per Station per Year	Total # of Operating Station-Yr	Emissions											
									(lb/station-yr)						(ton/project)					
		Type	Class						NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs	NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOC
Inspection Visits for Compressor Stations	Booster	Pickup Truck	LDGT2	20	15	182.5	243	1,604	0.54	0.05	0.04	0.06	6.24	0.40	0.4	0.0	0.0	0.0	5.0	0.3
	Recip	Pickup Truck	LDGT2	20	15	365	487	529	1.08	0.11	0.08	0.12	12.49	0.80	0.3	0.0	0.0	0.0	3.3	0.2
														Total	0.7	0.1	0.1	0.1	8.3	0.5

[a] Keanini (2001a).

A.2.4 Well Workover

A.2.4.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section A.1.2.1.

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi)	# of Round Trips per Well	Miles Traveled per Well	Total # of Wells Drilled	PM_{10}			$PM_{2.5}$		
							Emission Factor (lb/VMT)	Emissions (lb/well)	Emissions (ton/proj.)	Emission Factor (lb/VMT)	Emissions (lb/well)	Emissions (ton/proj.)
Well Workover [a]	Bobtail Truck [b]	40,000 [b]	50	1	50	39,367	1.40	70	1,378	0.20	10	201

[a] Performed once in the first year of well operation for one day.
[b] A 400-hp bobtail truck operating 10 hours/day with a fuel consumption rate of 60 gpd (Gomendi [2001]).

A.2.4.2 Exhaust Emissions - On-site

Emisison Factors for Industrial Engines: See Section A.1.1.2.

Emissions Estimation for Industrial Engines:

Activity	Equipment	Capacity (hp)	Operating Hours per Day	Total # of Wells Drilled	Emissions (lb/well)					Emissions (ton/project)				
					NO_x	PM_{10} [c]	SO_x	CO	VOCs	NO_x	PM_{10} [c]	SO_x	CO	VOCs
Well Workover [a]	Truck-Mounted Unit [b]	400	10	39,367	124	9	8	27	10	2,441	173	161	526	200

[a] Performed once in the first year of well operation for one day.
[b] A 400-hp bobtail truck operating 10 hours/day with a fuel consumption rate of 60 gpd (Gomendi [2001]).
[c] Emission factor for $PM_{2.5}$ was assumed to be the same as that for PM_{10}.

A.2.4.2 Exhaust Emissions - On-road

Emisison Factors for Road Traffic: See Section A.1.2.2.

Emissions Estimation for Road Traffic:

Activity	Vehicle		Round Trip Distance (mi)	Round Trip Per Well	Miles Traveled per Well	Total # of Wells Drilled	Emissions (lb/well)						Emissions (ton/project)					
	Type	Class					NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs	NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs
Well Workover [a]	Bobtail Truck	HDDV	50	1	50	39,367	0.9	0.2	0.2	0.2	1.9	0.5	18	4	4	4	37	10

[a] Performed once in the first year of well operation for one day.

A.2.5 Well and Pipeline Visits for Inspection and Repair

A.2.5.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section A.1.2.1.

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi/day)	# of Wells Visited per Day [a]	# of Visits per Well per Year [b]	Miles Traveled per Well per Year	Total # of Operating Well-Yr	PM_{10}			$PM_{2.5}$		
								Em. Factor (lb/VMT)	Emissions (lb/well-yr)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (lb/well-yr)	Emissions (ton/proj.)
Visits for Inspection and Repair	200-hp Pickup	7,000	75	120	12	7.5	221,416	0.70	5.2	579	0.10	0.8	85

[a] Gomendi (2001).
[b] Wells are visited once per month (Gomendi [2001]).

A.2.5.2 Exhaust Emissions

Emisison Factors for Road Traffic: See Section A.1.2.2.

Emisisons Estimation for Road Traffic:

Activity	Vehicle		Round Trip Distance (mi/day)	# of Wells Visited per Day [a]	# of Visits per Well per Year [b]	Miles Traveled per Well per Year	Total # of Operating Well-Yr	Emissions											
								(lb/well-yr)						(ton/project)					
	Type	Class						NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs	NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs
Visits for Inspection and Repair	200-hp Pickup	LDGT2	75	120	12	7.5	221,416	0.017	0.002	0.001	0.002	0.192	0.012	1.8	0.2	0.1	0.2	21.3	1.4

[a] Gomendi (2001).
[b] Wells are visited once per month (Gomendi [2001]).

A.3 Maintenance Activities

A.3.1 Road Maintenance - Heavy Equipment

Given Data:

Maintenance [a]	Equipment/Vehicle			Road Length Worked On per Day (miles)	# of Operating Hours per Day
	Type	Fuel	Capacity (hp)		
Summer	Heavy Equipment [b]	Diesel	135 [c]	6	10
	Commuting Vehicle	Gasoline	225	6 [d]	1 [e]
Winter	Heavy Equipment [b]	Diesel	135 [c]	5	10
	Commuting Vehicle	Gasoline	225	6 [d]	1.5 [e]

[a] Road maintenance would be made twice in summer and once in winter every year (Keanini [2001b]).
[b] Assume a motor grader (Gomendi [2001]).
[c] Revised from 100 hp to 135 hp (Gomendi [2001]).
[d] Average round trip mileage on unpaved road.
[e] Assume one round trip per day.

Estimation of Total and Cumulative Length of Roads for the Revised Proposed Action:

	Proposed Action
# of Well Pads	25,997 [a]
Length of Improved Roads (mi)	9,050
Length of Two-Track Roads (mi)	14,298
Total Length of Roads (mi)	23,348
Cumulative Length of Roads [b] (mi-yr)	131,317

[a] Beels (2001).
[b] = (total length of roads) *(total no. of operating well-yr)/(total no. of drilled wells).

Estimation of Total Operation Days and Hours:

Season	# of Operation per Year	Cumulative Length of Roads (mi-yr)	Road Length Worked On (mi/day)	# of Operating Hours per Day	Total # of Operating Days	Total # of Operating Hours
Summer	2	131,317	6	10	43,772	437,723
Winter	1	131,317	5	10	26,263	262,634
				Total	**70,036**	**700,356**

A.3.1.1 Fugitive Dust Emissions

Emission Factors for Grader:

Pollutant	Emission Factor Equation (lb/VMT)	S [a] (mph)	Emission Factor (lb/VMT)
PM_{10}	$E = (0.6)(0.051)\ S^2$	5	0.765
$PM_{2.5}$	$E = (0.031)(0.04)\ S^{2.5}$	5	0.069

[a] Assumed a mean vehicle speed (S) of 5 mph.

Source: EPA, *AP-42*, Volume I, Section 11.9 Western Surface Coal Mining (10/98).

Emissions Estimation for Grader:

Activity	Equipment	Total # of Operating Hours [a]	Mean Vehicle Speed (mph)	Total Miles Maintained	PM_{10}		$PM_{2.5}$	
					Em. Factor (lb/VMT)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (ton/proj.)
Road Maintenance	Grader	420,214	5	2,101,069	0.765	804	0.069	73

[a] Assumed that a grader would operate for 60% of the time, considering hours for preparation and closing of the shift, lunch break, and other extra activities.

A.3.1.2 Exhaust Emissions

Emission Factors for Grader:

Equipment	Emission Factors (g/hp-hr)				
	NO_x	PM_{10} [a]	SO_2	CO	VOCs
Grader	7.14	0.63	0.87	1.54	0.36

[a] Emission factor for $PM_{2.5}$ was assumed to be the same as that for PM_{10}.

Source: EPA, *AP-42*, Volume II, Section II-7 Heavy-Duty Construction Equipment (1985).

Emissions Estimation for Grader:

Activity	Vehicle Type	Capacity (hp)	Total # of Operating Hours [a]	Emissions									
				(lb/hr)					(ton/project)				
				NO_x	PM_{10} [b]	SO_x	CO	VOCs	NO_x	PM_{10} [b]	SO_x	CO	VOCs
Road Maintenance	Grader	135	420,214	2.13	0.19	0.26	0.46	0.11	446	39	55	96	23

[a] Assumed that a grader would operate for 60% of the time, considering hours for preparation and closing of the shift, lunch break, and other extra activities.
[b] Emissions of $PM_{2.5}$ were assumed to be the same as those for PM_{10}.

A.3.2 Road Maintenance - Commuting Vehicles

A.3.2.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section A.1.2.1.

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi/day)	Total # of Operating Days	Total Miles Traveled	PM_{10}		$PM_{2.5}$	
						Em. Factor (lb/VMT)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (ton/proj.)
Road Maintenance	Pickup Truck	7,000	6	70,036	420,214	0.70	147	0.10	21

A.3.2.2 Exhaust Emissions

Emission Factors for Road Traffic: See Section A.1.2.2.

Emissions Estimation for Road Traffic:

Activity	Vehicle		Round Trip Distance (mi/day)	Total # of Operating Days	Total Miles Traveled	Emissions (ton/project)					
	Type	Class				NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs
Road Maintenance	Pickup Truck	LDGT2	6	70,036	420,214	0.47	0.05	0.03	0.05	5.39	0.35

A.3.3 Maintenance Visits to Compressor Stations

A.3.3.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section A.1.2.1.

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Compressor Station	# of Stations	Cumulative # of Station-Yr	# of Visits per Year [a]	Total # of Round Trips	Round Trip Distance (mi)	Total Miles Traveled	PM_{10}		PM2.5	
										Em. Factor (lb/VMT)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (ton/proj.)
Maintenance Visits to Compressor	Pickup Truck	7,000	Booster	184	1,604	6	9,626	20	192,513	0.70	67	0.10	10
			Recip	61	529	6	3,174	20	63,473	0.70	22	0.10	3
								Total	**255,985**		**89**		**13**

[a] Maintenance visit frequency is approximately once every 60 days.
[b] Maintenance on compressor engines is mainly for oil changes.

A.3.3.2 Exhaust Emissions

Emission Factors for Road Traffic: See Section A.1.2.2.

Emissions Estimation for Road Traffic:

Activity	Vehicle		Compressor Station	# of Stations	Cumulative # of Station-Yr	# of Visits per Year	Total # of Round Trips	Round Trip Distance (mi)	Total Miles Traveled	Emissions (ton/project)					
	Type	Class								NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs
Maintenance Visits to Compressor Stations	Pickup Truck	LDGT2	Booster	184	1,604	6	9,626	20	192,513	0.21	0.02	0.02	0.02	2.47	0.16
			Recip	61	529	6	3,174	20	63,473	0.07	0.01	0.01	0.01	0.81	0.05
								Total	**255,985**	**0.28**	**0.03**	**0.02**	**0.03**	**3.28**	**0.21**

A.4 Reclamation Activities

Given Data: Compressor stations, pipelines, and electric utilities will be abandoned intact.

Type	Equipment/Vehicle				Miles/Day Worked On or Round Trip Mileage	# Hrs/Day
	Type	Number	Fuel	Engine Capacity (hp)		
Roads	Heavy Equipment	1	Diesel	80	6	10
	Commuting Vehicle	1	Gasoline	225	6	1.5
Wells [a]	Heavy Equipment	1	Diesel	100	N/A	10
	Commuting Vehicle	1	Gasoline	225	6	2

[a] Assumed ½ day with a blade and ½ day with a tractor for reseeding per well at time of abandonment.

A.4.1 Reclamation of Roads - Heavy Equipment

Estimation of Total Lengths of Roads to be Built and to be Reclaimed for the Project Period (2002-2011):

	Proposed Action
# of Well Pads	25,997 [a]
Length of Improved Roads (mi)	9,050
Length of Two-Track Roads (mi)	14,298
Total Length of Roads (mi)	23,348
Length of Roads to be Reclaimed [b] (mi)	9,469

[a] Keanini (2001c) and Bell (2001).

[b] Average well life is 7 years, so it was assumed that the roads would be reclaimed 7 years after their construction.
Used the equation = (total length of roads) * (total no. of well pads built from 2002 to 2004) / (total no. of well pads built from 2002 to 2011).

Estimation of Total Reclamation Days and Hours:

Length of Roads to be Reclaimed (mi)	Road Length Worked on (mi/day)	# of Operating Hours per Day	Total # of Operating Days	Total # of Operating Hours
9,469	6	10	1,578	15,782

A.4.1.1 Fugitive Dust Emissions

Emission Factors for Grader: See Section A.3.1.1.

Emissions Estimation for Grader:

Activity	Equipment	Total # of Operating Hours [a]	Mean Vehicle Speed (mph)	Total Miles Reclaimed	PM_{10}		$PM_{2.5}$	
					Em. Factor (lb/VMT)	Emissions (tons/proj.)	Em. Factor (lb/VMT)	Emissions (tons/proj.)
Road Reclamation	Grader	9,469	5	47,347	0.765	18	0.069	2

[a] Assumed that a grader would operate for 60% of the time, considering hours for preparation and closing of the shift, lunch break, and other extra activities.

A.4.1.2 Exhaust Emissions

Emission Factors for Grader: See Section A.3.1.2.

Emissions Estimation for Grader:

Activity	Vehicle Type	Capacity (hp)	Total # of Operating Hours [a]	Emissions									
				(lb/hr)					(ton/project)				
				NO_x	PM_{10} [b]	SO_x	CO	VOCs	NO_x	PM_{10} [b]	SO_x	CO	VOCs
Road Reclamation	Grader	80	9,469	1.26	0.11	0.15	0.27	0.06	6	1	1	1	0

[a] Assumed that a grader would operate for 60% of the time, considering hours for preparation and closing of the shift, lunch break, and other extra activities.
[b] Emissions of $PM_{2.5}$ were assumed to be the same as those for PM_{10}.

A.4.2 Reclamation of Roads - Commuting Vehicles

A.4.2.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section A.1.2.1.

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi/day)	Total # of Operating Days	Total Miles Traveled	PM_{10}		$PM_{2.5}$	
						Em. Factor (lb/VMT)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (ton/proj.)
Road Reclamation	Pickup Truck	7,000	6	1,578	9,469	0.70	3	0.10	0

A.4.2.2 Exhaust Emissions

Emission Factors for Road Traffic: See Section A.1.2.2.

Emissions Estimation for Road Traffic:

Activity	Vehicle		Round Trip Distance (mi/day)	Total # of Opearating Days	Total Miles Traveled	Emissions (ton/project)					
	Type	Class				NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs
Road Reclamation	Pickup Truck	LDGT2	6	1,578	9,469	0.01	0.00	0.00	0.00	0.12	0.01

A.4.3 Reclamation of Wells - Heavy Equipment

Estimation of Total Number of Wells to be Reclaimed for the Project Period (2002-2011):

Total Number of Wells to be Reclaimed [a] = 15,035

[a] Average well life is 7 years, so it was assumed that the wells would be reclaimed 7 years after their completion.

Estimation of Total Reclamation Days and Hours:

Equipment	# of Wells to be Reclaimed	# of Operating Hours per Day	Total # of Operating Days	Total # of Operating Hours
Grader [a]	15,035	10	15,035	150,350

[a] Assumed that a grader is working ½ day as a blade and ½ day as a tractor.

A.4.3.1 Fugitive Dust Emissions

Emission Factor for Grader: See Section A.3.1.1.

Emissions Estimation for Grader:

Activity	Equipment	Total # of Operating Hours [a]	Mean Vehicle Speed (mph)	Total Miles Reclaimed	PM_{10}		$PM_{2.5}$	
					Em. Factor (lb/VMT)	Emissions (tons/proj.)	Em. Factor (lb/VMT)	Emissions (tons/proj.)
Well Reclamation	Grader	90,210	5	451,050	0.765	173	0.069	16

[a] Assumed that a grader would operate for 60% of the time, considering hours for preparation and closing of the shift, lunch break, and other extra activities.

A.4.3.2 Exhaust Emissions

Emission Factor for Grader: See Section A.3.1.2.

Emissions Estimation for Grader:

Activity	Vehicle Type	Capacity (hp)	Total # of Operating Hours [a]	Emissions									
				(lb/hr)					(ton/project)				
				NO_x	PM_{10} [b]	SO_x	CO	VOCs	NO_x	PM_{10} [b]	SO_x	CO	VOCs
Well Reclamation	Grader	100	90,210	1.57	0.14	0.19	0.34	0.08	71	6	9	15	4

[a] Assumed that a grader would operate for 60% of the time, considering hours for preparation and closing of the shift, lunch break, and other extra activities.
[b] Emissions of $PM_{2.5}$ were assumed to be same as those for PM_{10}.

A.4.4 Reclamation of Wells - Commuting Vehicles

A.4.4.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section A.1.2.1.

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi/day)	Total # of Operating Days	Total Miles Traveled	PM_{10}		$PM_{2.5}$	
						Em. Factor (lb/VMT)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (ton/proj.)
Well Reclamation	Pickup Truck	7,000	6	15,035	90,210	0.70	31	0.10	5

A.4.4.2 Exhaust Emissions

Emission Factors for Road Traffic: See Section A.1.2.2.

Emissions Estimation for Road Traffic:

Activity	Vehicle Type		Round Trip Distance (mi/day)	Total # of Operating Days	Total Miles Traveled	Emissions (ton/project)					
	Type	Class				NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOCs
Well Reclamation	Pickup Truck	LDGT2	6	15,035	90,210	0.10	0.01	0.01	0.01	1.16	0.07

Appendix B:

Conventional Oil and Gas Project Emission Inventory

B.1 Construction Activities

B.2 Operational Activities

B.3 Maintenance Activities

B-1

APPENDIX B: Conventional Oil and Gas Project Emission Inventory

B.1 Construction Activities

B.1.1 Heavy Equipment

B.1.1.1 Fugitive Dust Emissions

Emission Factors for Construction Activities:

		Source
E =	1.2 tons of TSP/acre/month	EPA, *AP-42*, Volume I, Section 13.2.3 Heavy Construction Operations (1/95)
PM_{10} =	26 % of TSP	Muleski (2001)
$PM_{2.5}$ =	15 % of PM_{10}	Muleski (2001)
CE = control efficiency for watering	50 %	EPA, *Control of Open Fugitive Dust Sources*, Section 5.3.1 Watering of Unpaved Surfaces (1988)

Emissions Estimation for Construction Activities:

Area Disturbed for Oil Wells	Average Value per Well [a]				Total # of Wells	Total Area (acre)	Emissions					
							(lb/well)			(ton/project)		
	Length (mi)	Width (ft)	Area (acre)	Av. # of Days to Complete			TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Improved Road	1.0	40 [b]	4.8	1 [c]	3,200	15,515	194	50	8	310	81	12
Well Pad			4.0	3	3,200	12,800	768	200	30	768	200	30
					Total	**28,315**				**1,078**	**280**	**42**

[a] Martinez (2001a).
[b] Assumed the same width of 40 ft as used for CBM wells
[c] Duration of disturbance (clearing, digging, layout, and covering) for a given segment of road construction is assumed to be one day.

B.1.1.2 Exhaust Emissions

Emission Factors for Construction Equipment:

Equipment	Emission Factors (g/hp-hr)					Equipment Category in AP-42 [a]
	NO_x	PM_{10}	SO_2	CO	VOCs	
Dozer	7.81	0.69	0.85	2.15	0.75	Track-Type Tractor
Blade	7.14	0.63	0.87	1.54	0.36	Motor Grader

[a] Emission factors for the listed equipment category were assumed for equipment used in PRBO&G project construction.

Source: EPA, *AP-42*, Volume II, Section II-7 Heavy-Duty Construction Equipment (9/85).

Emissions Estimation for Construction Equipment:

Construction Site	Equipment Type	Capacity (hp)	# of Units	Av. Load Factor (%)	# of Oper. Hrs per Day	# of Oper. Days per Well	# of Oper. Hrs per Well	# of Wells	Emissions (lb/well)					Emissions (ton/equipment type)					Emissions (ton/construction site)				
									NO_x	PM_{10} [a]	SO_2	CO	VOC	NO_x	PM_{10} [a]	SO_2	CO	VOC	NO_x	PM_{10} [a]	SO_2	CO	VOC
Improved & Two-Track Road	Blade	100	1	75	10	2	20	3,200	24	2	3	5	1	38	3	5	8	2	38	3	5	8	2
Well Pad	Blade	100	1	75	10	3	30	3,200	35	3	4	8	2	57	5	7	12	3	156	14	18	40	12
	Dozer	150	1	80	10	3	30	3,200	62	5	7	17	6	99	9	11	27	10					
												Subtotal		194	17	22	48	14	194	17	22	48	14

[a] Emission factor for $PM_{2.5}$ was assumed to be the same as that for PM_{10}.

Emission Factors for Industrial Engines and Flaring:

Emission Source	Fuel Type	Emission Factors					
		Unit	NO_x	PM_{10}	SO_x	CO	VOC
Industrial Engine ≤ 600 hp [a]	Diesel	lb/hp-hr	3.10E-02	2.20E-03	2.05E-03	6.68E-03	2.51E-03
Industrial Engine > 600 hp [b]	Diesel [c]	lb/hp-hr	2.40E-02	7.00E-04	3.24E-03	5.50E-03	6.42E-04
Flaring [d,e]	Natural Gas	lb/MMCF	69	7.6 [f]	0.6 [f]	377	64

[a] Source: EPA, *AP-42*, Volume I, Section 3.3 Gasoline and Diesel Industrial Engines (10/96).
[b] Source: EPA, *AP-42*, Volume I, Section 3.4 Large Stationary Diesel and All Stationary Dual-Fuel Engines (10/96).
[c] Assume a sulfur content of 0.4%.
[d] Source: EPA, *AP-42*, Volume I, Section 13.5 Industrial Flares (9/91).
[e] Assumed a fuel heating value of 1,020 Btu/scf.
[f] Source: EPA, *AP-42*, Volume I, Section 1.4 Natural Gas Combustion (7/98).

Emissions Estimation for Industrial Engines and Flaring:

Construction Site Activity	Equipment Type	Capacity (hp)	# of Units	Av. Load Factor (%)	# of Operating Hours per Day	# of Operating Days per Well	# of Operating Hours per Well	# of Wells	Emissions (lb/well)					Emissions (ton/equipment type)					Emissions (ton/project activity)				
									NO_x	PM_{10} [a]	SO_2	CO	VOC	NO_x	PM_{10} [a]	SO_x	CO	VOC	NO_x	PM_{10} [a]	SO_x	CO	VOC
Rig-up, Drilling, and Rig-down	Main Deck	1,000	3	70	24	16	384	3,200	19,354	564	2,610	4,435	517	30,966	903	4,175	7,096	828	35,965	1,258	4,506	8,174	1,233
	Auxiliary Pump	600	1	80	8	15	120	3,200	1,786	127	118	385	145	2,857	203	189	616	232					
	Generators	150	2	75	24	8	192	3,200	1,339	95	89	289	109	2,143	152	142	462	174					
Well Completion & Testing	Main Deck	600	1	50	11	5	55	3,200	512	36	34	110	41	818	58	54	176	66	1,262	95	75	1,003	221
	Auxiliary Pump	225	1	80	8	2	16	3,200	89	6	6	19	7	143	10	9	31	12					
	Power Swivel	150	1	75	8	2	16	3,200	56	4	4	12	5	89	6	6	19	7					
	Equipment Type	**Capacity (kw)**	**Av. # of Wells Served**	**Average Load Factor [b] (%)**	**# of Operating Hours per Day**	**Av. # of Operating Days**	**# of Operating Hours per Well**	**# of Wells**															
	Field Generators for Pumps & Lighting	40	1	75	12	3	36	3,200	45	3	3	10	4	72	5	5	15	6					
	Emission Source	**Ave. Volume Flared (MCFD/day/well)**			**Ave. # of Days of Continuous Flaring**			**# of Wells**															
	Flaring of Natural Gas	60			21			3,200	87	10	1	476	81	140	15	1	761	130					
												Subtotal		37,228	1,353	4,581	9,176	1,454	37,228	1,353	4,581	9,176	1,454
												Total		37,421	1,370	4,604	9,224	1,468	37,421	1,370	4,604	9,224	1,468

[a] Emissions of $PM_{2.5}$ was assumed to be the same as those for PM_{10}.
[b] Gomendi (2001).

B.1.2 Commuting Vehicles

B.1.2.1 Road Dust Emissions

Emission Factors for Road Traffic:

$$E\ (lb/VMT) = \frac{k\ (s/12)^a\ (W/3)^b}{(M/0.2)^c}$$

Parameter	PM_{10}	$PM_{2.5}$
k	2.6	0.38
a	0.8	0.8
b	0.4	0.4
c	0.3	0.3

Source: EPA, *AP-42*, Volume I, Section 13.2.2 Unpaved Roads (9/98).

Function/Variable Description	Assumed Value	Source
E = size-specific emission factor (lb/VMT)		
s = surface material silt content (%)	5.1	EPA, *AP-42*, Volume I, Section 13.2.2 Unpaved Roads (9/98)
W = mean vehicle weight (tons)	Listed in the table below	
M = surface material moisture content (%)	0.2	Default value in EPA, *AP-42*, Volume I, Section 13.2.2 Unpaved Roads (9/98)
CE = control efficiency for watering (%)	50	EPA, *Control of Open Fugitive Dust Sources*, Section 5.3.1 Watering of Unpaved Surfaces (1988)

Emissions Estimation for Road Traffic:

Construction Site Destination	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi)	# of Round Trips per Well	Miles Traveled per Well	Total # of Wells	PM_{10}				$PM_{2.5}$			
							Controlled Em. Factor (lb/VMT)	Emissions (lb/well)	Emissions (ton/veh. type)	Emissions (ton/const. site)	Controlled Em. Factor (lb/VMT)	Emissions (lb/well)	Emissions (ton/veh. type)	Emissions (ton/const. site)
Improved & Two-Track Road	Semi Trucks	65,000	2	47	94	3,200	1.70	160	256	262	0.25	23	37	38
	Pickup Trucks	7,000	2	3	6	3,200	0.70	4	7		0.10	0.6	1.0	
Well Pad	Semi Trucks	65,000	2	5	10	3,200	1.70	17	27	36	0.25	2.5	4.0	5
	Pickup Trucks	7,000	2	4	8	3,200	0.70	6	9		0.10	0.8	1.3	
Other Construction Activities	Semi Trucks	80,000	2	2	4	3,200	1.85	7	12	23	0.27	1.1	1.7	3
	Haul Trucks	45,000	2	2	4	3,200	1.47	6	9		0.21	0.9	1.4	
	Pickup Trucks	7,000	2	1	2	3,200	0.70	1.4	2.2		0.10	0.2	0.3	
								Subtotal		**322**				**47**

B.1.2.1 Road Dust Emissions (Continued)

Construction Site Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi)	# of Round Trips per Well	Miles Traveled per Well	Total # of Wells	PM_{10} Controlled Em. Factor (lb/VMT)	PM_{10} Emissions (lb/well)	PM_{10} Emissions (ton/veh. type)	PM_{10} Emissions (ton/proj. activity)	$PM_{2.5}$ Controlled Em. Factor (lb/VMT)	$PM_{2.5}$ Emissions (lb/well)	$PM_{2.5}$ Emissions (ton/veh. type)	$PM_{2.5}$ Emissions (ton/proj. activity)
Rig-up, Drilling, and Rig-down	Semi Rig Transport, Drill Rig	60,000	2	44	88	3,200	1.65	145	232	520	0.24	21	34	76
	Fuel Haul Truck	50,000	2	6	12	3,200	1.53	18	29		0.22	3	4	
	Mud Haul Truck, Water Hauling	60,000	2	4	8	3,200	1.65	13	21		0.24	2	3	
	Rig Crew	7,000	2	51	102	3,200	0.70	71	114		0.10	10	17	
	Rig Mechanics	12,000	2	2	4	3,200	0.87	3	6		0.13	1	1	
	Co. Supervisor	7,000	2	20	40	3,200	0.70	28	45		0.10	4	7	
	Tool Pusher	7,000	2	8	16	3,200	0.70	11	18		0.10	2	3	
	Mud Logger	7,000	2	6	12	3,200	0.70	8	13		0.10	1	2	
	Mud Engineer	7,000	2	15	30	3,200	0.70	21	33		0.10	3	5	
	Logger, Engr Truck	45,000	2	1	2	3,200	1.47	3	5		0.21	0	1	
	Drill Bit Delivery	7,000	2	2	4	3,200	0.70	3	4		0.10	0	1	
Well Completion & Testing	Semi Casing Haulers	60,000	2	6	12	3,200	1.65	20	32	1,122	0.24	3	5	164
	Semi Completion, Unit Rig	120,000	2	1	2	3,200	2.17	4	7		0.32	1	1	
	Semi Fracing, Blender	85,000	2	1	2	3,200	1.89	4	6		0.28	1	1	
	Semi Pumping/Tank Battery	80,000	2	6	12	3,200	1.85	22	35		0.27	3	5	
	Tubing Truck	60,000	2	2	4	3,200	1.65	7	11		0.24	1	2	
	Haul Cementer, Pump Truck	85,000	2	2	4	3,200	1.89	8	12		0.28	1	2	
	Haul Cementer, Cement Truck	60,000	2	3	6	3,200	1.65	10	16		0.24	1	2	
	Haul Completion, Equip Truck	45,000	2	3	6	3,200	1.47	9	14		0.21	1	2	
	Haul Service Tools	7,000	2	2	4	3,200	0.70	3	4		0.10	0	1	
	Haul Perforators Logging Truck	45,000	2	1	2	3,200	1.47	3	5		0.21	0	1	
	Haul Anchor, Installation	40,000	2	1	2	3,200	1.40	3	4		0.20	0	1	
	Haul Anchor, Testing	12,000	2	1	2	3,200	0.87	2	3		0.13	0	0	
	Haul Fracing, Tank	40,000	2	6	12	3,200	1.40	17	27		0.20	2	4	
	Haul Fracing, Pump	85,000	2	3	6	3,200	1.89	11	18		0.28	2	3	
	Haul Fracing, Chemical	45,000	2	1	2	3,200	1.47	3	5		0.21	0	1	
	Haul Fracing, Sand	60,000	2	4	8	3,200	1.65	13	21		0.24	2	3	
	Haul Fracing, Other	85,000	2	2	4	3,200	1.89	8	12		0.28	1	2	
	Haul Welders	12,000	2	6	12	3,200	0.87	10	17		0.13	2	2	
	Haul Water Truck	60,000	2	150	300	3,200	1.65	494	790		0.24	72	116	
	Pickup Cementer, Engineer	7,000	2	2	4	3,200	0.70	3	4		0.10	0	1	
	Pickup Casing Crew	10,000	2	2	4	3,200	0.80	3	5		0.12	0	1	
	Pickup Completion Crew	10,000	2	5	10	3,200	0.80	8	13		0.12	1	2	
	Pickup Completion, Pusher	7,000	2	5	10	3,200	0.70	7	11		0.10	1	2	
	Pickup Perforators, Engineer	7,000	2	2	4	3,200	0.70	3	4		0.10	0	1	
	Pickup Fracing, Engineer	10,000	2	2	4	3,200	0.80	3	5		0.12	0	1	
	Pickup Co. Supervisor	7,000	2	10	20	3,200	0.70	14	22		0.10	2	3	
	Pickup Miscellaneous Supplies	7,000	2	3	6	3,200	0.70	4	7		0.10	1	1	
	Pickup Roustabout Crew	12,000	2	4	8	3,200	0.87	7	11		0.13	1	2	
								Subtotal		**1,643**				**240**
								Total		**1,965**				**287**

B.1.2.2 Exhaust Emissions

Emission Factors for Road Traffic:

Vehicle		Emission Factors (g/mi)					
Type	Class	NO_x	PM_{10} [a,b]	$PM_{2.5}$ [a,b]	SO_x [a]	CO	VOC
Light-Duty Gasoline Truck	LDGT2	1.01	0.10	0.08	0.11	11.64	0.75
Heavy-Duty Diesel Truck	HDDV	8.13	1.96	1.81	1.63	17.09	4.83

[a] Estimated using the EPA PART5 model (1995).

[b] Including tire and brake wear emissions.

Source: EPA, *AP-42*, Volume II, Appendix H-117, Table 3.1A.2 Light-Duty Gasoline Powered Trucks II and Appendix H-259, Table 7.1.2 Heavy Duty Diesel Powered Vehicles (High Altitude; Model Year 1991-1997; 50,000 mileage) (6/30/95).

Emissions Estimation Road Traffic:

Construction Site Destination	Vehicle		Round Trip Distance (mi)	# of Round Trips per Well	Miles Traveled per Well	Total # of Wells	Emissions																	
							(lb/well)						(ton/vehicle type)						(ton/construction site)					
	Type	Class					NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC	NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC
Improved & Two-Track Road	Semi Trucks	HDDV	2	47	94	3,200	1.68	0.41	0.37	0.34	3.54	1.00	2.70	0.65	0.60	0.54	5.67	1.60	2.72	0.65	0.60	0.54	5.91	1.62
	Pickup Trucks	LDGT2	2	3	6	3,200	1.E-02	1.E-03	1.E-03	1.E-03	2.E-01	1.E-02	2.E-02	2.E-03	2.E-03	2.E-03	2.E-01	2.E-02						
Well Pad	Semi Trucks	HDDV	2	5	10	3,200	0.18	0.04	0.04	0.04	0.38	0.11	0.29	0.07	0.06	0.06	0.60	0.17	0.32	0.07	0.07	0.06	0.93	0.19
	Pickup Trucks	LDGT2	2	4	8	3,200	2.E-02	2.E-03	1.E-03	2.E-03	2.E-01	1.E-02	3.E-02	3.E-03	2.E-03	3.E-03	3.E-01	2.E-02						
Other Construction Activities	Semi Trucks	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07	0.24	0.06	0.05	0.05	0.56	0.14
	Haul Trucks	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07						
	Pickup Trucks	LDGT2	2	1	2	3,200	4.E-03	4.E-04	3.E-04	5.E-04	5.E-02	3.E-03	7.E-03	7.E-04	5.E-04	8.E-04	8.E-02	5.E-03						
												Subtotal							**3.3**	**0.8**	**0.7**	**0.6**	**7.4**	**2.0**

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B.1.2.2 Exhaust Emissions (Continued)

Construction Site Activity	Vehicle Type	Vehicle Class	Round Trip Distance (mi)	# of Round Trips per Well	Miles Traveled per Well	Total # of Wells	Emissions (lb/well) NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC	(ton/vehicle type) NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC	(ton/project activity) NO_x	PM_{10}	$PM_{2.5}$	SO_2	CO	VOC
Rig-up, Drilling, and Rig-down	Semi Rig Transport, Drill Rig	HDDV	2	44	88	3,200	1.58	0.38	0.35	0.32	3.32	0.94	2.52	0.61	0.56	0.51	5.30	1.50	4.0	0.9	0.8	0.7	15.2	2.5
	Fuel Haul Truck	HDDV	2	6	12	3,200	0.22	0.05	0.05	0.04	0.45	0.13	0.34	0.08	0.08	0.07	0.72	0.20						
	Mud Haul Truck, Water Hauling	HDDV	2	4	8	3,200	0.14	0.03	0.03	0.03	0.30	0.09	0.23	0.06	0.05	0.05	0.48	0.14						
	Rig Crew	LDGT2	2	51	102	3,200	0.23	0.02	0.02	0.03	2.62	0.17	0.36	0.04	0.03	0.04	4.19	0.27						
	Rig Mechanics	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07						
	Co. Supervisor	LDGT2	2	20	40	3,200	0.09	0.01	0.01	0.01	1.03	0.07	0.14	0.01	0.01	0.02	1.64	0.11						
	Tool Pusher	LDGT2	2	8	16	3,200	0.04	0.00	0.00	0.00	0.41	0.03	0.06	0.01	0.00	0.01	0.66	0.04						
	Mud Logger	LDGT2	2	6	12	3,200	3.E-02	3.E-03	2.E-03	3.E-03	3.E-01	2.E-02	4.E-02	4.E-03	3.E-03	5.E-03	5.E-01	3.E-02						
	Mud Engineer	LDGT2	2	15	30	3,200	0.1	0.0	0.0	0.0	0.8	0.0	0.1	0.0	0.0	0.0	1.2	0.1						
	Logger, Engr Truck	HDDV	2	1	2	3,200	0.04	0.01	0.01	0.01	0.08	0.02	0.06	0.01	0.01	0.01	0.12	0.03						
	Drill Bit Delivery	LDGT2	2	2	4	3,200	9.E-03	9.E-04	7.E-04	1.E-03	1.E-01	7.E-03	1.E-02	1.E-03	1.E-03	2.E-03	2.E-01	1.E-02						
Well Completion & Testing	Semi Casing Haulers	HDDV	2	6	12	3,200	0.22	0.05	0.05	0.04	0.45	0.13	0.34	0.08	0.08	0.07	0.72	0.20	12.3	2.9	2.7	2.5	27.5	7.4
	Semi Completion, Unit Rig	HDDV	2	1	2	3,200	0.04	0.01	0.01	0.01	0.08	0.02	0.06	0.01	0.01	0.01	0.12	0.03						
	Semi Fracing, Blender	HDDV	2	1	2	3,200	0.04	0.01	0.01	0.01	0.08	0.02	0.06	0.01	0.01	0.01	0.12	0.03						
	Semi Pumping/Tank Battery	HDDV	2	6	12	3,200	0.22	0.05	0.05	0.04	0.45	0.13	0.34	0.08	0.08	0.07	0.72	0.20						
	Tubing Truck	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07						
	Haul Cementer, Pump Truck	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07						
	Haul Cementer, Cement Truck	HDDV	2	3	6	3,200	0.11	0.03	0.02	0.02	0.23	0.06	0.17	0.04	0.04	0.03	0.36	0.10						
	Haul Completion, Equip Truck	HDDV	2	3	6	3,200	0.11	0.03	0.02	0.02	0.23	0.06	0.17	0.04	0.04	0.03	0.36	0.10						
	Haul Service Tools	LDGT2	2	2	4	3,200	0.01	0.00	0.00	0.00	0.10	0.01	0.01	0.00	0.00	0.00	0.16	0.01						
	Haul Perforators Logging Truck	HDDV	2	1	2	3,200	0.04	0.01	0.01	0.01	0.08	0.02	0.06	0.01	0.01	0.01	0.12	0.03						
	Haul Anchor, Installation	HDDV	2	1	2	3,200	0.04	0.01	0.01	0.01	0.08	0.02	0.06	0.01	0.01	0.01	0.12	0.03						
	Haul Anchor, Testing	HDDV	2	1	2	3,200	0.04	0.01	0.01	0.01	0.08	0.02	0.06	0.01	0.01	0.01	0.12	0.03						
	Haul Fracing, Tank	HDDV	2	6	12	3,200	0.22	0.05	0.05	0.04	0.45	0.13	0.34	0.08	0.08	0.07	0.72	0.20						
	Haul Fracing, Pump	HDDV	2	3	6	3,200	0.11	0.03	0.02	0.02	0.23	0.06	0.17	0.04	0.04	0.03	0.36	0.10						
	Haul Fracing, Chemical	HDDV	2	1	2	3,200	0.04	0.01	0.01	0.01	0.08	0.02	0.06	0.01	0.01	0.01	0.12	0.03						
	Haul Fracing, Sand	HDDV	2	4	8	3,200	0.14	0.03	0.03	0.03	0.30	0.09	0.23	0.06	0.05	0.05	0.48	0.14						
	Haul Fracing, Other	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07						
	Haul Welders	HDDV	2	6	12	3,200	0.22	0.05	0.05	0.04	0.45	0.13	0.34	0.08	0.08	0.07	0.72	0.20						
	Haul Water Truck	HDDV	2	150	300	3,200	5.38	1.30	1.20	1.08	11.30	3.19	8.60	2.08	1.91	1.72	18.08	5.11						
	Pickup Cementer, Engineer	LDGT2	2	2	4	3,200	9.E-03	9.E-04	7.E-04	1.E-03	1.E-01	7.E-03	1.E-02	1.E-03	1.E-03	2.E-03	2.E-01	1.E-02						
	Pickup Casing Crew	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07						
	Pickup Completion Crew	HDDV	2	5	10	3,200	0.18	0.04	0.04	0.04	0.38	0.11	0.29	0.07	0.06	0.06	0.60	0.17						
	Pickup Completion, Pusher	LDGT2	2	5	10	3,200	2.E-02	2.E-03	2.E-03	2.E-03	3.E-01	2.E-02	4.E-02	3.E-03	3.E-03	4.E-03	4.E-01	3.E-02						
	Pickup Perforators, Engineer	LDGT2	2	2	4	3,200	9.E-03	9.E-04	7.E-04	1.E-03	1.E-01	7.E-03	1.E-02	1.E-03	1.E-03	2.E-03	2.E-01	1.E-02						
	Pickup Fracing, Engineer	HDDV	2	2	4	3,200	0.07	0.02	0.02	0.01	0.15	0.04	0.11	0.03	0.03	0.02	0.24	0.07						
	Pickup Co. Supervisor	LDGT2	2	10	20	3,200	4.E-02	4.E-03	3.E-03	5.E-03	5.E-01	3.E-02	7.E-02	7.E-03	5.E-03	8.E-03	8.E-01	5.E-02						
	Pickup Miscellaneous Supplies	LDGT2	2	3	6	3,200	1.E-02	1.E-03	1.E-03	1.E-03	2.E-01	1.E-02	2.E-02	2.E-03	2.E-03	2.E-03	2.E-01	2.E-02						
	Pickup Roustabout Crew	HDDV	2	4	8	3,200	0.14	0.03	0.03	0.03	0.30	0.09	0.23	0.06	0.05	0.05	0.48	0.14						
												Subtotal							**16**	**4**	**3**	**3**	**43**	**10**
												Total							**20**	**5**	**4**	**4**	**50**	**12**

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B.2 Operational Activities

B.2.1 Well Workover

B.2.1.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section B.1.2.1

Emissions Estimation for Road Traffic:

Activity	Vehicle Type [a]	Av. Vehicle Weight (lb)	Round Trip Distance (mi)	# of Round Trips per Well	Miles Traveled per Well	Total # of Wells Drilled	PM_{10}			$PM_{2.5}$		
							Emission Factor (lb/VMT)	Emissions (lb/well)	Emissions (ton/proj.)	Emission Factor (lb/VMT)	Emissions (lb/well)	Emissions (ton/proj.)
Well Workover	WO Rig	120,000	2	1	2	3,200	2.17	4	7	0.32	1	1
	Haul Truck	60,000	2	1	2	3,200	1.65	3	5	0.24	0	1
	Pickup Truck	7,000	2	3	6	3,200	0.70	4	7	0.10	1	1
						Total			**19**			**3**

[a] Gomendi (2001).

B.2.1.2 Exhaust Emissions - On-site

Emission Factors for Industrial Engines: See Section B.1.1.2

Emissions Estimation for Industrial Engines:

Activity	Equipment Type	Capacity (hp)	# of Operating Hours per Day	# of Operating Days per Well	# of Operating Hours per Well	Total # of Wells Drilled	Emissions (lb/well)					Emissions (ton/project)				
							NO_x	PM_{10} [a]	SO_x	CO	VOC	NO_x	PM_{10} [a]	SO_x	CO	VOC
Well Workover	Truck-Mounted Unit	600	10	3	30	3,200	558	40	37	120	46	893	63	59	192	73

[a] $PM_{2.5}$ was assumed to be same as PM_{10}.

B.2.1.2 Exhaust Emissions - On-road

Emission Factors for Road Traffic: See Section B.1.2.2

Emissions Estimation for Road Traffic:

Activity	Vehicle		Round Trip Distance (mi)	Round Trip per Well	Miles Traveled per Well	Total # of Wells Drilled	Emissions (lb/well)						Emissions (ton/project)					
	Type	Class					NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOC	NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOC
Well Workover [a]	WO Rig	HDDV	2	1	2	3,200	4.E-02	9.E-03	8.E-03	7.E-03	8.E-02	2.E-02	6.E-02	1.E-02	1.E-02	1.E-02	1.E-01	3.E-02
	Haul Truck	HDDV	2	1	2	3,200	4.E-02	9.E-03	8.E-03	7.E-03	8.E-02	2.E-02	6.E-02	1.E-02	1.E-02	1.E-02	1.E-01	3.E-02
	Pickup Truck	LDGT2	2	3	6	3,200	1.E-02	1.E-03	1.E-03	1.E-03	2.E-01	1.E-02	2.E-02	2.E-03	2.E-03	2.E-03	2.E-01	2.E-02
												Total	**1.E-01**	**3.E-02**	**3.E-02**	**3.E-02**	**5.E-01**	**8.E-02**

[a] Performed once in the first year of well operation for one day.

B.2.2 Well Visits for Inspection and Repair

B.2.2.1 Road Dust Emissions

Emission Factor for Road Traffic: See Section B.1.2.1

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi)	# of Visits per Well per Year [a]	Miles Traveled per Well per Year	Total # of Operating Well-Yr	PM_{10}			$PM_{2.5}$		
							Em. Factor (lb/VMT)	Emissions		Em. Factor (lb/VMT)	Emissions	
								(lb/well-yr)	(ton/proj.)		(lb/well-yr)	(ton/proj.)
Inspection Visits for Wells	Pickup Truck	7,000	2	12	24	17,600	0.70	16.7	147	0.10	2.4	22

[a] Gomendi (2001).

B.2.2.2 Exhaust Emissions

Emission Factor for Road Traffic: See Section B.1.2.2

Emissions Estimation for Road Traffic:

Activity	Vehicle		Round Trip Distance (mi)	# of Visits per Well per Year [a]	Distance per Well per Year (mi)	Total # of Operating Well per Project	Emissions											
							(lb/well-yr)						(ton/project)					
	Type	Class					NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOC	NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOC
Inspection Visits for Wells	Pickup Truck	LDGT2	2	12	24	17,600	0.05	0.01	0.00	0.01	0.62	0.04	0.5	0.0	0.0	0.1	5.4	0.3

[a] Gomendi (2001).

B.3 Maintenance Activities

B.3.1 Road Maintenance - Heavy Equipment

Given Data:

Maintenance [a]	Equipment/Vehicle			Road Length Worked On per Day (miles)	# of Operating Hours per Day
	Type	Fuel	Capacity (hp)		
Summer	Heavy Equipment [b]	Diesel-30 gpd	135 [c]	6	10
	Commuting Vehicle	Gas-5 gpd	225	6 [d]	1 [e]
Winter	Heavy Equipment [b]	Diesel-30 gpd	135 [c]	5	10
	Commuting Vehicle	Gas-5 gpd	225	6 [d]	2 [e]

[a] Road maintenance would be made twice in summer and once in winter every year (Keanini [2001b]).
[b] Assume a motor grader (Gomendi [2001]).
[c] Revised from 100 hp to 135 hp (Gomendi [2001]).
[d] Average round trip mileage on unpaved road.
[e] Assume one round trip per day.

Estimation of Total and Cumulative Length of Roads for the Project:

Length of Improved Roads per Well (mi) [a]	1
Number of Wells	3,200
Total Length of Improved Roads (mi)	3,200
Cumulative Length of Roads [b] (mi-yr)	17,600

[a] Martinez (2001a).
[b] = (total length of roads) *(total no. of operating well-yr)/(total no. of drilled wells).

Estimation of Total Operation Days and Hours:

Season	# of Operations per Season	Cumulative Length of Roads (mi-yr)	Road Length Worked On (mi/day)	# of Operating Hours per Day	Total # of Operating Days	Total # of Operating Hours
Summer	2	17,600	6	10	5,867	58,667
Winter	1	17,600	5	10	3,520	35,200
				Total	**9,387**	**93,867**

B.3.1.1 Fugitive Dust Emissions

Emission Factors for Grader:

Pollutant	Emission Factor Equation (lb/VMT)	S [a] (mph)	Em. Factors (lb/VMT)
PM_{10}	$E = (0.6)(0.051)\ S^2$	5	0.765
$PM_{2.5}$	$E = (0.031)(0.04)\ S^{2.5}$	5	0.069

[a] Assumed a mean vehicle speed (S) of 5 mph.

Source: EPA, *AP-42*, Volume I, Section 11.9 Western Surface Coal Mining (10/98).

Emissions Estimation for Grader:

Activity	Equipment	Total # of Operating Hours [a]	Mean Vehicle Speed (mph)	Total Miles Maintained	PM_{10}		$PM_{2.5}$	
					Em. Factor (lb/VMT)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (ton/proj.)
Road Maintenance	Grader	56,320	5	281,600	0.765	108	0.069	10

[a] Assumed that a grader would operate at 60% of the time, considering hours for clothing change, lunch break, and other extra activities.

B.3.1.2 Exhaust Emissions

Emission Factors for Grader:

Equipment	Emission Factors (g/hp-hr)				
	NO_x	PM_{10} [a]	SO_2	CO	VOCs
Grader	7.14	0.63	0.87	1.54	0.36

[a] $PM_{2.5}$ was assumed to be same as PM_{10}.

Source: EPA, *AP-42*, Volume II., Section II-7, Heavy-Duty Construction Equipment (1985).

Emissions Estimation for Grader:

Activity	Vehicle Type	Capacity (hp)	Total # of Operating Hours [a]	Emissions									
				(lb/hr)					(ton/project)				
				NO_x	PM_{10} [b]	SO_x	CO	VOC	NO_x	PM_{10} [b]	SO_x	CO	VOC
Road Maintenance	Grader	135	56,320	2.13	0.19	0.26	0.46	0.11	60	5	7	13	3

[a] Assumed that a grader would operate at 60% of the time, considering hours for clothing change, lunch break, and other extra activities.
[b] $PM_{2.5}$ was assumed to be same as PM_{10}.

B.3.2 Commuting Vehicles

B.3.2.1 Road Dust Emissions

Emission Factors for Road Traffic: See Section B.1.2.1

Emissions Estimation for Road Traffic:

Activity	Vehicle Type	Av. Vehicle Weight (lb)	Round Trip Distance (mi/day)	Total # of Operating Days	Total Miles Traveled	PM_{10}		$PM_{2.5}$	
						Em. Factor (lb/VMT)	Emissions (ton/proj.)	Em. Factor (lb/VMT)	Emissions (ton/proj.)
Road Maintenance	Pickup Truck	7,000	6	9,387	56,320	0.70	20	0.10	3

B.3.2.2 Exhaust Emissions

Emission Factors for Road Traffic: See Section B.1.2.2

Emissions Estimation for Road Traffic:

Activity	Vehicle		Round Trip Distance (mi/day)	Total # of Operating Days	Total Miles Traveled	Emissions (ton/project)					
	Type	Class				NO_x	PM_{10}	$PM_{2.5}$	SO_x	CO	VOC
Road Maintenance	Pickup Truck	LDGT2	6	9,387	56,320	0.06	0.01	0.00	0.01	0.72	0.05

Appendix C:

Updated New and RFD Source Emission Inventory

C.1 Montana Sources

C.2 Nebraska Sources

C.3 South Dakota Sources

C.4 Wyoming Sources

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C.1 Montana Sources

C.1.1 New Sources: Permit Actions (9/1/94 - 8/31/01) [a]

County	Company	Facility	Facility Classification	Location			Elev. (m)	Permit		Change in Potential Emissions due to the Permitting Action (TPY)								Permit Description
				UTM X	UTM Y	Zone		Date	No.	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO [c]	
Big Horn	Redstone Gas Partners, LLC	CX-19 Battery	Compressor Station	351965	4988232	13	1122	08/10/00	3118-00	15.45	0.28	0.28		0.02	23.18	7.73	1.54	Permit to construct a compressor station with two 400-hp Waukesha F18GL gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	CX-24 Battery	Compressor Station	350249	4987901	13	1103	03/08/99	3036-00	14.68	0.26	0.26		0.02	22.02	7.34	1.47	Permit to construct a compressor station with two 380-hp CAT G3408TA gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	CX-25 Battery	Compressor Station	350070	4986300	13	1103	03/08/99	3037-00	14.68	0.26	0.26		0.02	22.02	7.34	1.47	Permit to construct a compressor station with two 380-hp CAT G3408ta gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	CX-35 Battery	Compressor Station	348986	4985247	13	1119	08/10/00	3122-00	15.45	0.28	0.28		0.02	23.18	7.73	1.54	Permit to construct a compressor station with two 400-hp Waukesha F18GL gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	P&M 26 Battery	Compressor Station	348241	4986968	13	1195	08/10/00	3121-00	15.45	0.28	0.28		0.02	23.18	7.73	1.54	Permit to construct a compressor station with two 400-hp Waukesha F18GL gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	P&M 34 Battery	Compressor Station	347286	4985087	13	1201	08/10/00	3120-00	15.45	0.28	0.28		0.02	23.18	7.73	1.54	Permit to construct a compressor station with two 400-hp Waukesha F18GL gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	School House Battery	Compressor Station	353259	4985082	13	1119	07/07/00	3035-01	15.45	0.28	0.28		0.02	23.18	7.73	1.54	Permit to replace two previously permitted 380-hp CAT G3408TA engines (permit no. 3035-00 issued on 3/7/99) with two 400-hp Waukesha F18GL compressor engines.
Big Horn	Redstone Gas Partners, LLC	Shell 33 Creek Battery	Compressor Station	356040	4984889	13	1201	08/10/00	3119-00	15.45	0.28	0.28		0.02	23.18	7.73	1.54	Permit to construct a compressor station with two 400-hp Waukesha F18GL gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	Squirrel Creek Battery	Compressor Station	351274	4986741	13	1085	03/07/99	3038-00	14.68	0.26	0.26		0.02	22.02	7.34	1.47	Permit to construct a compressor station with two 380-hp CAT G3408TA gas-fired engines.
Big Horn	Redstone Gas Partners, LLC	State Line Battery	Compressor Station	351379	4984558	13	1074	10/28/99	3070-00	14.68	0.28	0.28		0.02	22.02	7.34	1.47	Permit to construct a compressor station with two 380-hp CAT G3408TA gas-fired engines.
Carbon	Montana Power Co.	Dry Creek Field Station 056-1 thru 4	Gas Processing Plant	647007	5013219	12	1353	11/06/98	2784-02	3.3E-01	2.6E-02	1.7E-02		9.7E-01	3.6E-02	6.1E-04	2.0E-04	Permit to incorporate Smart Ash Incinerator into plant operations.
Rosebud	Montana Power Co.	Colstrip Units 1&2	Power Plant	374768	5082266	13	1000	06/17/98	0513-01		1.12	0.35						Permit to install and operate a new Syncoal Truck dump and lime silo bin vent.
Stillwater	Stillwater Mining Co.	Stillwater Mining Co. Smelter	Smelter - Precious Metals	637200	5054650	12	1091	08/05/98	2635-06	6.3	62.577	62.577	73.386		1.575			Application to add a second smelting circuit with an increased capacity of 100 TPD of concentrate and/or PGM catalyst. New smelter will include: new silos, bins, an electric furnace, Top Blown Rotary Converters (TBRCs), granulators, and a dryer.
Yellowstone	Cenex, Inc.	Laurel Refinery	Petroleum Refinery	674042	5058290	12	1000	02/01/97	1821-02	25.38	4.38	4.38		16.79	43.76	6.56		Permit to install a new gas-fired boiler to generate 80,000 lbs of steam per hour.
Yellowstone	Cenex, Inc.	Laurel Refinery	Petroleum Refinery	673780	5058293	12	999	06/04/97	1821-03	0	-3.79			2.87	0	0.11		Permit to modify emissions and operational limitations on components in the Hydrodesulfurization Complex (Reformer Heater [H-101]).

C.1.1 New Sources: Permit Actions (9/1/94 - 8/31/01) [a] (Continued)

County	Company	Facility	Facility Classification	Location			Elev. (m)	Permit		Change in Potential Emissions due to the Permitting Action (TPY)								Permit Description
				UTM X	UTM Y	Zone		Date	No.	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO [c]	
Yellowstone	Cenex, Inc.	Laurel Refinery	Petroleum Refinery	673875	5058240	12	999	06/04/97	1821-03	2.32	1.16	1.16		6.04	4.03	0.32		Permit to modify emissions and operational limitations on components in the Hydrodesulfurization Complex (Reactor Charge Heater [H-201]).
Yellowstone	Cenex, Inc.	Laurel Refinery	Petroleum Refinery	673828	5058221	12	999	06/04/97	1821-03	2.08	1.3	1.3		4.4	3.13	0.25		Permit to modify emissions and operational limitations on components in the Hydrodesulfurization Complex (Fractionator [H-202]).
Yellowstone	Cenex, Inc.	Laurel Refinery	Petroleum Refinery	673803	5058259	12	999	06/04/97	1821-03	12.01	0.57	0.57		0	52.14	3.88		Permit to modify emissions and operational limitations on components in the Hydrodesulfurization Complex (Compressor [C201-B]).
Yellowstone	Cenex, Inc.	Laurel Refinery	Petroleum Refinery	673808	5058359	12	999	06/04/97	1821-03	1.43	0.27	0.27		0	1.08	0.15		Permit to modify emissions and operational limitations on components in the Hydrodesulfurization Complex (Sulfur recovery unit [E-407/INC-401]).
Yellowstone	Cenex, Inc.	Laurel Refinery	Petroleum Refinery	673584	5058625	12	999	03/06/98	1821-04	1.82					4.54	4.54		Permit to install gasoline vapor collection system and enclosed flare to reduce VOCs and HAPs (Flare).
Yellowstone	Conoco Inc.	Billings Refinery	Petroleum Refinery	694960	5072825	12	948	07/28/95	2619-07							2.89		Permit for construction and operation of new equipment within the refinery's alkylation and gas recovery plant/no. 1 amine units.
Yellowstone	Conoco Inc.	Billings Refinery	Petroleum Refinery	694960	5072825	12	948	07/30/97	2619-10	7.89					19.74	19.82		Permit application to install a vapor collection system and enclosed flare to gather gasoline vapors from trucks during loading.
Yellowstone	Conoco Inc.	Billings Refinery	Petroleum Refinery	694960	5072825	12	948	02/18/98	2619-11				0.9					Modification permit to allow the continuous incineration of a PB Merox Unit off gas stream in the firebox of Heater #16.
Yellowstone	Exxon Company USA	Billings Refinery	Petroleum Refinery	699453	5076490	12	948	11/12/94	1564-04							0.9		Permit to construct and operate an 800 TPD polymer modified asphalt (PMA) unit.
Yellowstone	Laurel East Vet Service	Animal Crematorium	Incinerator	679141	5061223	12	988	04/19/96	2915-00	0.32	0.13	0.09	0		0.07	0.02	2.1E-04	Permit to install pathological Incinerator to dispose of animal carcasses.
Yellowstone	Montana Sulphur & Chemical Co.	Montana Sulphur	Gas Processing Plant	699900	5076350	12	947	08/15/99	2611-02	8.38	1.23	1.23		37.42	2.73	0.42		Permit to install a 17 MMBtu/hr gas-fired boiler for steam generation and plant heating, and a 35 MMBtu/hr gas-fired incinerator to serve in 2 modes 1) back up to current incinerator; and 2) as sulfur feed to ammonium thiosulfate plant (Boiler).
Yellowstone	Montana Sulphur & Chemical Co.	Montana Sulphur	Gas Processing Plant	699900	5076350	12	947	08/15/99	2611-02	15.33	1.17	1.17		0.04	6.25	0.41	0.038	Permit to install a 17 MMBtu/hr gas-fired boiler for steam generation and plant heating, and a 35 MMBtu/hr incinerator to serve in 2 modes 1) back up to current incinerator; and 2) as sulfur feed to ammonium thiosulfate plant (Incinerator).
Yellowstone	Yellowstone Energy Ltd. Partnership	YELP	Cogeneration Facility	700461	5076223	12	954	01/12/00	2650-05		9.62	3.02						Permit alteration to add an enclosed petroleum coke unloading/crushing/processing plant and a processed petroleum coke storage and handling building.

[a] Blank spaces in the columns of emissions data indicate that no data are available from permit/application materials.

[b] $PM_{2.5}$ emissions were estimated from PM_{10} emissions using the AP-42 particle size distribution data for specific emission category.

[c] Based on an emission factor of 0.2 g/hp-hr ("lean burn") for gas-fired compressor engines (see Wyoming CT-1928) under continuous full-load operation.

C.2 Nebraska Sources

C.2.1 New Sources: Permit Actions (9/1/94 - 8/31/00)

County	Company	Facility	Facility # ID	Facility Classificaiton	Location			Elev. (m)	Permit/Application		Change in Potential Emissions due to the Permitting Action (TPY)								Permit/Application Description
					UTM X	UTM Y	Zone		Date	No.	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	
Box Butte	Farmers Cooperative Elevator Co.	Hemingford Elevator	57252	Grain Elevator	658826	4686723	13	1298	5/16/2000	00-0021		3.38	0.95						Permit to add two 250K bushel concrete bins or 8 concrete bins with a total storage cap. of 500K bushels, a new dump pit, a new 30K bushel/hr leg, two conveyors to the bins and two drag conveyors under the bins.
Morrill	Progress Rail Company	Microturbine Test Site	65269	Microturbine	671724	4622552	13	1283	8/4/2000	00-0038	0.9					0.5			Permit to replace original microturbine with a new identical unit that can operate independently of the distribution grid resulting from upgraded electrical controls.
Scottsbluff	Crossroads Cooperative Association	Lyman Grain Elevator	43659	Grain Elevator	590883	4647185	13	1226	8/4/1995	GR-0221		10.22	2.88						Permit to construct a grain elevator facility (Facility 1).
Scottsbluff	Crossroads Cooperative Association	Lyman Grain Elevator	43659	Grain Elevator	590883	4647185	13	1226	8/4/1995	GR-0221		4.25	1.20						Permit to construct a grain elevator facility (Facility 2).
Scottsbluff	Crossroads Cooperative Association	Lyman Grain Elevator	43659	Grain Elevator	590883	4647185	13	1226	8/4/1995	GR-0221		4.22	1.19						Permit to construct a grain elevator facility (Facility 3).
Scottsbluff	N.A. Corporation	Portable Gravel Crushing and Screening Plant	62757	Gravel Crushing, Receiving, and Storage	609946	4634657	13	1182	4/25/1995	94-0018	22.9	10.46	3.29	1.48		4.9	2.24		Permit to construct a gravel crushing and screening plant. Annual production of 2 million tons of gravel, plant mix or combination.
Scottsbluff	New Alliance Bean & Grain	Bean & Grain Receiving and Storage	59327	Grain Elevator	612684	4630499	13	1184	4/7/1999	99-0009		0.47	0.13						Permit application for proposed installation of additional receiving and storing facilities.
Scottsbluff	Panhandle Humane Society		44716	Animal Waste Incinerator	610872	4634321	13	1180	10/13/1994	94-0026	0.5	0.9	0.60		1.4	0.03	0.5		Permit to install animal waste incinerator.
Scottsbluff	Simon Contractors	Asphalt Production	64259	Asphalt Production	609660	4634700	13	1183	5/6/2000	96-0006-CP	3.8	2.0	0.12	0.5		34	1.7	0.09	Permit to construct an asphalt production plant (stack emission).
Scottsbluff	Simon Contractors	Asphalt Production	64259	Asphalt Production	609660	4634700	13	1183	5/6/2000	96-0006-CP		5.8	1.82						Permit to construct an asphalt production plant (aggregate processing fugitive emissions).
Sheridan	Gordon Memorial Hospital	Gordon Memorial Hospital	57220	Medical Waste Incinerator	728954	4743712	13	1090	8/28/97 [c]										

[a] Blank spaces in the columns of emissions, stack parameters, operating conditions, and building data indicate that no data are available from permit/application materials.

[b] $PM_{2.5}$ emissions were estimated from PM_{10} emissions using the AP-42 particle size distribution data for specific emission category.

[c] Information on 8/28/97 permit action was not available from the State of Nebraka DEQ emission inventory files.

C.3 South Dakota Sources

C.3.1 RFD Sources

County	Company	Facility	Facility Classificaiton	Location			Elev. (m)	Permit		Change in Potential Emissions due to the Permitting Action (TPY)								Permit/Waiver Description
				UTM X	UTM Y	Zone		Date	No.	NOx	PM_{10}	$PM_{2.5}$ [a]	SO_2	SOx	CO	VOCs	HCHO	
Pennington	Black Hills Power and Light Company	Black Hills Power and Light Plant	Power Plant	639199.4	4886578.6	13	1062.4	10/10/2000	28.0802-PSD	144.5	26.5	26.5	17.5		87.6	35.5		PSD Permit to construct peaking station with two NG-burning turbines power. Has not been constructed yet. (NG Turbine 1)
Pennington	Black Hills Power and Light Company	Black Hills Power and Light Plant	Power Plant	639220.6	4886578.6	13	1060.7	10/10/2000	28.0802-PSD	144.5	26.5	26.5	17.5		87.6	35.5		PSD Permit to construct peaking station with two NG-burning turbines power. Has not been constructed yet. (NG Turbine 2)

[a] Emisisons of $PM_{2.5}$ were assumed to be the same as those for PM_{10}.

C.4 Wyoming Sources

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Agave Energy Company	K-Bar Compressor Station	Compressor Station	445170	4841620	13	1524	CT-1481	2/10/1999	10			0.01		9	4	0.52	construct 2 new compressor engines: either a 530 hp Waukesha H24GL or 400 hp Caterpillar G3408TL
Campbell	Agave Energy Company	K-Bar Compressor Station	Compressor Station	445170	4841620	13	1524	CT-1481	2/10/1999	21			0.04		43	14	1.44	construct 2 new compressor engines: either a 1478 hp Waukesha 7042 GL or 1085 hp Caterpillar 3516LE
Campbell	Bear Paw Energy Incorporated	Antelope Valley Compressor Station	Compressor Station	462241	4892929	13	1480	CT-1578	9/27/1999	61.9					98.3	18.4	4	Permit to construct compressor station. 4, 1,580 hp Waukesha 7044GSI engines. engine emissions (1 g/hp-hr Nox, 1.6 g/hp-hr CO). Formaldehyde - 0.9 TPY per engine
Campbell	Incorporated	Compressor Station	Station	462241	4892929	13	1480	MD-446	3/16/2000	30.4					30.4	9.2	2	install two additional 1580 Waukesha L7044GSI engines
Campbell	Bear Paw Energy Incorporated	Appel Compressor Station	Compressor Station	460169	4887783	13	1453	CT-1993	8/18/2000	19.5					38.5	6	1.2	Permit to construct a new station consisting of either five (5) 400 hp Caterpillar G3408TA engines or five (5) 400 hp Waukesha F18GL engines. If installed, the F18GL engines will be equipped with oxidation catalyst
Campbell	Bear Paw Energy Incorporated	Black Rock Main Station	Compressor Station	428728	4891260	13	1335	CT-1737	2/19/2000	91.2					91.2	27.6	5.5	permit proposed engines: six 1580 hp Waukesha L7044GSI compressor engines, glycol dehy
Campbell	Bear Paw Energy Incorporated	Black Rock Pod A Station	Compressor Station	427153	4892641	13	1362	CT-1738	2/19/2000	55.8					78	15.2	3.3	permit proposed engines: 15--385 hp CAT G3408TA compressor engines
Campbell	Bear Paw Energy Incorporated	Black Rock Pod B	Compressor Station	429573	4889795	13	1407	CT-1739	2/19/2000	70.7					98.8	19.2	4.2	permit proposed engines: 19--385 hp CAT G3408TA compressor engines
Campbell	Bear Paw Energy Incorporated	Black Rock Pod C	Compressor Station	429757	4887062	13	1346	CT-1740	2/19/2000	44.6					62.4	12.1	2.7	permit proposed engines: 12--385 hp CAT G3408TA compressor engines
Campbell	Bear Paw Energy Incorporated	Bone Pile Booster Station	Compressor Station	454998	4891977	13	1498	CT-1726	2/15/2000	13.4					13.4	4	1	permit proposed equipment: one 1390 hp Waukesha L7042GSI engine
Campbell	Bear Paw Energy Incorporated	Bone Pile Booster Station	Compressor Station	454998	4891977	13	1498	CT-1726	2/15/2000	60.8					60.8	18.4	5.2	permit proposed equipment: four 1580 hp Waukesha L7044GSI engines
Campbell	Bear Paw Energy Incorporated	Busskohol Station	Compressor Station	454286	4894114	13	1494	CT-1724	2/15/2000	22.3					44.7	6.1	1.7	permit proposed equipment: six 385 CAT G3408TA engines
Campbell	Bear Paw Energy Incorporated	Coal Seam Compressor Station	Compressor Station	466706	4893955	13	1456	MD-424	8/31/1999	-11					-28	-6		Permit for modify operations: remove 585 hp Superior 8G825 Compressor engine
Campbell	Bear Paw Energy Incorporated	Coal Seam Compressor Station	Compressor Station	466706	4893955	13	1456	MD-424	8/31/1999	13.4					26.8	4	0.45	Permit for modify operations: add 1,390 hp Waukesha L7042 GSI compressor engine (1 g/hp-hr Nox) (2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Coal Seam Compressor Station	Compressor Station	466706	4893955	13	1456	MD-513	8/18/2000	32.8					39.5	10	2.02	Permit to modify an existing station to include the addition of two (2) Waukesha L7044GSI engines and correct the site horsepower for the Waukesha L7042GSI
Campbell	Bear Paw Energy Incorporated	Doud Station	Compressor Station	450911	4896797	13	1456	CT-1721	2/15/2000	7.4					14.9	2.2	0.46	permit proposed engines: two 385 hp CAT G3408TA compressor engines
Campbell	Bear Paw Energy Incorporated	East Rourke Compressor Station	Compressor Station	467655	4889055	13	1407	CT-1790	3/22/2000	22.2					45	6.6	1.38	permit proposed equipment: six 385 horsepower Caterpillar G3408TA engines
Campbell	Bear Paw Energy Incorporated	Farleigh Compressor Station	Compressor Station	452957	4894805	13	1494	CT-1723	2/15/2000	2.3					4.6	0.7	0.2	permit proposed engines plus the engine temp. waived for this site: one Waukesha F11GSI (waived under R40)
Campbell	Bear Paw Energy Incorporated	Farleigh Compressor Station	Compressor Station	452957	4894805	13	1494	CT-1723	2/15/2000	11.1					22.5	3	0.9	permit proposed engines plus the engine temp. waived for this site: three CAT G3408TA
Campbell	Bear Paw Energy Incorporated	Harry Wolf Field Compressor	Compressor Station	465129	4896616	13	1421	CT-1570A	1/19/2000	-3.7					-7.4	-1	-0.3	CT-1570: permit to construct two 385 hp Caterpillar G3408TA compressor engines (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO) at the existing G3408TA engine (2.0 g/hp-hr Nox, 2.0 g/hp-hr CO). CT-1570a: permit to remove one CAT G3408 and relocate to South Jim Wolf.
Campbell	Bear Paw Energy Incorporated	Harry Wolf Field Compressor	Compressor Station	465129	4896616	13	1421	CT-1570	9/23/1999	7.4					14.8	2	0.6	Permit to construct two, 385 hp Caterpillar G3408TA compressor engines at the existing station (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO) ... existing engine (2.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Hemela Compressor Station	Compressor Station	465682	4894330	13	1451	CT-1571	9/23/1999	11.1					22.2	3	0.69	Permit to construct three, 385 hp Caterpillar G3408TA compressor engines at existng facility (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO) existing engine (2.0 g/hp-hr Nox, 2.0 g/hp-hr CO
Campbell	Incorporated	Station	Station	465682	4894330	13	1451	CT-1571A	1/19/2000	-3.7					-7.4	-1	-0.23	remove one CAT G3408 and relocate to South Jim Wolf
Campbell	Bear Paw Energy Incorporated	J. Mill Iron Field Station	Compressor Station	461440	4896884	13	1435	CT-1576	9/23/1999	11.1					22.2	3	0.69	Permit to construct compressor station: three 385 hp Caterpillar G3408TA compressor engines (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Jim Wolf Field Comp. Station	Compressor Station	463173	4894189	13	1453	CT-1569	9/23/1999	11.1					22.2	3	0.69	Permit to construct three, 385 hp Caterpillar G3408TA compressor engines (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO) - one engine already exists at this site.

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Bear Paw Energy Incorporated	Jim Wolf Field Comp. Station	Compressor Station	463174	4894190	13	1453	CT-1569A	1/19/2000	-3.7					-7.4	-1	-0.23	remove one CAT G3408 and relocate to South Jim Wolf
Campbell	Bear Paw Energy Incorporated	Lone Tree Compressor Station	Compressor Station	452965	4908848	13	1425	CT-1582	10/1/1999	11.1					22.2	3	0.69	Permit to construct compressor station: 3, site-rated 385 hp Caterpillar G3408 compressor engines emissions (each): 1.0 g/hp-hr Nox, 2.0 g/hp-hr CO
Campbell	Bear Paw Energy Incorporated	Lone Tree Compressor Station	Compressor Station	452965	4908848	13	1425	MD-523	8/29/2000	24					47.1	7.5	1.45	Permit to modify an existing source to include the addition of either six 400 hp Caterpillar G3408TA engines or six 400 hp Waukesha F18GL engines equipped with oxidation catalysts
Campbell	Bear Paw Energy Incorporated	Meserve Field Station	Compressor Station	459533	4897347	13	1380	CT-1577	9/23/1999	14.8					29.6	4	1.2	Permit to costruct compressor station: four 385 hp Caterpillar G3408TA compressor engines (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Meserve Field Station	Compressor Station	459533	4897347	13	1380	CT-1577A	7/5/2000	4.7					8.9	2	0.3	add either 400 hp CAT 3408 or 400 hp Waukesha F18 and upgrade existing engines from 385 hp to 400 hp.
Campbell	Bear Paw Energy Incorporated	Milne Station	Compressor Station	456369	4892322	13	1460	CT-1725	2/15/2000	14.9					29.8	4	1.2	permit proposed equipment: four 385 hp CAT G3408TA compressor engines
Campbell	Bear Paw Energy Incorporated	North Ostlund/Daly Compressor Station	Compressor Station	450444	4913512	13	1318	CT-1581	10/13/1999	3.7					7.4	1	0.23	Permit to construct compressor station: one, 385 hp (site-rated) G3408TA Caterpillar engine emissions: 1.0 g/hp-hr Nox, 2.0 g/hp-hr CO
Campbell	Bear Paw Energy Incorporated	North Ostlund/Daly Compressor Station	Compressor Station	450444	4913512	13	1318	MD-440	3/16/2000	3.7					7.4	1	0.23	install an additional Caterpillar G3408 engine, relocate
Campbell	Bear Paw Energy Incorporated	North Ostlund/Daly Compressor Station	Compressor Station	450444	4913512	13	1318	MD-522	8/29/2000	12.3					24	3.9	0.69	Permit to modify an existing source to include the addition of either three 400 hp Caterpillar G3408TA engines or three 400 hp Waukesha F18GL engines equipped with oxidation catalysts, and also upgrade the existing CATS to 400 hp.
Campbell	Bear Paw Energy Incorporated	RAG Compressor Station	Compressor Station	461236	4888619	13	1419	CT-1994	8/18/2000	31.2					61.6	9.6	1.8	Permit to construct a new station consisting of either eight (8) 400 hp Caterpillar G3408TA engines or eight (8) 400 hp Waukesha F18GL engines. If installed, the F18GL engines will be equipped with oxidation catalyst
Campbell	Bear Paw Energy Incorporated	Rourke Field Compressor Station	Compressor Station	465821	4891800	13	1409	CT-1572	9/23/1999	25.9					51.8	7	1.56	Permit to construct seven additional 385 hp Caterpillar G3408TA compressor engines at the existing facility (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Rourke Field Compressor Station	Compressor Station	465821	4891800	13	1409	CT-1572A2	7/5/2000	-3.7					-7.4	-1	-0.3	remove one CAT 3408 to Meserve
Campbell	Bear Paw Energy Incorporated	South Coal Creek Pod A	Compressor Station	435562	4972488	13	1228	CT-1773	3/8/2000	11.1					22.5	3.3	0.9	permit proposed equipment: three 385 hp CAT G3408TA engines
Campbell	Bear Paw Energy Incorporated	South Coal Creek Pod B	Compressor Station	438540	4969113	13	1250	CT-1774	3/8/2000	14.8					30	4.4	1.2	permit proposed equipment: four 385 hp CAT G3408TA engines
Campbell	Bear Paw Energy Incorporated	South Jim Wolf Field Station	Compressor Station	462157	4891882	13	1438	CT-1573	9/23/1999	18.5					37	5	1.5	Permit to construct compressor station: five 385 hp Caterpillar G3408TA engines (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	South Jim Wolf Field Station	Compressor Station	462157	4891882	13	1438	CT-1573A	1/19/2000	11.1					22.2	3	0.9	relocation of 3 more CAT G3408 to this site from other Bear Paw Sites
Campbell	Bear Paw Energy Incorporated	South Jim Wolf Field Station	Compressor Station	462157	4891882	13	1438	MD-467	5/30/2000	23.4					23.4	7.8	1.2	permit installation of six additional 400 hp CAT 3408 engines
Campbell	Bear Paw Energy Incorporated	South Joe Creek Booster	Compressor Station	438420	4966687	13	1254	CT-1772	3/8/2000	45.7					45.7	13.7	3.6	permit proposed equipment; three 1580 hp Waukesha L7044 engines and one glycol dehydration unit
Campbell	Bear Paw Energy Incorporated	South Joe Creek Pod A	Compressor Station	432974	4968068	13	1127	CT-1775	3/8/2000	11.1					22.5	3.3	0.9	permit proposed equipment: three 385 hp CAT 3408 engines
Campbell	Bear Paw Energy Incorporated	South Joe Creek Pod B	Compressor Station	436918	4966042	13	1170	CT-1776	3/8/2000	7.4					15	2.2	0.6	permit proposed equipment: two 385 hp CAT 3408TA engines

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Bear Paw Energy Incorporated	South Joe Creek Pod C	Compressor Station	433972	4962752	13	1257	CT-1777	3/8/2000	7.4					15	2.2	0.6	permit proposed equipment: two 385 CAT G3408TA engines
Campbell	Bear Paw Energy Incorporated	South Meserve Compressor Station	Compressor Station	459154	4895622	13	1428	CT-1902	5/30/2000	23.2					47.4	7.8	1.2	permit proposed equipment: six 400 hp CAT G3408TA engines
Campbell	Bear Paw Energy Incorporated	South Ostlund/Daly Compressor Station	Compressor Station	450461	4909548	13	1384	CT-1580	10/13/1999	7.4					14.8	2	0.46	Permit to construct compressor station: two, 385 hp (site-rated) Caterpillar G3408TA enginesemissions: 1.0 g/hp-hr Nox, 2.0 g/hp-hr CO
Campbell	Bear Paw Energy Incorporated	South Ostlund/Daly Compressor Station	Compressor Station	450461	4909548	13	1384	MD-444	3/16/2000	3.7					7.5	1.1	0.23	install additional Caterpillar 3408 engine
Campbell	Bear Paw Energy Incorporated	South Ostlund/Daly Compressor Station	Compressor Station	450461	4909548	13	1384	MD-521	8/29/2000	16					31.4	5.2	0.98	Permit to modify an existing source to include the addition of either four 400 hp Caterpillar G3408TA engines or four 400 hp Waukesha F18GL engines equipped with oxidation catalysts. Also accounts for an increase in the horsepower of the existing compres
Campbell	Bear Paw Energy Incorporated	South Rourke Field Station	Compressor Station	465189	4888471	13	1399	CT-1574	9/23/1999	22.2					44.4	6	1.33	Permit to construct compressor station: six 385 hp Caterpillar G3408TA compressore engines (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Steinhoffal Field Station	Compressor Station	463917	4899462	13	1405	CT-1575	9/23/1999	18.5					37	5	1.11	Permit to construct compressor station: five 385 hp Caterpillar G3408TA compressor engines (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Swanson Field Compressor Station	Compressor Station	460102	4895164	13	1471	CT-1568	9/23/1999	7.4					14.8	2	0.46	Permit to construct two, 385 hp Caterpillar G3408TA compressor engines (1 g/hp-hr Nox, 2.0 g/hp-hr CO), site already has two engines in existance
Campbell	Bear Paw Energy Incorporated	Swansong Station	Compressor Station	452618	4895846	13	1477	CT-1722	2/15/2000	18.6					37.3	5.1	1.5	permit proposed equipment: five 385 hp CAT G3408TA compressor engines
Campbell	Bear Paw Energy Incorporated	Twenty Mile Compressor Station	Compressor Station	450273	4910844	13	1369	CT-1579	10/13/1999	7.4					14.8	2	0.46	Permit to construct compressor station: two 385 hp (site-rated) G3408TA Caterpillar engines, Caterpillar emissions (1.0 g/hp-hr Nox, 2.0 g/hp-hr CO)
Campbell	Bear Paw Energy Incorporated	Twenty Mile Compressor Station	Compressor Station	450273	4910844	13	1369	CT-1579	10/13/1999	13.4					20.1	4	3.1	Permit to construct compressor station: one 1,390 hp (site-rated) Waukesha L7042GSI compressor engine, Waukesha emissions (1.0 g/hp-hr Nox,
Campbell	Bear Paw Energy Incorporated	Twenty Mile Compressor Station	Compressor Station	450273	4910844	13	1369	MD-445	3/16/2000	3.7					7.5	1.1	0.3	install one additional Caterpillar G3408, relocation
Campbell	Bear Paw Energy Incorporated	Twenty Mile Compressor Station	Compressor Station	450273	4910844	13	1369	MD-445	3/16/2000	13.4					7.4	4	1	install one Waukesha 7042 engines, relocation
Campbell	Bear Paw Energy Incorporated	Twenty Mile Compressor Station	Compressor Station	450273	4910844	13	1369	MD-524	8/29/2000	32.4					38.8	9.8	2.02	Permit to modify an existing source to include the addition of two 1680 hp Waukesha L7044GSI engines
Campbell	Bear Paw Energy Incorporated	Twenty Mile Compressor Station	Compressor Station	450273	4910844	13	1369	MD-524	8/29/2000	4.5					8.6	1.5	0.27	Permit to modify an existing source to include the addition of either one 400 hp Caterpillar G3408TA engines or one 400 hp Waukesha F18GL engines equipped with oxidation catalysts and to correct the site horsepower rating from 385 to 400 hp
Campbell	Bear Paw Energy Incorporated	Twenty Mile Compressor Station	Compressor Station	450273	4910844	13	1369	MD-524	8/29/2000	0.8					1.4	0.4	0.05	Permit to modify an existing source to correct the site horsepower rating of Waukesha L7042GSI from 1390 to 1434 hp
Campbell	Bitter Creek Pipelines LLC	North Daly Battery	Compressor Station	448446	4925917	13	1298	CT-1674	1/12/2000	7.4					7.4	2.2	0.45	permit proposed compressor station with 2 Waukesha F18GSID engines
Campbell	Bitter Creek Pipelines LLC	Pineview Battery	Compressor Station	452003	4923000	13	1356	CT-1671	1/12/2000	7.4					7.4	2.2	0.45	permit proposed compressor station with 2 Waukesha F18GSID engines
Campbell	Bitter Creek Pipelines LLC	East Hall Battery	Compressor Station	455078	4929048	13	1298	MD-422	7/27/1999	3.7					9.2			installation of a 2nd site-rated 380 HP Caterpillar G3408TA engine (1.0 g/hp-hr Nox, 2.5 g/hp-hr CO)
Campbell	Bitter Creek Pipelines LLC	West Bowen Battery	Compressor Station	445352	4931104	13	1288	CT-1673	1/12/2000	7.4					7.4	2.2	0.44	permit proposed compressor station with 2 Waukesha F18GSID engines
Campbell	Bitter Creek Pipelines LLC	West Bowen Battery	Compressor Station	445352	4931104	13	1288	CT-1673A	4/5/2000	-3.7					-3.7	-1.1	-0.22	replace F18GSID with Ajax 2802LE (316 hp) (remove F18GSID)
Campbell	Bitter Creek Pipelines LLC	West Bowen Battery	Compressor Station	445352	4931104	13	1288	CT-1673A	4/5/2000	3.1					6.4	1.7	0.3	replace F18GSID with Ajax 2802LE (316 hp) (add Ajax 2802LE)
Campbell	Bitter Creek Pipelines LLC	West Hill Battery	Compressor Station	451502	4925000	13	1356	CT-1672	1/12/2000	7.4					7.4	2.2	0.44	permit proposed compressor station with 2 Waukesha F18GSID engines
Campbell	Bitter Creek Pipelines LLC	West Hill Battery	Compressor Station	451502	4925000	13	1356	CT-1672A	4/5/2000	-3.7					-3.7	-1.1	-0.22	replace one F18GLD with 316 hp Ajax 2802LE (remove F18GLD)
Campbell	Bitter Creek Pipelines LLC	West Hill Battery	Compressor Station	451502	4925000	13	1356	CT-1672A	4/5/2000	3.1					6.4	1.7	0.3	replace one F18GLD with 316 hp Ajax 2802LE (add Ajax 2802LE)

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	CMS Gas Gathering LLC	14-16Y Station	Compressor Station	415069	4948135	13	1158	CT-1585	9/27/1999	35.6	1.65	1.65	0.10		93.6	17.8	2.9	Permit to construct compressor station: three, 1,215 hp Waukesha L5790GL compressor engines (1.0 g/hp-hr Nox, 2.7 g/hp-hr CO)
Campbell	CMS Gas Gathering LLC	Billy Creek Y	Compressor Station	432560	4892104	13	1402	CT-1604	10/19/1999	36.1					94	17.7	6.9	Permit to construct compressor station: Three, 1,215 hp Waukesha L 5790 GL Compressor engines. engine emissions (each): 1.0 g/hp-hr Nox, 2.65 g/hp-hr CO
Campbell	CMS Gas Gathering LLC	Collums Central Station	Compressor Station	451283	4958664	13	1280	CT-1835	4/20/2000	35.6					35.5	9	2.1	permit proposed equipment: three 1215 hp Waukesha 5790 engines, one dehy
Campbell	CMS Gas Gathering LLC	Collums Compressor Station	Compressor Station	452619	4955604	13	1256	CT-1636	10/25/1999	5.1					8.7	2.7	1	Permit proposed equipment: 1-530 hp Waukesha H24GL compressor engine, 210 bbl storage tank form.: 0.2 g/hp-hr
Campbell	CMS Gas Gathering LLC	Collums Prospect "B" Compressor Station	Compressor Station	451157	4956039	13	1278	CT-2034	8/29/2000	23.4	1.08	1.08	0.06		62.2	5.8	1.6	Permit to construct a new station: two 1215 hp Waukesha L5790GL engines equipped with oxidation catalysts
Campbell	CMS Gas Gathering LLC	"B" Compressor Station	Compressor Station	451157	4956039	13	1278	CT-2034	8/29/2000	21	0.92	0.92	0.06		35.2	5.2	4	Permit to construct a new station: four 530 hp Waukesha H24GL engines, and associated equipment.
Campbell	CMS Gas Gathering LLC	Felix "B" Central Compressor Station	Compressor Station	438676	4913611	13	1325	CT-1935	7/5/2000	35.7	1.66	1.66	0.10		93.4	8.7	2.1	Permit to construct a compressor station which consists of three 1215 hp Waukesha L5790GL engines with oxidation catalysts plus dehy unit.
Campbell	CMS Gas Gathering LLC	Felix Central Station	Compressor Station	437681	4915341	13	1335	CT-1836	4/20/2000	35.6					35.5	9	2.1	permit proposed equipment: three 1215 hp Waukesha 5790 engines, one dehy
Campbell	CMS Gas Gathering LLC	Felix Prospect "B" Compressor Station	Compressor Station	441440	4912577	13	1402	CT-1630	10/25/1999	5.1					8.7	2.7	1	Permit proposed equipment: 1-530 hp Waukesha H24GL engine, 210 bbl storage tank
Campbell	CMS Gas Gathering LLC	Felix Prospect "C" Compressor Station	Compressor Station	439840	4914538	13	1368	CT-1732	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	1.01	permit either a 400 hp Waukesha F18 or 530 hp Waukesha H24 and one storage tank. Emissions based on worst case
Campbell	CMS Gas Gathering LLC	Felix Prospect "C" Compressor Station	Compressor Station	439840	4914538	13	1368	MD-512	8/10/2000	15.9	0.70	0.70	0.04		26.5	3.9	3	Permit to modify an existing station by adding three (3) 530 hp Waukesha H24GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	Felix Prospect "C" Compressor Station	Compressor Station	439840	4914538	13	1368	MD-512	8/10/2000	23.4	1.08	1.08	0.06		62.2	5.8	1.6	Permit to modify an existing station by adding two (2) 1215 hp Waukesha L5790GL engines
Campbell	CMS Gas Gathering LLC	Felix Prospect "D" Compressor Station	Compressor Station	436951	4913009	13	1341	CT-1730	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	1.2	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions based on worst case.
Campbell	CMS Gas Gathering LLC	Felix Prospect "E" Compressor Station	Compressor Station	439335	4910898	13	1402	CT-1728	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	1.2	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions based on worst case
Campbell	CMS Gas Gathering LLC	Felix Prospect "F" Compressor Station	Compressor Station	440410	4912074	13	1354	CT-1727	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	1.02	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions based on worst case
Campbell	CMS Gas Gathering LLC	Felix Prospect Compressor Station	Compressor Station	437791	4914698	13	1352	CT-1634	10/25/1999	5.1					8.7	2.7	1	Permit proposed equipment: 1-530 hp Waukesha H24GL engine, 210 bbl storage tank
Campbell	CMS Gas Gathering LLC	Felix Prospect Compressor Station	Compressor Station	437791	4914698	13	1352	MD-511	8/10/2000	26.1	1.14	1.14	0.07		43.9	6.5	5	Permit to modify an existing station by adding five (5) 530 hp Waukesha H24GL engines
Campbell	CMS Gas Gathering LLC	Fitch Ranch "B" Central Compressor Station	Compressor Station	441574	4942644	13	1280	CT-1958	8/10/2000	35.7	1.66	1.66	0.10		93.7	8.7	2.1	Permit to construct a new source consisting of three (3) 1215 hp Waukesha L5790GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	Fitch Ranch "B" Compressor Station	Compressor Station	440766	4940543	13	1273	CT-1733	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	1.2	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions are based on worst case
Campbell	CMS Gas Gathering LLC	Fitch Ranch "B" Compressor Station	Compressor Station	440766	4940543	13	1273	MD-501	7/20/2000	26	1.36	1.36	0.08		43.6	6.5	5	Permit to modify operations at this existing compressor station by adding five (5) 530 horsepower Waukesha H24GL compressor engines and associated equipment
Campbell	CMS Gas Gathering LLC	Fitch Ranch Central Station	Compressor Station	450795	4958176	13	1280	CT-1833	6/20/2000	35.6	0.17	0.17	0.10		35.5	9	2.1	permit proposed equipment: three 1215 hp Waukesha 5790 engines, one dehy
Campbell	CMS Gas Gathering LLC	Fitch Ranch Compressor Station	Compressor Station	439785	4940402	13	1285	CT-1735	2/15/2000	5	0.22	0.22	0.01		8.7	0.6	1.2	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions based on worst case
Campbell	CMS Gas Gathering LLC	Fitch Ranch Compressor Station	Compressor Station	439785	4940402	13	1285	MD-506	8/3/2000	26.1	1.14	1.14	0.07		43.9	6.5	5	Permit to modify an existing station by adding five (5) 530 hp Waukesha H24GL engines and associated equipment

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	CMS Gas Gathering LLC	Fitch Ranch Prospect "C" Compressor Station	Compressor Station	437832	4939822	13	1365	CT-1957	8/10/2000	31.2	1.36	1.36	0.08		52.6	7.8	6	Permit to construct a new source consisting of six (6) 530 hp Waukesha H24GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	Fitch Ranch Prospect "D" Compressor Station	Compressor Station	436682	4944505	13	1320	CT-1936	7/5/2000	31.2	1.36	1.36	0.08		52.6	7.8	6	Permit to construct a new compressor station which consists of six 530 hp Waukesha H24GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	Fitch Ranch Prospect "E" Compressor Station	Compressor Station	442965	4942561	13	1294	CT-1937	7/5/2000	31.2	1.4	1.4	0.1		52.6	7.8	6	Permit to construct a new compressor station which consists of six 530 hp Waukesha H24GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	Hank Williams Compressor Station	Compressor Station	417852	4949329	13	1171	CT-1934	7/6/2000	23.6	1.08	1.08	0.06		62.2	6.2	1.4	Permit to construct the station including two 1215 horsepower Waukesha L5790GL engines
Campbell	CMS Gas Gathering LLC	Hank Williams Compressor Station	Compressor Station	417852	4949329	13	1171	CT-1934	7/6/2000	21.7	0.92	0.92	0.06		35.3	5.2	4.8	Permit to construct the station including four 530 horsepower Waukesha H24GL engines, and associated equipment
Campbell	CMS Gas Gathering LLC	Inkline Prospect Compressor Station	Compressor Station	423630	4961795	13	1158	CT-1914	5/31/2000	11.7	0.54	0.54	0.03		11.7	3	0.7	permit proposed equipment: one 1215 hp Waukesha 5790
Campbell	CMS Gas Gathering LLC	Inkline Prospect Compressor Station	Compressor Station	423630	4961795	13	1158	CT-1914	5/31/2000	11.1	0.48	0.48	0.03		17.7	0.8	2.6	permit proposed equipment: two 530 hp Waukesha H24 engines, one TEG dehydration unit
Campbell	CMS Gas Gathering LLC	Iron Horse Prospect Compressor Station	Compressor Station	422191	4934881	13	1188	CT-2035	8/29/2000	23.4	1.08	1.08	0.06		62.2	5.8	1.6	Permit to construct a new station: two 1215 hp Waukesha L5790GL engines equipped with oxidation catalysts
Campbell	CMS Gas Gathering LLC	Iron Horse Prospect Compressor Station	Compressor Station	422191	4934881	13	1188	CT-2035	8/29/2000	21	0.92	0.92	0.06		35.2	5.2	4	Permit to construct a new station: four 530 hp Waukesha H24GL engines, and associated equipment.
Campbell	CMS Gas Gathering LLC	Kline Draw Compressor Station	Compressor Station	426564	4963325	13	1219	CT-1584	9/30/1999	5.1					8.7	2.7	1.0	Permit to construct compressor station: one, 530 hp Waukesha H24GL lean burn screw compressor engine emissions: 1.0 g/hp-hr Nox, 1.7 g/hp-hr CO
Campbell	CMS Gas Gathering LLC	Kline Draw Compressor Station	Compressor Station	426564	4963325	13	1219	MD-518	8/25/2000	26.1	1.10	1.10	0.07		43.9	6.5	5	Permit to modify an existing station to include the addition of five (5) 530 hp Waukesha H24GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	LS Draw "B" Compressor Station	Compressor Station	428385	4961099	13	1219	CT-1731	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	1.2	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions are based on worst case
Campbell	CMS Gas Gathering LLC	LS Draw "B" Compressor Station	Compressor Station	428315	4960971	13	1219	MD-517	8/25/2000	23.4	1.08	1.08	0.06		62.2	5.8	1.4	Permit to modify an existing source to include the addition of two (2) 1215 hp Waukesha L5790GL engines equipped with oxidation catalysts
Campbell	CMS Gas Gathering LLC	LS Draw "B" Compressor Station	Compressor Station	428315	4960971	13	1219	MD-517	8/25/2000	15.9	0.70	0.70	0.04		26.5	3.9	3	Permit to modify an existing source to include the addition of three (3) 530 horsepower Waukesha H24GL engines, and associated equipment.
Campbell	CMS Gas Gathering LLC	LS Draw C Compressor Station	Compressor Station	428357	4962823	13	1219	CT-1729	2/15/2000	5					8.7	0.6	1.0	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions based on worst case
Campbell	CMS Gas Gathering LLC	LS Draw C Compressor Station	Compressor Station	428357	4962823	13	1219	MD-516	8/25/2000	23.4	1.08	1.08	0.06		62.2	5.8	1.4	Permit to modify an existing source to include the addition of two (2) 1215 hp Waukesha L5790GL engines equipped with oxidation catalysts
Campbell	CMS Gas Gathering LLC	LS Draw C Compressor Station	Compressor Station	428357	4962823	13	1219	MD-516	8/25/2000	15.9	0.70	0.70	0.04		26.5	3.9	3	Permit to modify an existing source to include the addition of three (3) 530 horsepower Waukesha H24GL engines, and associated equipment.
Campbell	CMS Gas Gathering LLC	LS Draw Central Station	Compressor Station	429992	4961643	13	1219	CT-1834	4/20/2000	35.6	0.17	0.17	0.10		35.5	9	2.1	permit proposed equipment: three 1215 hp Waukesha 5790 engines, one dehy
Campbell	CMS Gas Gathering LLC	LS Draw Compressor Station	Compressor Station	429292	4961459	13	1219	CT-1633	10/25/1999	5.1					8.7	2.7	1	Permit proposed equipment: 1-530 hp Waukesha H24GL engine, 210 bbl storage tank
Campbell	CMS Gas Gathering LLC	LS Draw Compressor Station	Compressor Station	429292	4961459	13	1219	MD-515	8/25/2000	23.4	1.08	1.08	0.06		62.2	5.8	1.4	Permit to modify an existing source to include the addition of two (2) 1215 hp Waukesha L5790GL engines equipped with oxidation catalysts
Campbell	CMS Gas Gathering LLC	LS Draw Compressor Station	Compressor Station	429292	4961459	13	1219	MD-515	8/25/2000	15.9	0.66	0.66	0.04		26.5	3.9	3	Permit to modify an existing source to include the addition of three (3) 530 horsepower Waukesha H24GL engines, and associated equipment.
Campbell	CMS Gas Gathering LLC	Middle Prong Compressor Station	Compressor Station	426389	4942275	13	1242	CT-1635	10/25/1999	5.1					8.7	2.7	1	Permit proposed equipment: 1-530 hp Waukesha H24GL engine, 210 bbl storage tank
Campbell	CMS Gas Gathering LLC	Railroad "B" Central Compressor Station	Compressor Station	429043	4925377	13	1228	CT-1960	8/10/2000	35.7	1.66	1.66	0.10		93.7	8.7	2.1	Permit to construct a new source consisting of three (3) 1215 hp Waukesha L5790GL engines and associated equipment

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	CMS Gas Gathering LLC	Railroad "C" Central Compressor Station	Compressor Station	427560	4927028	13	1207	CT-1959	8/10/2000	35.7	1.66	1.66	0.10		93.7	8.7	2.1	Permit to construct a new source consisting of three (3) 1215 hp Waukesha L5790GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	Railroad Prospect "B" Compressor Station	Compressor Station	426705	4929058	13	1216	CT-1736	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	1	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions based on worst case
Campbell	CMS Gas Gathering LLC	Railroad Prospect "C" Compressor Station	Compressor Station	429249	4925108	13	1238	CT-1938	7/5/2000	23.4	1.08	1.08	0.06		62.2	6	1.6	Permit to construct a new compressor station: two 1215 hp Waukesha L5790GL engines
Campbell	CMS Gas Gathering LLC	Railroad Prospect "C" Compressor Station	Compressor Station	429249	4925108	13	1238	CT-1938	7/5/2000	21	0.92	0.92	0.06		35.2	5.2	4	Permit to construct a new compressor station: four 530 hp Waukesha H24GL engines and associated equipment
Campbell	CMS Gas Gathering LLC	Railroad Prospect Compressor Station	Compressor Station	426583	4927479	13	1234	CT-1632	10/25/1999	5.1					8.7	2.7	1	Permit proposed equipment: 1-530 hp Waukesha H24GL engine, 210 bbl storage tank
Campbell	CMS Gas Gathering LLC	Spotted Horse Compressor Station	Compressor Station	437413	4948390	13	1280	CT-1631	10/25/1999	5.1					8.7	2.7	1	Permit proposed equipment: 1-530 hp Waukesha H24GL engine, 210 bbl storage tank
Campbell	CMS Gas Gathering LLC	West Kitty	Compressor Station	444429	4910752	13	1402	CT-1734	2/15/2000	5	0.22	0.22	0.013		8.7	0.6	0.97	permit either 400 hp Waukesha F18 or 530 hp Waukesha H24 and storage tank. Emissions based on worst case
Campbell	CMS Gas Gathering LLC	Wild Horse Compressor Station	Compressor Station	419074	4943038	13	1158	CT-1583	9/30/1999	5.1	0.22	0.22	0.013		8.7	2.7	0.97	Permit to construct compressor station: one 530 hp Waukesha H24GL lean burn screw compressor engine emissions: 1.0 g/hp-hr Nox, 1.7 g/hp-hr CO
Campbell	CMS Gas Gathering LLC	Wild Horse Compressor Station	Compressor Station	419074	4943038	13	1158	MD-503	7/25/2000	10.2	0.44	0.44	0.03		17.4	2.6	2	Permit to modify this existing compressor station to include two (2) additional 530 horsepower Waukesha H24GL engines and a tank-to-truck loadout operation
Campbell	CMS Gas Gathering LLC	Wild Horse Prospect "B" Station	Compressor Station	423712	4942163	13	1219	CT-1915	5/31/2000	31.2	1.4	1.4	0.1		52.3	7.8	7.8	permit proposed equipment: six 530 hp Waukesha H24GL engines and a TEG dehy unit
Campbell	Coastal Field Services	Lazy B Station	Compressor Station	441634	4897185	13	1411	CT-1847	4/28/2000	18.3					18.3	12.2	0.9	permit proposed equipment: one 1265 hp CAT 3516LE engine, controlled with oxidation catalyst
Campbell	Coastal field Services	PRFC #1 (Rawhide) Compressor Station	Compressor Station	456760	4916352	13	1325	CT-1637	11/4/1999	14.5					29.1	9.7	3.39	Formaldehyde emissions is for total facility, with Caterpillar 3512 compressor engine (1004 hp Caterpillar G3512LE)
Campbell	Coastal field Services	PRFC #1 (Rawhide) Compressor Station	Compressor Station	456760	4916352	13	1325	CT-1637	11/4/1999	5.9					11.6	3.9	1.35	Formaldehyde emissions is for total facility, withWaukesha F18 compressor engine (400 hp Waukesha F18GL)
Campbell	Coastal field Services	PRFC #1 (Rawhide) Compressor Station	Compressor Station	456760	4916352	13	1325	CT-1637A	3/23/2000	-5.8					-11.6	-3.9	-1.35	replace Waukesha F18GL with 600 hp CAT 3412LE engine (remove F18GL)
Campbell	Coastal field Services	PRFC #1 (Rawhide) Compressor Station	Compressor Station	456760	4916352	13	1325	CT-1637A	3/23/2000	5.8					17.4	5.8	2	replace Waukesha F18GL with 600 hp CAT 3412LE engine (add 3412LE)
Campbell	Coastal Field Services	PRFC #11 Station	Compressor Station	447351	4935876	13	1277	CT-1891	5/22/2000	3.7					3.7	1.9	0.8	permit proposed equipment: one 400 hp Waukesha F18GL engine
Campbell	Coastal Field Services	PRFC #3 Compressor Station	Compressor Station	452025	4882611	13	1445	CT-1961	8/10/2000	58.2					38.7	38.7	2.7	Permit a new station consisting of three 1340 hp Caterpillar 3516LE engines equipped with oxidation catalysts
Campbell	Enron Midstream Services, LLC	Box Draw Main Compressor Station	Compressor Station	449755	4919744	13	1333	CT-1622	10/18/1999	32.4					32.4	16.2	2.02	Coal Bed Methane Compression; two (2) 1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	Box Draw Main Compressor Station	Compressor Station	449755	4919744	13	1333	MD-507	8/3/2000	32.4					32.4	16.2	2.02	Permit to modify an existing station by adding two 1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	Box Draw Pod 1	Compressor Station	445921	4923170	13	1315	CT-1623	10/18/1999	10.2					14.8	4.1	0.9	Coal Bed Methane Compression; two (2) 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Box Draw Pod 2	Compressor Station	446394	4919470	13	1403	CT-1624	10/18/1999	10.2					14.8	4.1	0.9	Coal Bed Methane Compression; two (2) 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Box Draw Pod 3	Compressor Station	448996	4919424	13	1335	CT-1625	10/18/1999	10.2					14.8	4.1	0.9	Coal Bed Methane Compression; two (2) 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Box Draw Pod 3	Compressor Station	448996	4919424	13	1335	MD-478	6/16/2000	5.1					8.9	2.1	1	permit additional Waukesha H24GL engine
Campbell	Enron Midstream Services, LLC	Box Draw Pod 4	Compressor Station	448378	4917829	13	1350	CT-1626	10/18/1999	10.2					14.8	4.1	0.9	Coal Bed Methane Compression; two (2) 530 hp Waukesha H24GL engines

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Enron Midstream Services, LLC	Box Draw Pod 4	Compressor Station	448378	4917829	13	1350	MD-479	6/16/2000	5.1					8.9	2.1	1	permit one additional Waukesha H24GL engine
Campbell	Enron Midstream Services, LLC	Box Draw Pod 5	Compressor Station	451376	4919132	13	1321	CT-1627	10/18/1999	5.1					7.4	2.1	0.45	Coal Bed Methane Compression; one (1) 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Box Draw Pod 5	Compressor Station	451376	4919132	13	1321	MD-508	8/3/2000	5.1					9.2	2	1	Permit to modify an existing station by adding one 530 hp Waukesha H24GL engine
Campbell	Enron Midstream Services, LLC	Box Draw Pod 6	Compressor Station	452236	4920978	13	1310	CT-1628	10/18/1999	5.1					7.4	2.1	0.45	Coal Bed Methane Compression; one (1) 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Box Draw Pod 6	Compressor Station	452236	4920978	13	1310	MD-509	8/3/2000	5.1					9.2	2	1	Permit to modify an existing station by adding one 530 hp Waukesha H24GL engine
Campbell	Enron Midstream Services, LLC	Clydesdale Compressor System	Compressor Station	447063	4883770	13	1481	CT-1780	3/15/2000	32.4					32.4	16.2	1.8	permit proposed equipment: two 1680 hp Waukesha L7044 engines
Campbell	Enron Midstream Services, LLC	Clydesdale Compressor System	Compressor Station	447063	4883770	13	1481	CT-1780	3/15/2000	10.2					17.8	4.2	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Clydesdale Pod 1	Compressor Station	447528	4884210	13	1489	CT-1781	3/15/2000	10.2					17.8	4.2	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Clydesdale Pod 2	Compressor Station	445511	4883836	13	1472	CT-1782	3/15/2000	10.2					17.8	4.2	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Hannum Compressor Station	Compressor Station	448074	4878899	13	1488	CT-1640	11/8/1999	32.6					32.6	16.2	2.02	Permit 2-1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	Hannum Compressor Station	Compressor Station	448074	4878899	13	1488	MD-460	5/11/2000	32.6					32.5	16.2	1.9	permit to add 2- 1680 hp Waukesha 7044 GSI compressor engines and 1 additional TEG dehy unit.
Campbell	Enron Midstream Services, LLC	Haracz Compressor Station	Compressor Station	453861	4882238	13	1436	CT-1788	3/15/2000	32.4					32.4	16.2	1.95	permit proposed equipment: two 1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	Hoe Creek Main Station	Compressor Station	437749	4880197	13	1471	CT-1856	5/5/2000	32.4					32.4	16.2	2.4	permit proposed equipment: two 1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	Hoe Creek Pod 1	Compressor Station	437336	4880605	13	1460	CT-1857	5/5/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Hoe Creek Pod 2 Station	Compressor Station	436565	4883280	13	1473	CT-1858	5/5/2000	10.2					17.9	4	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Hoe Creek Pod 2 Station	Compressor Station	436565	4883280	13	1473	CT-1858A	7/12/2000	20.4					35.6	8	3.6	move engines from Pod 3 and Pod 4 to new location (NOW 6 ENGINES)
Campbell	Enron Midstream Services, LLC	Hoe Creek Pod 5	Compressor Station	439160	4877789	13	1517	CT-1861	5/5/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Kudzu Main Compressor Station	Compressor Station	432450	4861406	13	1478	CT-1862	5/5/2000	48.6					48.6	24.3	2.4	permit proposed equipment: three 1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	Kudzu Main Compressor Station	Compressor Station	432450	4861406	13	1478	CT-1862	5/5/2000	10.2					17.8	4	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Kudzu Pod 1	Compressor Station	426486	4862349	13	1479	CT-1863	5/5/2000	10.2					17.9	4.1	1.7	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Kudzu Pod 2	Compressor Station	419450	4862778	13	1458	CT-1864	5/5/2000	10.2					17.9	4.1	1.7	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Kudzu Pod 3	Compressor Station	426457	4861085	13	1500	CT-1865	5/5/2000	10.2					17.9	4.1	1.7	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Kudzu Pod 4	Compressor Station	427560	4859242	13	1513	CT-1866	5/5/2000	10.2					17.9	4.1	1.7	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Kudzu Pod 5	Compressor Station	431635	4859019	13	1498	CT-1867	5/5/2000	10.2					17.9	4.1	1.7	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Kudzu Pod 6	Compressor Station	429206	4856353	13	1526	CT-1868	5/5/2000	10.2					17.9	4.1	1.7	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Maverick Compressor Station	Compressor Station	427915	4892331	13	1340	CT-1621	11/1/1999	58.2					15.6	15.6	7.8	Permit to construct compressor station: three (3) - 1,340 HP Caterpillar 3516 TALE Lean Burn engines emissions: 1.5 g/hp-hr Nox, 0.4 g/hp-hr CO
Campbell	Enron Midstream Services, LLC	Maverick Compressor Station	Compressor Station	427915	4892331	13	1340	MD-463	5/16/2000	19.4					5.2	5.2	2.6	install one additional 1340 hp CAT 3516LE engine (to be controlled with an oxidation catalyst)

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Enron Midstream Services, LLC	Mustang Main Station	Compressor Station	459291	4886429	13	1391	CT-1783	3/15/2000	32.4					32.4	16.2	1.6	permit proposed equipment: two 1680 hp Waukesha L7044
Campbell	Enron Midstream Services, LLC	Mustang Main Station	Compressor Station	459291	4886429	13	1391	CT-1783	3/15/2000	15.3					26.7	6.3	2.7	permit proposed equipment: three 530 Waukesha H24GL
Campbell	Enron Midstream Services, LLC	Mustang Pod 1	Compressor Station	458681	4887695	13	1397	CT-1784	3/15/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Mustang Pod 2	Compressor Station	458685	4887296	13	1395	CT-1785	3/15/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Mustang Pod 3	Compressor Station	459093	4887305	13	1398	CT-1786	3/15/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Mustang Pod 4	Compressor Station	458672	4886849	13	1390	CT-1787	3/15/2000	5.1					8.9	2.1	0.9	permit proposed equipment: one 530 hp Waukesha H24GL engine
Campbell	Enron Midstream Services, LLC	Natural Gas Fuels Main Station	Compressor Station	453979	4867959	13	1448	CT-1923	6/15/2000	16.2					16.2	8.1	1	permit proposed equipment: one 1680 hp Waukesha 7044
Campbell	Enron Midstream Services, LLC	Natural Gas Fuels Main Station	Compressor Station	453979	4867959	13	1448	CT-1923	6/15/2000	5.1					9	2	1	permit proposed equipment: one 530 hp Waukesha H24GL
Campbell	Enron Midstream Services, LLC	Natural Gas Fuels Pod 1	Compressor Station	454000	4868859	13	1474	CT-1924	6/15/2000	5.1					9	2	1	permit proposed equipment: one 530 hp Waukesha H24GL
Campbell	Enron Midstream Services, LLC	Natural Gas Fuels Pod 2	Compressor Station	454914	4868843	13	1482	CT-1925	6/15/2000	5.1					9	2	1	permit proposed equipment: one 530 hp Waukesha H24GL engine
Campbell	Enron Midstream Services, LLC	Natural Gas Fuels Pod 3	Compressor Station	454827	4866339	13	1473	CT-1926	6/15/2000	5.1					9	2	1	permit proposed equipment: one 530 hp Waukesha H24GL engine
Campbell	Enron Midstream Services, LLC	Palomino Compressor Station	Compressor Station	456729	4881053	13	1419	CT-1778	3/15/2000	48.6					48.6	24.3	2.4	permit proposed equipment: three 1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	Palomino Compressor Station	Compressor Station	456729	4881053	13	1419	CT-1778	3/15/2000	30.6					53.4	12.6	5.4	permit proposed equipment: six 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	Palomino Pod 1	Compressor Station	453731	4877372	13	1437	CT-1779	3/15/2000	15.4					26.8	6.2	2.7	Construct New Compressor Station with three 530 hp Waukesha H24GL engines.
Campbell	Enron Midstream Services, LLC	South Kitty Main Compressor Station	Compressor Station	447806	4900924	13	1447	CT-1870	5/8/2000	48.6					48.6	24.3	2.4	permit proposed equipment: three 1680 hp Waukesha L7044GSI engines
Campbell	Enron Midstream Services, LLC	South Kitty Pod 1	Compressor Station	451096	4902559	13	1480	CT-1871	5/8/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	South Kitty Pod 2	Compressor Station	453507	4902203	13	1461	CT-1872	5/8/2000	15.4					26.8	6.2	2.7	permit proposed equipment: three 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	South Kitty Pod 3	Compressor Station	450262	4899750	13	1439	CT-1873	5/8/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	South Kitty Pod 4	Compressor Station	448629	4900543	13	1442	CT-1874	5/8/2000	10.2					17.9	4.1	1.8	permit proposed equipment: two 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	South Kitty Pod 5	Compressor Station	448251	4904220	13	1453	CT-1875	5/8/2000	15.4					26.8	6.2	2.7	permit proposed equipment: three 530 hp Waukesha H24GL engines
Campbell	Enron Midstream Services, LLC	True Oil Pod 1	Compressor Station	442935	4884559	13	1517	CT-1927	6/16/2000	15.4					27	6	3	permit proposed equipment: three 530 hp Waukesha H24GL engines
Campbell	Hi-Pro Production	Echo Field Compressor Station	Compressor Station	455748	4914785	13	1327	CT-1917	6/1/2000	3.9					5.8	1.9	0.8	permit one 400 hp Waukesha F18 engine
Campbell	Independent Production Company	Hannum Pod 1	Compressor Station	448069	4879111	13	1484	CT-1641	11/8/1999	20.4					35.6	8	4	permit satellite pod with : 4 Waukesha 530 hp H24GL compressor engines
Campbell	Independent Production Company	Hannum Pod 1	Compressor Station	448069	4879111	13	1484	MD-461	5/16/2000	15.3					26.7	6	3	install three additional 530 hp Waukesha H24GL compressor engines
Campbell	Independent Production Company	Pronghorn North	Compressor Station	447812	4882220	13	1455	CT-1889	5/22/2000	15.3					26.7	6	3	permit proposed equipment; three 530 hp Waukesha H24GL engines
Campbell	Independent Production Company	Pronghorn South	Compressor Station	446544	4877331	13	1491	CT-1890	5/22/2000	35.7					62.3	14	7	permit proposed equipment: seven 530 hp Waukesha H24GL engines
Campbell	Independent Production Company	Terra Compressor Station	Compressor Station	450850	4889398	13	1466	CT-1962	8/10/2000	16.2					16.2	8.1	1	Permit to construct a new station: one 1680 hp Waukesha L7044GSI engine
Campbell	Independent Production Company	Terra Compressor Station	Compressor Station	450850	4889398	13	1466	CT-1962	8/10/2000	10.2					17.8	4	2	Permit to construct a new station: two 530 hp Waukesha H24GL engines
Campbell	Jim's Water Service	JWS-COOK 1-1	Compressor Station	443750	4909448	13	1408	CT-1590	9/23/1999	3.9					11.6	3.9	0.24	permit to construct compressor station: one 400 hp Caterpillar 3408 compressor engine (1.0 g/hp-hr Nox, 3.0 g/hp-hr CO) - formaldehyde emissions = 0.24 TPY

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Jim's Water Service	JWS-COOK 1-14	Compressor Station	441809	4907100	13	1433	CT-1589	9/23/1999	3.9					11.6	3.9	0.24	Permit to construct compressor station: one 400 hp Caterpillar 3408 engine (1.0 g/hp-hr Nox, 3.0 g/hp-hr CO) - formaldehyde emissions = 0.24 TPY
Campbell	Jim's Water Service	JWS-COOK 1-15	Compressor Station	440173	4905940	13	1366	CT-1588	9/23/1999	3.9					11.6	3.9	0.24	permit to construct compressor station: one, 400 hp Caterpillar 3408 compressor engine (1 g/hp-hr Nox, 3 g/hp-hr CO) - formaldehyde emissions = 0.24 TPY
Campbell	Jim's Water Service	JWS-COOK 1-16	Compressor Station	439807	4905766	13	1372	CT-1587	9/23/1999	3.9					11.6	3.9	0.24	Permit to construct compressor station: one, 400 hp Caterpillar 3408 compressor engine (1.0 g/hp-hr Nox, 3.0 g/hp-hr CO) - formaldehyde emissions = 0.24 TPY
Campbell	KN Gas Gathering	North Buck Draw Compressor Station	Compressor Station	446551	4819024	13	1547	CT-1951	8/29/2000	39.9					91.8	55.4	2.4	Permit to construct a new station which consists of three (3) 1380 hp Waukesha 5794GSI engines and associated equipment
Campbell	Maverick Pipeline LLC	Lazy B	Compressor Station	442921	4898655	13	1448	CT-1717	2/10/2000	4					4	5.2	0.24	permit proposed equipment: 2-207 hp Waukesha F1905G compressor engines
Campbell	Maverick Pipeline LLC	LX Bar	Compressor Station	433062	4959100	13	1220	CT-1716	2/10/2000	4					4	5.2	0.24	permit proposed compressor engines: 2 - 207 horsepower Waukesha F1905G engines
Campbell	Maverick Pipeline LLC	Wolf Compressor Station	Compressor Station	426903	4976530	13	1049	CT-1718	2/10/2000	4					4	5.2	0.24	permit proposed equipment: 2- 207hp Waukesha F1905G
Campbell	MIGC Incorporated	Bonepile Compressor Station	Compressor Station	453172	4888497	13	1428	MD-464	5/23/2000	3.9					11.6	3.9	0.04	install additional 400 hp CAT G3408 engine
Campbell	MIGC Incorporated	Buck Draw Compressor Station	Compressor Station	447159	4819193	13	1546	CT-1657	12/21/1999	14.5					28.9	14.5	0.14	Permit proposed equipment: 1500 hp Waukesha L7042GSI compressor engine and associated storage tanks
Campbell	MIGC Incorporated	Gas Draw Compressor Station	Compressor Station	442553	4945115	13	1260	CT-1452	12/8/1998	29.4					86.9	29	0.2	construct a new compressor station to process coal seam gas -- 2 Waukesha 7042 GSI compressor engines site 1500 hp (1 gm/hp-hr) with catalytic converters and air/fuel ratio controllers, dehydration unit, dehy condensate tank, 6 lube oil tanks, 2 antifreez
Campbell	MIGC Incorporated	Gas Draw Compressor Station	Compressor Station	442553	4945115	13	1260	MD-465	5/23/2000	32.4					64.8	32.4	0.4	permit additional two 1680 hp Waukesha 7044
Campbell	MIGC Incorporated	Gas Draw Compressor Station	Compressor Station	442553	4945115	13	1260	MD-465	5/23/2000	15.6					46.4	15.6	0.4	permit additional four 400 hp Caterpillar G3409
Campbell	MTG Operating Company	Carter Pod Compressor Station	Compressor Station	460150	4879243	13	1406	CT-1697	1/27/2000	5.1					7.4	2.6	0.86	permit proposed equipment: one 530 hp Waukesha H24GL engine 1.0 g/hp-hr Nox
Campbell	MTG Operating Company	Eagle II Compressor Station	Compressor Station	460141	4879311	13	1402	CT-1586	9/23/1999	3.6					12.7	3.6	0.97	Permit to construct compressor station: one rotary screw site rated 375 hp Waukesha F-18GL Lean Burn compressor engine emissions: 1.0 g/hp-hr Nox, 3.5 g/hp-hr CO
Campbell	MTG Operating Company	Hawk Point	Compressor Station	455078	4879884	13	1450	CT-1698	1/27/2000	10.2					14.8	5.2	1.72	permit proposed equipment: two 530 hp Waukesha H24GL engines 1.0 g/hp-hr
Campbell	MTG Operating Company	Madison #1	Compressor Station	457396	4884400	13	1408	CT-1689	1/27/2000	10.2					14.8	4.1	1.72	permit proposed equipment: two 530 hp Waukesha H24GL engines 1.0 g/hp-hr Nox
Campbell	MTG Operating Company	Madison #2	Compressor Station	458640	4885650	13	1388	CT-1696	1/27/2000	10.2					14.8	4.1	1.72	permit proposed equipment: two 530 hp Waukesha H24GL engines 1.0 g/hp-hr
Campbell	MTG Operating Company	MTG-1 Main Site	Compressor Station	460478	4884636	13	1389	CT-1692	1/27/2000	22.4					32.2	16	1.95	permit proposed equipment: 2 1665 hp Cat 3606LE engines 0.7 g/hp-hr Nox
Campbell	MTG Operating Company	MTG-1A Pod Site	Compressor Station	459958	4883742	13	1437	CT-1693	1/27/2000	5.1					7.4	2.1	0.86	permit proposed equipment: one 530 hp Waukesha H24GL engine 1.0 g/hp-hr Nox
Campbell	MTG Operating Company	MTG-1B Pod Site	Compressor Station	460828	4884171	13	1396	CT-1694	1/27/2000	5.1					7.4	2.1	0.86	permit proposed equipment: one 530 hp Waukesha H24GL engine 1.0 g/hp-hr Nox
Campbell	MTG Operating Company	MTG-1C Pod Site	Compressor Station	461569	4884694	13	1385	CT-1695	1/27/2000	5.1					7.4	2.1	0.86	permit proposed equipment: one 530 hp Waukesha H24GL engine 1.0 g/hp-hr
Campbell	MTG Operating Company	MTG-2 Main Site	Compressor Station	459920	4882562	13	1427	CT-1685	1/27/2000	22.4					32.2	16	1.95	permit proposed equipment: two 1665 hp CAT3606LE engines 0.7 g/hp-hr Nox
Campbell	MTG Operating Company	MTG-2A Pod Site	Compressor Station	458833	4881993	13	1395	CT-1686	1/27/2000	10.2					14.8	4.1	1.72	permit proposed equipment: two Waukesha H24GL engines site rated at 530 hp 1.0 g/hp-hr Nox
Campbell	MTG Operating Company	MTG-2B Pod Site	Compressor Station	460310	4882061	13	1416	CT-1687	1/27/2000	10.2					14.8	4.1	1.72	permit proposed equipment: two 530 hp Waukesha H24GL engines 1.0 g/hp-hr Nox
Campbell	MTG Operating Company	MTG-3 Main Site	Compressor Station	456422	4881892	13	1410	CT-1688	1/27/2000	22.4					32.2	16.2	1.95	Permit proposed equipment: two 1665 hp Caterpillar 3606LE 0.7g/hp-hr Nox
Campbell	MTG Operating Company	MTG-3B Pod Site	Compressor Station	456416	4882283	13	1402	CT-1690	1/27/2000	10.2					14.8	4.1	1.72	permit proposed equipment: two 530 hp Waukesha H24GL engines 1.0 g/hp-hr
Campbell	MTG Operating Company	MTG-3C Pod Site	Compressor Station	457554	4882181	13	1400	CT-1691	1/27/2000	10.2					14.8	4.1	1.72	Construct Compressor Station; two 530hp Waukesha H24GL engines

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	MTG Operating Company	MTG-3C Pod Site	Compressor Station	457554	4882181	13	1400	CT-1691A	3/13/2000	-5.1					-7.4	-2.1	-0.86	remove one engine from this site (WaukeshaH24) and move it to the 3C-1 site
Campbell	MTG Operating Company	MTG-3C-1 Pod Site	Compressor Station	457280	4880722	13	1419	CT-1691A	3/13/2000	5.1					7.4	2.1	0.86	permit relocation of one Waukesha H24 to the 3C-1 from the 3C
Campbell	Nielson & Associates	Hawk Point CBM Pod Facility	Compressor Station	456071	4875106	13	1469	CT-1928	6/16/2000	15.6					23.2	7.6	3.2	permit four 400 hp Waukesha F18GL engines
Campbell	Nielson & Associates	Hawk Point CBM Pod Facility	Compressor Station	456071	4875106	13	1469	CT-1928	6/16/2000	11					16.5	2.8	0.4	permit one 1140 hp Waukesha L7042GSI engine
Campbell	North Finn	Kane Screw	Compressor Station	464016	4929477	13	1207	CT-1894	5/22/2000	3.7					3.7	1.9	0.8	permit proposed equipment: one 400 hp Waukesha F18GL engine
Campbell	North Finn	North Carson Screw	Compressor Station	445635	4949043	13	1295	CT-1892	5/22/2000	3.7					3.7	1.9	0.8	permit proposed equipment: one 400 hp Waukesha engine
Campbell	North Finn	Oxbow Screw	Compressor Station	462422	4882589	13	1384	CT-1893	5/22/2000	3.7					3.7	1.9	0.8	permit proposed equipment: one 400 hp Waukesha F18GL engine
Campbell	Petrogulf Corporation	Petrogulf/Palomino Compressor Station	Compressor Station	461000	4874000	13	1475	MD-451	4/11/2000	2					2.8			permit installation of 400 hp Waukesha F18GL engine for 6 months after startup
Campbell	Petroleum Development Corporation	LX Bar Compressor Station	Compressor Station	433239	4959312	13	1158	CT-1520	5/24/1999	14.3					28.5	4.3	0.9	Permit to construct Facility: Waukesha L7042GSI - catalytically controlled - 1478 hp - 1g/hp-hr Nox
Campbell	Petroleum Development Corporation	LX Bar Compressor Station	Compressor Station	433239	4959312	13	1158	MD-493	7/14/2000	11.1					22.2	2.8	0.7	Permit to modify the station by adding one 1150 hp Waukesha L7042GSI compressor engine to the facility.
Campbell	Petroleum Development Corporation	Screw Compressor Station 1	Compressor Station	433268	4960083	13	1189	CT-1520	5/24/1999	3.9					7.7	1.2	0.2	Permit to construct facility: 400 HP Caterpillar G3408 Engine (catalytically controlled) - 1g/hp-hr Nox
Campbell	Petroleum Development Corporation	Screw Compressor Station 1	Compressor Station	433268	4960083	13	1189	MD-494	7/14/2000	3.9					5.8	1.9	0.8	Permit to modify an existing station by adding one 400 hp Waukesha F18GL compressor engine
Campbell	Petroleum Development Corporation	Screw Compressor Station 2	Compressor Station	433891	4960786	13	1250	CT-1520	5/24/1999	3.9					7.7	1.2	0.2	Permit to construct facility: 400 hp Caterpillar G3408 Engine (catalytically controlled) 1 g/hp-hr Nox
Campbell	Petroleum Development Corporation	Screw Compressor Station 2	Compressor Station	433891	4960786	13	1250	MD-495	7/14/2000	3.5					5.3	1.8	0.2	Permit to modify an existing station by adding one 365 hp Caterpillar G3408TA compressor engine
Campbell	Petroleum Development Corporation	Screw Compressor Station 3	Compressor Station	432458	4958302	13	1158	CT-1520	5/24/1999	3.9					7.7	1.2	0.2	Permit to Construct Facility: 400 hp Caterpillar G3408 Engine (catalytically Controlled) 1 g/hp-hr Nox
Campbell	Petroleum Development Corporation	Screw Compressor Station 3	Compressor Station	432458	4958302	13	1158	MD-496	7/14/2000	2.9					4.3	1.4	0.2	Permit to modify an existing station by adding one-300 hp Caterpillar G3406TA compressor engine
Campbell	Petroleum Development Corporation	Screw Compressor Station 4	Compressor Station	433321	4958787	13	1158	CT-1520	5/24/1999	3.9					7.7	1.2	0.2	Permit to Construct facility: 400 HP Caterpillar G3408 Engine (catalytically controlled) 1 g/hp-hr Nox
Campbell	Petroleum Development Corporation	Screw Compressor Station 4	Compressor Station	433321	4958787	13	1158	MD-497	7/14/2000	3.9					5.8	1.9	0.8	Permit to modify an existing station by adding one 400 hp Waukesha F18GL compressor engine
Campbell	Prima Oil & Gas Company	Stones Throw Main Station	Compressor Station	438721	4957206	13	1253	CT-1963	8/15/2000	58.2					69.9	17.7	2.7	Permit to construct a new station with three (3) 1340 horsepower Caterpillar 3516LE engines equipped with oxidation catalysts
Campbell	Prima Oil & Gas Company	Stones Throw Pod 1 Station	Compressor Station	438700	4954803	13	1259	CT-1964	8/15/2000	11.4					34	17	2.1	Permit to construct a new station with two (2) 586 hp Caterpillar G3412LE engines equipped with oxidation catalysts
Campbell	Prima Oil & Gas Company	Stones Throw Pod 2 Station	Compressor Station	436334	4955640	13	1243	CT-1965	8/15/2000	11.4					34	17	2.1	Permit to construct a new station with two (2) 586 hp Caterpillar G3412LE engines equipped with oxidation catalysts
Campbell	Prima Oil & Gas Company	Stones Throw Pod 3 Station	Compressor Station	437560	4957315	13	1260	CT-1966	8/15/2000	5.7					17	8.5	1.0	Permit to construct a new station with one (1) 586 hp Caterpillar G3412LE engine equipped with an oxidation catalysts
Campbell	Prima Oil & Gas Company	Stones Throw Pod 4 Station	Compressor Station	436876	4958514	13	1257	CT-1967	8/15/2000	11.4					34	17	2.1	Permit to construct a new station with two (2) 586 hp Caterpillar G3412LE engines equipped with oxidation catalysts
Campbell	Prima Oil & Gas Company	Stones Throw Pod 5 Station	Compressor Station	438721	4957367	13	1249	CT-1968	8/15/2000	11.4					34	17	2.1	Permit to construct a new station with two (2) 586 hp Caterpillar G3412LE engines equipped with oxidation catalysts

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Prima Oil & Gas Company	Stones Throw Pod 6 Station	Compressor Station	439744	4958962	13	1233	CT-1969	8/15/2000	5.7					17	8.5	1.0	Permit to construct a new station with one (1) 586 hp Caterpillar G3412LE engine equipped with an oxidation catalyst
Campbell	Pumpkin Buttes Pipeline & Marketing LLP	Pumpkin Buttes	Compressor Station	424193	4843932	13	1542	CT-1702	2/3/2000	4.8					14.4	4.8	0.86	permit proposed equipment: one 498 hp Waukesha H24GL engine
Campbell	Thunder Creek Gas Services	FB-1156	Compressor Station	422601	4955566	13	1205	CT-1789	3/16/2000	58.2					58.2	38.7	2.7	permit proposed equipment: three 1340 hp CAT 3516LE engines
Campbell	Thunder Creek Gas Services	FB-1156	Compressor Station	422601	4955566	13	1205	CT-1789	3/16/2000	18.3					25.7	21.3	1.2	permit proposed equipment: three 586 hp CAT 3412LE engines, two glycol dehydration units
Campbell	Thunder Creek Gas Services	FB-2055	Compressor Station	427566	4952360	13	1244	CT-1770	3/8/2000	38.8					38.8	25.8	1.8	permit proposed equipment: two Cat 3516LE engines
Campbell	Thunder Creek Gas Services	FB-2055	Compressor Station	427566	4952360	13	1244	CT-1770	3/8/2000	6.3					8.6	7.1	0.4	permit proposed equipment: one CAT 3412LE engine and a glycol dehydration unit.
Campbell	Thunder Creek Gas Services	House Creek Compressor Station	Compressor Station	436700	4855200	13	1527	CT-1564	9/17/1999	30.1					53.7	35.2	3.01	Permit to construct compressor station: two, 2225 hp Caterpillar 3608 LE engines 0.7 g/hp-hr Nox 1.25 g/hp-hr CO
Campbell	Thunder Creek Gas Services	Kitty Booster Station	Compressor Station	447877	4923794	13	1310	MD-449	3/23/2000	17					28.2	11.2	1.2	permit proposed equipment: two previously shut-down White Superior 8G825 engines
Campbell	Thunder Creek Gas Services	Kitty Booster Station	Compressor Station	447877	4923794	13	1310	MD-449	3/23/2000	19.4					13.1	13.1	0.9	permit proposed equipment: one CAT 3516LE
Campbell	Thunder Creek Gas Services	Kitty Booster Station	Compressor Station	447877	4923794	13	1310	MD-449	3/23/2000	11.4					14.6	11.4	0.8	permit proposed equipment: two CAT 3412LE engines
Campbell	Thunder Creek Gas Services	MTG Compressor Station	Compressor Station	450239	4928693	13	1246	CT-1519	5/7/1999	129					161	129.1	5.84	construct new facility: 6 - 2225 hp Caterpillar 3608 LE engines with oxidation catalyts
Campbell	Thunder Creek Gas Services	SC-0113	Compressor Station	454300	4919400	13	1285	MD-481	6/20/2000	11.4					25.4	11.4	3	permit proposed modification: install either 2 additional 586 hp CAT 3412LE engines or 2 400 hp Waukesha F18GL
Campbell	Thunder Creek Gas Services	SC-0113	Compressor Station	454300	4919400	13	1285	MD-481A	8/18/2000	-5.7					-12.7	-5.7	-1.5	remove one 3412
Campbell	Thunder Creek Gas Services	SC-0113	Compressor Station	454300	4919400	13	1285	MD-481A	8/18/2000	4.8					8.4	1.3	1	Install one 530hp Waukesha H24GL
Campbell	Thunder Creek Gas Services	SC-0156 Compressor Station	Compressor Station	423900	4957400	13	1183	CT-1992	8/18/2000	11.4					29.4	14.2	3	Permit to construct a new station consisting of two (2) 586 horsepower Caterpillar 3412LE engines
Campbell	Thunder Creek Gas Services	SC-0513	Compressor Station	447091	4920144	13	1408	CT-1842	4/26/2000	11.4					29.4	14.2	3	permit proposed equipment: two 586 hp CAT3412LE and storage tanks
Campbell	Thunder Creek Gas Services	SC-1003	Compressor Station	450831	4907493	13	1437	CT-1844	4/26/2000	11.4					29.4	14.2	3	permit proposed equipment: two 586 hp CAT 3412LE engines
Campbell	Thunder Creek Gas Services	SC-1413	Compressor Station	452190	4916451	13	1318	MD-482	6/20/2000	11.4					25.4	11.4	3	permit proposed modification: 2 additional 586 hp CAT 3412 engines or 2 400 hp Waukesha F18GL engines
Campbell	Thunder Creek Gas Services	SC-1513	Compressor Station	450108	4916216	13	1307	MD-483	6/20/2000	5.7					12.7	5.7	1.5	permit proposed modification: 1 additional 586 hp CAT 3413
Campbell	Thunder Creek Gas Services	SC-1613	Compressor Station	449415	4916034	13	1319	MD-484	6/20/2000	5.7					12.7	5.7	1.5	permit proposed modification: one additional 586 hp CAT 3412 engine
Campbell	Thunder Creek Gas Services	SC-2314	Compressor Station	442451	4915346	13	1389	CT-1843	4/26/2000	11.4					29.4	14.2	3	permit proposed equipment: two 586 hp CAT 3412LE
Campbell	Thunder Creek Gas Services	SC-2613	Compressor Station	452414	4912766	13	1332	CT-1945	7/18/2000	17.1					51	17.1	4.5	Permit to modify an existing compressor station by adding three 586 horsepower Caterpillar 3412LE compressor engines
Campbell	Thunder Creek Gas Services	SC-30-55	Compressor Station	426092	4951717	13	1238	CT-1769	3/8/2000	5.7					14.8	7.1	1.53	permit proposed equipment: one 586 hp CAT 3412LE
Campbell	Services	SC-30-55	Station	426092	4951717	13	1238	CT-1769	3/8/2000	3.6					4.7	1.4	0.73	permit proposed equipment: one 372 hp Waukesha F18
Campbell	Thunder Creek Gas Services	South Kitty (Kitty South #2)	Compressor Station	448563	4912582	13	1405	CT-1771	3/8/2000	14.3					42.9	14.3	1.4	permit proposed equipment: one 1478 hp Waukesha 7042
Campbell	Services	South #2)	Station	448563	4912582	13	1405	CT-1771	3/8/2000	58.2					39.3	39.3	2.7	permit proposed equipment: three 1340 hp CAT 3516LE
Campbell	Thunder Creek Gas Services	South Kitty (Kitty South #2)	Compressor Station	448563	4912582	13	1405	CT-1771	3/8/2000	5.7					7.4	5.7	1.5	permit proposed equipment: one 586 hp CAT 3412 engine
Campbell	Thunder Creek Gas Services	South Kitty (Kitty South #2)	Compressor Station	448563	4912582	13	1405	MD-499	7/18/2000	11.4					11.4	5.7	1.5	Permit to modify this existing station by adding two 586 hp Caterpillar 3412LE engines to the facility

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Western Gas Resources	Badger Station	Compressor Station	446146	4893515	13	1477	CT-1916	5/31/2000	11.7					34.8	11.7	0.12	permit proposed equipment: three 400 hp CAT 3408 engines
Campbell	Western Gas Resources	Badger Station	Compressor Station	446146	4893515	13	1477	CT-1916	5/31/2000	24.3					48.6	24.3	0.24	permit proposed equipment: three 840 hp Waukesha 3524 engines
Campbell	Western Gas Resources	Belle Creek Compressor Station	Compressor Station	445181	4885012	13	1478	CT-1538	6/28/1999	31.6					48.8	22.6	2.3	Permit to construct compressor station: 2, Caterpillar G3608 engines (2225 HP) (0.7 g/hp-hr Nox, 0.75 g/hp-hr CO). Also, construction of 12 screw compressors: 1, Catalytically controlled 400-HP caterpillar G3408 engines (1.0 g/hp-hr Nox, 3.0 g/hp-hr CO)
Campbell	Western Gas Resources	Belle Creek Compressor Station	Compressor Station	445181	4885012	13	1478	CT-1898	5/23/2000	32.9					65.2	32.4	0.4	permit installation of two additional 1680 hp Waukesha 7044GSI engines
Campbell	Western Gas Resources	Black Thunder Compressor Station	Compressor Station	469833	4834415	13	1467	MD-492	7/5/2000	32.4					64.8	32.4	0.4	Permit to modify this station due to the addition of two 1680 horsepower Waukesha L7044GSI compressor engines
Campbell	Western Gas Resources	Bud Station	Compressor Station	462346	4858615	13	1459	CT-1887	5/16/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp Caterpillar 3408 engines
Campbell	Western Gas Resources	Bud Station	Compressor Station	462346	4858615	13	1459	CT-1887	5/16/2000	16.2					32.4	16.2	0.16	permit proposed equipment: two 840 hp Waukesha 3524GSI engines
Campbell	Western Gas Resources	Caballo Pod Screw Compressor Station	Compressor Station	453418	4882965	13	1422	MD-400	4/20/1999	7.8					23.6	7.8	0.08	construct 2 - 400 hp Caterpillar G3408 engines (Catalytic Control)
Campbell	Western Gas Resources	Clarkellen Compressor Station	Compressor Station	448068	4871660	13	1505	CT-1537	6/28/1999	30.6					32.5	13	4.2	Permit to construct compressor station: 2, Caterpillar G3608 (2225HP) (0.7 g/hp-hr Nox, 0.75 g/hp-hr CO) and a 15 MSCFD dehydration unit. Also, construction of 12 screw compressor stations: 1, catalytically controlled, 400 HP Caterpillar G3408 (1.0 g/hp
Campbell	Western Gas Resources	Clarkellen Compressor Station	Compressor Station	448068	4871660	13	1505	CT-1830	4/13/2000	98.4					195.6	97.2	0.9	permit additional six Waukesha 1680 hp 7044 engines and three glycol dehys
Campbell	Western Gas Resources	Comet Station	Compressor Station	441640	4870315	13	1574	CT-1827	4/13/2000	15.4					46.3	15.4	0.16	permit proposed equipment: four 400 hp Caterpillar G3408 engines
Campbell	Western Gas Resources	Comet Station	Compressor Station	441640	4870315	13	1574	CT-1827	4/13/2000	8.1					16.2	8.1	0.08	permit proposed equipment: one 840 hp Waukesha 3524GSI engine
Campbell	Western Gas Resources	Coyote Station	Compressor Station	446740	4886915	13	1497	CT-1900	5/23/2000	11.7					34.8	11.7	0.12	permit proposed equipment: three 400 hp Caterpillar 3408 engines
Campbell	Western Gas Resources	Cumulus Station	Compressor Station	467035	4848315	13	1511	CT-1841	4/25/2000	7.8					23.2	7.8	0.08	permit proposed equipment: two 400 hp CAT 3408 engines
Campbell	Western Gas Resources	Cumulus Station	Compressor Station	467035	4848315	13	1511	CT-1841	4/25/2000	8.1					16.2	8.1	0.08	permit proposed equipment: one 840 hp Waukesha 3524 engine
Campbell	Western Gas Resources	Davis Station	Compressor Station	452346	4877015	13	1458	CT-1901	5/23/2000	23.4					69.6	23.4	0.24	permit existing equipment: six 400 hp Caterpillar 3408 engines
Campbell	Western Gas Resources	Dopplebach Compressor Station	Compressor Station	456543	4893137	13	1482	MD-468	5/31/2000	32.9					65.2	32.4	0.4	permit additional two 1680 hp Waukesha 7044 and dehy unit
Campbell	Western Gas Resources	Down Under Compressor Station	Compressor Station	455553	4872457	13	1500	CT-1768	3/7/2000	32.4					64.8	32.4	0.32	permit to install two Waukesha L7044
Campbell	Western Gas Resources	Down Under Compressor Station	Compressor Station	455553	4872457	13	1500	CT-1768	3/7/2000	4.3					11.7	3.9	0.04	permit to install one Caterpillar G3408, and one glycol dehy
Campbell	Western Gas Resources	Down Under Compressor Station	Compressor Station	455553	4872457	13	1500	MD-408	5/19/1999	0.4					13.9	7		permit to modify operations: replace 1500 hp Waukesha 7042 with 2225 hp Caterpillar G3608 compressor engine, revise allowable Nox emissions rates from the (2) 1500 hp Waukesh7042 compressor engines. construct 6 individual screw compressor stations with
Campbell	Western Gas Resources	Hail Station	Compressor Station	475035	4843215	13	1457	CT-1839	4/25/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp CAT 3408 engines
Campbell	Western Gas Resources	Hawk Point Compressor Station	Compressor Station	451347	4881362	13	1431	MD-400	4/20/1999	-14.5					-29	-14.5		remove 1500 hp Waukesha 7042 engine
Campbell	Western Gas Resources	Hawk Point Compressor Station	Compressor Station	451347	4881362	13	1431	MD-400	4/20/1999	14.9					42.9	21.5		add 2225 hp Caterpillar G3608 engine
Campbell	Western Gas Resources	Hawk Point Compressor Station	Compressor Station	451347	4881362	13	1431	MD-452	4/14/2000	48.6					97.2	48.6	0.48	permit modifications: install three 1680 hp Waukesha 7044 engines
Campbell	Western Gas Resources	Hawk Point Compressor Station	Compressor Station	451347	4881362	13	1431	MD-452	4/14/2000	4.9					12.4	4.1	0.12	permit modifications: one 400 hp Caterpillar 3408, two dehys

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Western Gas Resources	Hay Creek Station	Compressor Station	455897	4852315	13	1536	CT-1885	5/16/2000	97.7					194.8	97.2	1.2	permit proposed equipment: six 1680 hp Waukesha 7044GSI engines and a glycol dehy unit
Campbell	Western Gas Resources	Kestrel Station	Compressor Station	456829	4879715	13	1460	CT-1767	3/7/2000	3.9					11.6	3.9	0.04	install Cat 3408
Campbell	Western Gas Resources	Kestrel Station	Compressor Station	456829	4879715	13	1460	MD-480	6/16/2000	3.9					11.6	3.9	0.04	permit additional 400 hp CAT 3408 engine
Campbell	Western Gas Resources	Kestrel Station	Compressor Station	456829	4879715	13	1460	MD-480	6/16/2000	8.1					24.4	8.1	0.08	permit additional 840 hp Waukesha 3524GSI engine
Campbell	Western Gas Resources	Kline Draw Station	Compressor Station	431635	4965515	13	1264	CT-1852	5/2/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp CAT G3408
Campbell	Western Gas Resources	Krypton Station	Compressor Station	451024	4869915	13	1473	CT-1537	6/28/1999	7.8					23.2	7.8	0.08	2 CAT G3408 site rated at 400 hp
Campbell	Western Gas Resources	Lane Station	Compressor Station	446218	4870315	13	1501	CT-1537	6/28/1999	11.7					34.8	11.7	0.12	3 CAT G3408 site rated at 400 hp
Campbell	Western Gas Resources	Lane Station	Compressor Station	446218	4870315	13	1501	CT-1824	4/13/2000	-3.9					-11.6	-3.9	-0.04	replace one CAT 3408 with one Waukesha 3524 (remove CAT 3408)
Campbell	Western Gas Resources	Lane Station	Compressor Station	446218	4870315	13	1501	CT-1824	4/13/2000	8.1					16.2	8.1	0.08	replace one CAT 3408 with one Waukesha 3524 (add Waukesha 3524)
Campbell	Western Gas Resources	Lane Station	Compressor Station	446218	4870315	13	1501	MD-489	6/22/2000	7.8					23.2	7.8	0.08	install two additional 400 hp CAT 3408 engines
Campbell	Western Gas Resources	Lane Station	Compressor Station	446218	4870315	13	1501	MD-489	6/22/2000	8.1					16.2	8.1	0.08	install one additional 840 hp Waukesha 3524 engine.
Campbell	Western Gas Resources	Lightning Station	Compressor Station	472751	4845615	13	1461	CT-1840	4/25/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp CAT 3408 engines
Campbell	Western Gas Resources	Linn Draw Station	Compressor Station	433035	4949015	13	1202	CT-1853	5/2/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp CAT G3408
Campbell	Western Gas Resources	Little Thunder Compressor Station	Compressor Station	463780	4839401	13	1482	CT-1453	12/8/1998	43.8					130.2	43.4	0.20	new compressor station -- 3 1500 site HP Waukesha 7042 GSI compressor engines (1 gm/hp-hr NOx) with catalytic converters and air/fuel ratio controller, dehydration unit, dehy condensate tank, 9 lube oil tanks, 3 antifreeze tanks
Campbell	Western Gas Resources	Little Thunder Compressor Station	Compressor Station	463780	4839401	13	1482	MD-491	7/5/2000	32.4					64.8	32.4	0.4	Permit to modify this station due to the addition of two 1680 horsepower Waukesha L7044GSI compressor engines
Campbell	Resources	LX Bar Compressor	Station	433328	4959147	13	1237	CT-1855	5/2/2000	2.3					1.9	0.8	0.08	permit proposed equipment: 80 hp Ajax DPC-80 engine
Campbell	Western Gas Resources	LX Bar Compressor	Compressor Station	433328	4959147	13	1237	CT-1855	5/2/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp CAT G3408 engines
Campbell	Resources	Meserve Station	Station	457818	4891815	13	1454	MD-469	5/31/2000	11.7					34.8	11.7	0.12	recognize as built configuration of MD-402
Campbell	Western Gas Resources	Meserve Station	Compressor Station	457829	4891815	13	1454	MD-469A	6/5/2000	3.9					11.6	3.9	0.04	add Cattail pod engine to equipment list (400 hp CAT 3408)
Campbell	Western Gas Resources	Meteor Station	Compressor Station	444946	4865817	13	1501	CT-1826	4/13/2000	15.4					46.3	15.4	0.16	permit proposed equipment: four 400 hp Caterpillar G3408TA engines
Campbell	Western Gas Resources	Meteor Station	Compressor Station	444946	4865817	13	1501	CT-1826	4/13/2000	16.2					32.4	16.2	0.16	permit proposed equipment: two 840 hp Waukesha 3524GSI engines
Campbell	Western Gas Resources	Moon Station	Compressor Station	442494	4879615	13	1504	CT-1829	4/13/2000	15.4					46.3	15.4	0.16	permit proposed equipment: four 400 hp CAT 3408 engines
Campbell	Western Gas Resources	Moon Station	Compressor Station	442494	4879615	13	1504	CT-1829	4/13/2000	16.2					32.4	16.2	0.16	permit proposed equipment: two 840 hp Waukesha 3524GSI
Campbell	Resources	Station	Station	450535	4884615	13	1486	MD-472	5/31/2000	15.6					46.4	15.6	0.16	recognize as built configuration of MD-402
Campbell	Western Gas Resources	MTG 2 Screw Compressor Station	Compressor Station	455078	4879884	13	1450	MD-400	4/20/1999	3.9					11.8	3.9	0.04	construct 400 hp Caterpillar G3408 engine (Catalytic Control)
Campbell	Western Gas Resources	MTG 2 Screw Compressor Station	Compressor Station	455078	4879884	13	1450	MD-400	4/20/1999	10.1					9	3.9	0.5	530 hp Waukesha H24GL engine (lean burn)
Campbell	Western Gas Resources	Porter Station	Compressor Station	454618	4898515	13	1436	MD-471	5/31/2000	11.7					34.8	11.7	0.12	recognize as built configuration of MD-402
Campbell	Western Gas Resources	Reeves Station	Compressor Station	450635	4874015	13	1499	CT-1537	6/28/1999	15.4					46.3	15.4	0.2	4 CAT G3408 site rated at 400 hp
Campbell	Western Gas Resources	Rocky Station	Compressor Station	458735	4854615	13	1528	CT-1888	5/16/2000	7.8					23.2	7.8	0.08	permit proposed equipment: two 400 hp Caterpillar G3408 engines

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Campbell	Western Gas Resources	Rocky Station	Compressor Station	458735	4854615	13	1528	CT-1888	5/16/2000	16.2					32.4	16.2	0.16	permit proposed equipment: two 840 hp Waukesha 3524GSI engines
Campbell	Western Gas Resources	SA Creek Station	Compressor Station	429246	4955615	13	1166	CT-1854	5/2/2000	23.4					69.6	23.4	0.24	permit proposed equipment: six 400 hp CAT G3408 engines
Campbell	Western Gas Resources	Sager Compressor Station	Compressor Station	463740	4853715	13	1452	CT-1886	5/16/2000	7.8					23.2	7.8	0.08	permit proposed equipment: two 400 hp Caterpillar G3408 engines
Campbell	Western Gas Resources	Sager Compressor Station	Compressor Station	463740	4853715	13	1452	CT-1886	5/16/2000	24.3					48.6	24.3	0.24	permit proposed equipment: three 840 Waukesha 3524GSI engines
Campbell	Western Gas Resources	Sleet Station	Compressor Station	475935	4846115	13	1503	CT-1838	4/25/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp CAT 3408 engines
Campbell	Western Gas Resources	Spotted Horse Station	Compressor Station	429064	4959715	13	1228	CT-1850	5/2/2000	48.6					97.2	48.6	0.48	permit proposed equipment: three 1680 hp Waukesha L7044GSI engines
Campbell	Western Gas Resources	Spotted Horse Station	Compressor Station	429064	4959715	13	1228	CT-1850	5/2/2000	23.9					70	23.4	0.24	permit proposed equipment: six 400 hp CAT G3408 engines and TEG dehydration unit.
Campbell	Western Gas Resources	Star Station	Compressor Station	443840	4876015	13	1499	CT-1828	4/13/2000	15.4					46.3	15.4	0.16	permit four 400 hp Caterpillar G3408 engines
Campbell	Western Gas Resources	Star Station	Compressor Station	443840	4876015	13	1499	CT-1828	4/13/2000	8.1					16.2	8.1	0.08	permit one 840 hp Waukesha 3524GSI engine
Campbell	Western Gas Resources	Stone Draw Station	Compressor Station	438135	4954015	13	1266	CT-1851	5/2/2000	15.6					46.4	15.6	0.16	permit proposed equipment: four 400 hp CAT G3408 engines
Campbell	Western Gas Resources	Stout Compressor Station	Compressor Station	457229	4893815	13	1483	MD-470	5/31/2000	7.8					23.2	7.8	0.08	recognize as built configuration of MD-402
Campbell	Western Gas Resources	Stout Compressor Station	Compressor Station	457229	4893815	13	1483	MD-470A	6/5/2000	3.9					11.6	3.9	0.04	add engine from Wallam Station to equipment list (400 hp CAT 3408)
Campbell	Western Gas Resources	Tessmocker Station	Compressor Station	445729	4873215	13	1515	CT-1537	6/28/1999	11.7					34.8	11.7	0.12	3 CAT G3408 site rated at 400 hp
Campbell	Western Gas Resources	Tessmocker Station	Compressor Station	445729	4873215	13	1515	CT-1825	4/13/2000	-3.9					-11.6	-3.9	-0.04	replace one CAT 3408 with one Waukesha 3524 (remove CAT 3408)
Campbell	Western Gas Resources	Tessmocker Station	Compressor Station	445729	4873215	13	1515	CT-1825	4/13/2000	8.1					16.2	8.1	0.08	replace one CAT 3408 with one Waukesha 3524 (add Waukesha 3526)
Campbell	Western Gas Resources	Wallaby Station	Compressor Station	455735	4871315	13	1510	CT-1766	3/7/2000	15.6					46.4	15.6	0.16	install four Caterpillar G3408 engines
Campbell	Western Gas Resources	Werner Compressor Station	Compressor Station	434933	4952715	13	1249	CT-1849	5/2/2000	14.5					29	14.5	0.14	permit proposed equipment: one 1500 hp Waukesha L7042GSI engine
Campbell	Western Gas Resources	Werner Compressor Station	Compressor Station	434933	4952715	13	1249	CT-1849	5/2/2000	49.1					97.6	48.6	0.48	permit proposed equipment: three 1680 hp Waukesha L7044GSI engines and one TEG dehydration unit.
Campbell	Western Gas Resources	Wolf Compressor Station	Compressor Station	449740	4894715	13	1474	CT-1899	5/23/2000	11.7					34.8	11.7	0.12	three 400 hp CAT G3408
Carbon	Colorado Interstate Gas	Muddy Gap Station	Compressor Station	300051	4693931	13		MD-387	1/4/1999	0.3					1.5	6.8		construct a pig receiver, pressurized NGL bullet, and flare uncontrolled (167.3 TPY VOC)
Converse	Thunder Creek Gas Services	Buckshot Treating Facility	Compressor Station	449470	4737309	13	1570	CT-1528	6/15/1999	58.8					35.3	37.8	5.9	Permit to construct 360MDFD gas treating facility: six 1,450 hp CAT 3606 LE turbo charged compressor station (0.7 gm/hp-hr Nox, 0.42 gm/hp-hr CO) each
Converse	Thunder Creek Gas Services	Buckshot Treating Facility	Compressor Station	449610	4737309	13	1570	CT-1528	6/15/1999	39.4					34.4	42	0	Permit to construct 360MDFD gas treating facility: two 97.5 MMBtu/hr amine heaters and associated equipment
Converse	Western Gas Resources	Python Compressor Station	Compressor Station	455100	4799600	13	1499	MD-476	6/5/2000	8.3					16.2	8.3	0.08	install 840 hp Waukesha L3524GSI engine Previously known as the Nortex
Converse	Wyoming Interstate Gas	Douglas Compressor Station	Compressor Station	449410	4736830	13	1569	CT-1540	7/20/1999	27.5					30.6	8.8	2.20	Permit to construct compressor station: (1) 6,278 hp solar Taurus 60-T7300S fild gas fired turbine (5.1 lb/hr Nox, 6.2 lb/hr CO)
Converse	Wyoming Interstate Gas	Douglas Compressor Station	Compressor Station	449410	4736830	13	1569	CT-1540	7/20/1999	2.9					0.9	3.3	0.30	Permit to construct compressor station: (1) 529 hp emergency generator and associated equipment (2.6 g/hp-hr Nox, 1.8 g/hp-hr CO)
Converse	Wyoming Interstate Gas	Douglas Compressor Station	Compressor Station	449410	4736830	13	1569	MD-453	4/15/2000	27.5					30.6	8.8	2.20	permit modification for the installation of a 6278 hp Solar Taurus 60-T7300S gas fired turbine
Johnson	KLT Gas Operating Company	Holler Draw Unit	Compressor Station	411292	4847226	13	1433	CT-1821	4/10/2000	3.7					7.5	1	0.2	Construct 385-hp CAT G3408TA Compressor Engine
Johnson	Redstone Gas Partners LLC	Piney Creek Central Station	Compressor Station	357433	4929760	13	1441	CT-1950	7/25/2000	86.2					85.9	31.8	5.4	Permit to construct a new compressor station which consists of six (6) 1478 Waukesha 7042GSI compressor engines and one (1) dehydration unit

C.4.1 New Sources: Permit Actions (9/1/94 - 8/31/00) (Continued)

				Location				Permit/Waiver		Change in Potential Emissions due to the Permitting Action (TPY)								
County	Company	Facility	Facility Classificaiton	UTM X (m)	UTM Y (m)	Zone	Elev. (m)	No.	Date	NOx	PM_{10}	$PM_{2.5}$ [b]	SO_2	SOx	CO	VOCs	HCHO	Permit/Waiver Description
Johnson	Williston Basin Pipeline Company	Billy Creek Compressor	Compressor Station	361520	4886923	13	1515	MD-415	6/21/1999	14					36	7	0.89	Permit modifications at Compressor station.: installation of 1,478 HP Waukesha 7042GSI compressor engine. (Catalytically controlled) 1 g/hp-hr Nox, 2.5 g/hp-hr CO
Johnson	Williston Basin Pipeline Company	Billy Creek Compressor	Compressor Station	361520	4886923	13	1515	MD-415	6/21/1999	14					10	0.27		Permit modifications at Compressor station.: Establish enforceable limits so that station qualifies as synthetic minor - Increase operation hours of (2) 247 hp Ingersoll Rand compressors from 6175 to 7400 hours per year.
Sheridan	CMS Gas Gathering LLC	Arvada "T" Central Compressor Station	Compressor Station	415557	4949179	13	1192	CT-1947	7/20/2000	35.7	1.7	1.7	0.1		93.4	8.7	2.1	Permit to construct a new compressor station with three (3) 1215 hp Waukesha L5790GL compressor engines equipped with oxidation catalysts and associated equipment
Sheridan	CMS Gas Gathering LLC	Hank Williams Prospect "B"	Compressor Station	414869	4945947	13	1124	CT-1944	7/18/2000	23.4	1.1	1.1	0.1		62.2	5.8	1.4	Permit to construct a new compressor station with two 1215 hp Waukesha L5790GL engines equipped with oxidation catalysts.
Sheridan	CMS Gas Gathering LLC	Hank Williams Prospect "B"	Compressor Station	414869	4945947	13	1124	CT-1944	7/18/2000	21	0.9	0.9	0.1		35.2	5.2	4	Permit to construct a new compressor station with four 530 hp Waukesha H24GL engines, and associated equipment.
Sheridan	CMS Gas Gathering LLC	Hank Williams Prospect "C"	Compressor Station	416611	4948118	13	1158	CT-1943	7/18/2000	23.4	1.08	1.08	0.06		62.2	5.8	1.4	Permit to construct a new station: two 1215 hp Waukesha L5790GL engines equipped with oxidation catalysts
Sheridan	CMS Gas Gathering LLC	Hank Williams Prospect "C"	Compressor Station	416611	4948118	13	1158	CT-1943	7/18/2000	21	0.92	0.92	0.06		35.2	4.2	4	Permit to construct a new station: four 530 hp Waukesha H24GL engines, and associated equipment.
Sheridan	CMS Gas Gathering LLC	Wild Horse Central Station	Compressor Station	419489	4942855	13	1158	CT-1832	6/5/2000	35.6					35.5	9	2.1	permit proposed equipment: three 1215 hp Waukesha 5790 engines, one dehy
Sheridan	Federated Oil and Gas	Wild Horse Creek Compressor Station	Compressor Station	417300	4943669	13	1147	CT-1942	7/17/2000	14.3					14.3	10.7	0.14	Permit to construct a new compressor station with one 1478 horsepower Waukesha 7042GSI engine
Sheridan	Federated Oil and Gas	Wild Horse Creek Compressor Station	Compressor Station	417300	4943669	13	1147	CT-1942	7/17/2000	7.8					11.6	3.8	0.08	Permit to construct a new compressor station with two 400 hp Waukesha F18GL engines with oxidation catalysts
Sheridan	Redstone Gas Partners LLC	Gladewater Central Station	Compressor Station	351611	4979587	13	1168	MD-490	6/27/2000	71.5					71.5	26.5	4.5	Modify the Gladewater Central Station due to the addition of five (5) 1478 horsepower Waukesha 7042GSI compressor engines.

C.4 Wyoming Sources

C.4.2 RFD Sources

County	Company	Facility	Facility Classificaiton	Location			Elev. (m)	Permit		Change in Potential Emissons due to the Permitting Action (TPY)								Note
				UTM X (m)	UTM Y (m)	Zone		Date	No.	NOx	PM_{10}	$PM_{2.5}$ [a]	SO_2	SOx	CO	VOCs	HCHO	
Campbell	Basin Electric Power Coop.	Arvada Generating Station	Power Plant	422,539	4,949,145	13	1230	[c]		29.63	1.96	1.96	1.01		36.15	10.37	2.35E-01	Turbine Generator Taurus 70 - 1
				422,539	4,949,137	13	1229			29.63	1.96	1.96	1.01		36.15	10.37	2.35E-01	Turbine Generator Taurus 70 - 2
				422,539	4,949,130	13	1229			29.63	1.96	1.96	1.01		36.15	10.37	2.35E-01	Turbine Generator Taurus 70 - 3
				422,518	4,949,157	13	1230			1.38	0.42	0.42	0.15		1.44	0.02	6.22E-03	Backup Generator
Campbell	Basin Electric Power Coop.	Barber Creek Generating Station	Power Plant	428,353	4,893,113	13	1383	[d]		29.09	1.92	1.92	0.99		35.49	10.18	2.30E-01	Turbine Generator Taurus 70 - 1
				428,355	4,893,106	13	1383			29.09	1.92	1.92	0.99		35.49	10.18	2.30E-01	Turbine Generator Taurus 70 - 2
				428,358	4,893,099	13	1382			29.09	1.92	1.92	0.99		35.49	10.18	2.30E-01	Turbine Generator Taurus 70 - 3
				428,330	4,893,117	13	1385			1.38	0.42	0.42	0.15		1.44	0.02	6.22E-03	Backup Generator
Campbell	Basin Electric Power Coop.	Hartzog Generating Station	Power Plant	437,170	4,847,024	13	1570	[c]		28.39	1.87	1.87	0.91		34.64	9.94	2.25E-01	Turbine Generator Taurus 70 - 1
				437,169	4,847,016	13	1570			28.39	1.87	1.87	0.91		34.64	9.94	2.25E-01	Turbine Generator Taurus 70 - 2
				437,169	4,847,009	13	1570			28.39	1.87	1.87	0.91		34.64	9.94	2.25E-01	Turbine Generator Taurus 70 - 3
				437,148	4,846,996	13	1570			1.38	0.42	0.42	0.15		1.44	0.02	6.22E-03	Backup Generator

[a] Emisisons of $PM_{2.5}$ were assumed to be the same as those for PM_{10}.

[b] Assumed ambient temp. 45 deg. Farenheit and 100% load.

[c] Permit application submitted, but permit has not been issued as of 7/25/01.

[d] Permit application has yet to be submitted as of 7/25/01.

Appendix D:

Procedures for Predicting Maximum and Daily Visibility Impairment

The Federal Land Managers' Air-Quality-Related Values Workgroup (FLAG), consisting of the Forest Service in the U.S. Department of Agriculture (USDA), and the National Park Service and U.S. Fish and Wildlife Service in the Department of the Interior (USDI), has established recommended procedures to identify and evaluate potential visibility impacts primarily in mandatory federal PSD Class I areas (FLAG 2000). The procedures are designed to help FLAG agencies, when they are reviewing New Source Review permit applications, to focus on the potential contribution of anthropogenic pollutant emissions to visibility degradation. Although the FLAG visibility analysis approach applies conservative assumptions (tending to overestimate potential impacts), it does represent an appropriate screening level analysis (e.g., if potential impacts do not exceed the conservative screening thresholds, then further refined analysis is not necessary).

FLAG has developed a generalized analysis approach on the basis of the following:

- Estimation of the potential concentration of visibility-impairing pollutants (mainly primary fine particulate matter [PM], secondary ammonium nitrate, and secondary ammonium sulfate);
- Application of bulk-averaged visibility extinction efficiencies, including a representative relative humidity adjustment factor;
- Computation of the predicted percent change (increase) of predicted extinction above an assumed "natural background" reference level; and
- Comparison of the predicted change with FLAG-prescribed threshold levels.

Representative site-specific, seasonal relative humidity adjustment factors and estimated "natural background" reference visibility levels are presented in Table 4-7 and in Appendix 2.B (Estimate of Natural Conditions) of the FLAG Report (2000).

Specifically, the maximum 24-hour concentrations of primary fine particulate ($PM_{2.5}$), as well as of nitrate ion (NO_3^-) and sulfate ion ($SO_4^=$), are predicted at each of the Class I areas and Class II areas of concern included in the modeling domain. The mass concentrations of secondary ammonium nitrate (NH_4NO_3) and ammonium sulfate ($[NH_4]_2SO_4$) are calculated by assuming the presence of excess ambient ammonia (by using adjustment factors of 1.290 and 1.375, respectively). Separate "dry" extinction coefficients are applied for each pollutant species (e.g., 1.0 for primary fine particulate matter, 3.0 for ammonium nitrate, and 3.0 for ammonium sulfate). A relative humidity adjustment factor representative of each specific modeled location is also applied to account for greater extinction due to hygroscopic aerosol growth as the humidity level increases.

In summary, the total modeled extinction (b_{ext}) due to pollutant scattering (extinction due to absorption is assumed to be negligible) is:

$$b_{ext}\,(\text{modeled}) = b_{ext}\,(PM_{2.5}) + b_{ext}\,(NH_4NO_3) + b_{ext}\,([NH_4]_2SO_4)$$

where

$b_{ext}\,(PM_{2.5}) = 1.0 \times [PM_{2.5}]$,

$b_{ext}\,(NH_4NO_3) = 3.0 \times 1.290 \times [NO_3^-] \times f(RH)$,

$b_{ext}\,([NH_4]_2SO_4) = 3.0 \times 1.375 \times [SO_4^=] \times f(RH)$, and

$[PM_{2.5}]$ = maximum 24-hour primary fine particulate matter concentration,

$[NO_3^-]$ = maximum 24-hour nitrate ion concentration,

$[SO_4^=]$ = maximum 24-hour sulfate ion concentration, and

$f(RH)$ = site-specific, seasonal relative humidity adjustment factor.

The site-specific total modeled extinction is then compared to each site-specific assumed "natural background" reference level to determine the potential percent (and corresponding deciview [*dv*]) change. A 10% change in extinction corresponds to 1.0 *dv*. Finally, the predicted potential change in visibility is compared to the FLAG-prescribed threshold levels of 5% and 10% change in extinction (0.5 and 1.0 *dv* change) as their limits of acceptable change (LACs). If the predicted visibility impairment is less than 5% (0.5 *dv*), then "the FLM would not likely object to the proposed action." Where a cumulative analysis has been performed, and the predicted visibility impairment is greater than, or equal to, 10% (1.0 *dv*), then "the FLM will consider the magnitude, frequency, duration, and other factors to assess the impact, but is likely to object to the issuance of the permit." Where a cumulative analysis has been performed, and the predicted visibility impairment is greater than or equal to 5% (0.5 *dv*) but less 10% (1.0 *dv*), then "the FLM is not likely to object to the proposed action."

For example, if the maximum 24-hour primary fine particulate matter, nitrate ion, and sulfate ion concentrations at Badlands Wilderness Area were predicted to be 0.01, 0.10, and 0.06 $\mu g/m^3$, respectively, on August 31, then, the f(RH) would be assumed to be 2.2, and the "natural background" reference level would be assumed to be 15.8 Mm^{-1} (FLAG 2000). Then the predicted extinction due to pollutant scattering would be 1.41 Mm^{-1}, resulting in predicted visibility impairment of about 9% (0.9 *dv*). However, if the same pollutant concentrations were predicted to occur on the next day (September 1), when the f(RH) would be assumed to be 2.8 and the "natural background" reference level would be assumed to be 16.2 Mm^{-1}, then the predicted extinction due to pollutant scattering would be 1.79 Mm^{-1}, resulting in predicted visibility impairment of about 11.0% (1.1 *dv*). Since this is a cumulative

impact analysis, in the first case, the predicted visibility impairment would be less than 10% (1.0 *dv*), and "the FLM is not likely to object." However, in the second case, the predicted visibility impairment would be more than 10% (1.0 *dv*), and "the FLM is likely to object."

In the current study for the PRBO&G Project EIS, the total modeled extinction level (on the basis of predicted site-specific maximum 24-hour primary fine particulate matter, nitrate ion, and sulfate ion concentrations and the assumed site-specific relative humidity adjustment factor) would be compared with the "natural background" reference level at each mandatory Class I area and each Class II area of concern. Where the predicted maximum visibility impairment would equal or exceed 10% (1.0 *dv*), an assessment of potential daily visibility impairment would be made in order to determine the magnitude, frequency, and duration of such impairment.

The daily visibility impairment analysis calculates total modeled extinction on the basis of predicted maximum 24-hour primary fine particulate matter, nitrate ion, and sulfate ion concentrations, as described above, but it uses site-specific daily relative humidity adjustment factors that are based on a determination of hourly site-specific relative humidity values computed as a 200-m vertical average at the nearest MM4 grid point. The relative humidity vertical average is more representative than are distant surface-based measurements. For the days without MM4 relative humidity data, CALMET values are used. A maximum relative humidity of 90% is used because direct optical monitoring devices are not reliable above this level.

Potential daily visibility impairment is calculated on the basis of direct total optical monitoring (transmissometer) data collected at Badlands Wilderness Area (also used for Agate Fossil Beds National Monument, Black Elk Wilderness Area, Devils Tower National Monument, Fort Laramie National Historic Site, Jewel Cave National Monument, Mount Rushmore National Memorial, Soldier Creek Wilderness Area, and Wind Cave National Park) and at Bridger Wilderness Area (also used for Bighorn Canyon National Recreation Area, Cloud Peak Wilderness Area, Fitzpatrick Wilderness Area, North Absaroka Wilderness Area, Northern Cheyenne Indian Reservation, and Washakie Wilderness Area).

For example, if on April 1, 1990, the daily average transmissometer value was measured to be 32.16 Mm^{-1}; the maximum 24-hour primary fine particulate matter, nitrate ion, and sulfate ion concentrations at Badlands Wilderness Area were predicted to be 0.03, 0.07, and 0.16 $\mu g/m^3$, respectively; and the daily 200-m vertical average f(RH) was calculated to be 1.8, then the predicted extinction due to pollutant scattering would be 1.71 Mm^{-1}, resulting in predicted visibility impairment of about 5% (0.5 *dv*). By reporting the entire range of potential visibility impairment throughout the optical monitoring period, the magnitude, frequency, and duration of such impairment will be evident.

Appendix E:

Estimated Far-Field Air Quality Impacts at Sensitive Receptors

E.1 Far-Field Impacts of Criteria Pollutants under Alternative 1

E.2 Far-Field Impacts of Criteria Pollutants under Alternative 2a

E.3 Far-Field Impacts of Criteria Pollutants under Alternative 2b

E.4 Far-Field Impacts of Criteria Pollutants under Alternative 3

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E.1 Far-Field Impacts of Criteria Pollutants under Alternative 1

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
SO2	Annual	Badlands NP	0.06	0.00	0.06	2	3	3.06	60	80
SO2	Annual	Black Elk WA	0.14	0.01	0.15	20	3	3.15	60	80
SO2	Annual	Mt Rushmore NM	0.12	0.01	0.13	20	3	3.13	60	80
SO2	Annual	Wind Cave NP	0.12	0.01	0.13	2	3	3.13	60	80
SO2	Annual	Jewel Cave NM	0.18	0.01	0.19	20	3	3.19	60	80
SO2	Annual	Devil's Tower NM	0.14	0.04	0.19	20	3	3.19	60	80
SO2	Annual	N. Cheyenne Reserv	0.04	0.01	0.05	2	3	3.05	60	80
SO2	Annual	Cloud Peak WA	0.03	0.01	0.03	20	3	3.03	60	80
SO2	Annual	Soldier Creek WA	0.07	0.00	0.08	20	3	3.08	60	80
SO2	Annual	Agate Fos Beds NM	0.05	0.00	0.06	20	3	3.06	60	80
SO2	Annual	Ft Laramie NHS	0.03	0.00	0.04	20	3	3.04	60	80
SO2	Annual	Bighorn Canyon NRA	0.01	0.00	0.01	20	3	3.01	60	80
SO2	Annual	Bridger WA	0.01	0.00	0.01	2	3	3.01	60	80
SO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	Washakie WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	24-hour	Badlands NP	0.56	0.03	0.58	5	8	8.58	260	365
SO2	24-hour	Black Elk WA	1.11	0.07	1.12	91	8	9.12	260	365
SO2	24-hour	Mt Rushmore NM	0.84	0.07	0.85	91	8	8.85	260	365
SO2	24-hour	Wind Cave NP	1.20	0.12	1.21	5	8	9.21	260	365
SO2	24-hour	Jewel Cave NM	1.48	0.15	1.51	91	8	9.51	260	365
SO2	24-hour	Devil's Tower NM	0.73	0.34	0.95	91	8	8.95	260	365
SO2	24-hour	N. Cheyenne Reserv	1.22	0.17	1.38	5	8	9.38	260	365
SO2	24-hour	Cloud Peak WA	0.88	0.14	0.90	91	8	8.90	260	365
SO2	24-hour	Soldier Creek WA	0.45	0.08	0.45	91	8	8.45	260	365
SO2	24-hour	Agate Fos Beds NM	0.49	0.13	0.62	91	8	8.62	260	365
SO2	24-hour	Ft Laramie NHS	0.54	0.10	0.55	91	8	8.55	260	365
SO2	24-hour	Bighorn Canyon NRA	0.46	0.10	0.54	91	8	8.54	260	365
SO2	24-hour	Bridger WA	0.68	0.02	0.70	5	8	8.70	260	365
SO2	24-hour	Fitzpatrick WA	0.07	0.01	0.08	5	8	8.08	260	365
SO2	24-hour	Washakie WA	0.14	0.01	0.14	5	8	8.14	260	365
SO2	24-hour	N. Absaroka WA	0.10	0.01	0.11	5	8	8.11	260	365
SO2	3-hour	Badlands NP	1.79	0.08	1.81	25	8	9.81	1300	1300
SO2	3-hour	Black Elk WA	3.70	0.42	3.70	512	8	11.70	1300	1300
SO2	3-hour	Mt Rushmore NM	2.96	0.35	3.00	512	8	11.00	1300	1300
SO2	3-hour	Wind Cave NP	2.94	0.67	3.61	25	8	11.61	1300	1300
SO2	3-hour	Jewel Cave NM	4.62	0.39	4.63	512	8	12.63	1300	1300
SO2	3-hour	Devil's Tower NM	1.88	1.17	2.26	512	8	10.26	1300	1300
SO2	3-hour	N. Cheyenne Reserv	3.19	0.75	3.69	25	8	11.69	1300	1300
SO2	3-hour	Cloud Peak WA	2.10	0.55	2.11	512	8	10.11	1300	1300
SO2	3-hour	Soldier Creek WA	1.63	0.25	1.74	512	8	9.74	1300	1300
SO2	3-hour	Agate Fos Beds NM	1.70	0.46	1.79	512	8	9.79	1300	1300
SO2	3-hour	Ft Laramie NHS	2.17	0.51	2.18	512	8	10.18	1300	1300
SO2	3-hour	Bighorn Canyon NRA	1.46	0.50	1.93	512	8	9.93	1300	1300
SO2	3-hour	Bridger WA	1.51	0.08	1.53	25	8	9.53	1300	1300
SO2	3-hour	Fitzpatrick WA	0.27	0.03	0.31	25	8	8.31	1300	1300
SO2	3-hour	Washakie WA	0.52	0.05	0.57	25	8	8.57	1300	1300
SO2	3-hour	N. Absaroka WA	0.43	0.05	0.48	25	8	8.48	1300	1300
PM10	Annual	Badlands NP	0.14	0.05	0.19	4	17	17.19	50	50
PM10	Annual	Black Elk WA	0.23	0.08	0.31	17	17	17.31	50	50
PM10	Annual	Mt Rushmore NM	0.22	0.07	0.29	17	17	17.29	50	50
PM10	Annual	Wind Cave NP	0.22	0.08	0.30	4	17	17.30	50	50
PM10	Annual	Jewel Cave NM	0.31	0.10	0.41	17	17	17.41	50	50
PM10	Annual	Devil's Tower NM	0.38	0.25	0.63	17	17	17.63	50	50
PM10	Annual	N. Cheyenne Reserv	0.17	0.12	0.28	4	17	17.28	50	50
PM10	Annual	Cloud Peak WA	0.07	0.07	0.15	17	17	17.15	50	50

E.1 Far-Field Impacts of Criteria Pollutants under Alternative 1 (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
PM10	Annual	Soldier Creek WA	0.16	0.06	0.22	17	17	17.22	50	50
PM10	Annual	Agate Fos Beds NM	0.16	0.06	0.22	17	17	17.22	50	50
PM10	Annual	Ft Laramie NHS	0.15	0.04	0.19	17	17	17.19	50	50
PM10	Annual	Bighorn Canyon NRA	0.16	0.03	0.17	17	17	17.17	50	50
PM10	Annual	Bridger WA	0.01	0.01	0.02	4	17	17.02	50	50
PM10	Annual	Fitzpatrick WA	0.00	0.00	0.01	4	17	17.01	50	50
PM10	Annual	Washakie WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	Annual	N. Absaroka WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	24-hour	Badlands NP	1.26	0.70	1.82	8	42	43.82	150	150
PM10	24-hour	Black Elk WA	1.61	0.79	2.38	30	42	44.38	150	150
PM10	24-hour	Mt Rushmore NM	1.48	0.72	2.20	30	42	44.20	150	150
PM10	24-hour	Wind Cave NP	2.06	1.04	2.90	8	42	44.90	150	150
PM10	24-hour	Jewel Cave NM	2.28	1.19	3.35	30	42	45.35	150	150
PM10	24-hour	Devil's Tower NM	2.70	2.05	3.96	30	42	45.96	150	150
PM10	24-hour	N. Cheyenne Reserv	2.78	2.07	4.85	8	42	46.85	150	150
PM10	24-hour	Cloud Peak WA	1.38	1.07	2.27	30	42	44.27	150	150
PM10	24-hour	Soldier Creek WA	1.27	0.61	1.77	30	42	43.77	150	150
PM10	24-hour	Agate Fos Beds NM	1.50	0.92	2.26	30	42	44.26	150	150
PM10	24-hour	Ft Laramie NHS	0.94	0.47	1.40	30	42	43.40	150	150
PM10	24-hour	Bighorn Canyon NRA	2.08	1.51	3.58	30	42	45.58	150	150
PM10	24-hour	Bridger WA	0.54	0.39	0.93	8	42	42.93	150	150
PM10	24-hour	Fitzpatrick WA	0.39	0.26	0.65	8	42	42.65	150	150
PM10	24-hour	Washakie WA	0.68	0.45	1.13	8	42	43.13	150	150
PM10	24-hour	N. Absaroka WA	0.71	0.48	1.18	8	42	43.18	150	150
PM25	Annual	Badlands NP	0.11	0.04	0.15	- [a]	7.6	7.75	15	15
PM25	Annual	Black Elk WA	0.16	0.06	0.22	-	7.6	7.82	15	15
PM25	Annual	Mt Rushmore NM	0.16	0.06	0.22	-	7.6	7.82	15	15
PM25	Annual	Wind Cave NP	0.15	0.06	0.21	-	7.6	7.81	15	15
PM25	Annual	Jewel Cave NM	0.19	0.08	0.27	-	7.6	7.87	15	15
PM25	Annual	Devil's Tower NM	0.25	0.17	0.42	-	7.6	8.02	15	15
PM25	Annual	N. Cheyenne Reserv	0.10	0.07	0.17	-	7.6	7.77	15	15
PM25	Annual	Cloud Peak WA	0.06	0.06	0.11	-	7.6	7.71	15	15
PM25	Annual	Soldier Creek WA	0.12	0.05	0.17	-	7.6	7.77	15	15
PM25	Annual	Agate Fos Beds NM	0.11	0.05	0.16	-	7.6	7.76	15	15
PM25	Annual	Ft Laramie NHS	0.09	0.04	0.13	-	7.6	7.73	15	15
PM25	Annual	Bighorn Canyon NRA	0.04	0.02	0.06	-	7.6	7.66	15	15
PM25	Annual	Bridger WA	0.01	0.01	0.02	-	7.6	7.62	15	15
PM25	Annual	Fitzpatrick WA	0.00	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	Washakie WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	N. Absaroka WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	24-hour	Badlands NP	1.06	0.65	1.65	-	19	20.65	65	65
PM25	24-hour	Black Elk WA	1.26	0.64	1.88	-	19	20.88	65	65
PM25	24-hour	Mt Rushmore NM	1.21	0.61	1.82	-	19	20.82	65	65
PM25	24-hour	Wind Cave NP	1.26	0.72	1.89	-	19	20.89	65	65
PM25	24-hour	Jewel Cave NM	1.58	0.85	2.43	-	19	21.43	65	65
PM25	24-hour	Devil's Tower NM	2.24	1.25	3.37	-	19	22.37	65	65
PM25	24-hour	N. Cheyenne Reserv	2.07	1.55	3.61	-	19	22.61	65	65
PM25	24-hour	Cloud Peak WA	1.13	0.99	2.12	-	19	21.12	65	65
PM25	24-hour	Soldier Creek WA	1.18	0.54	1.59	-	19	20.59	65	65
PM25	24-hour	Agate Fos Beds NM	1.20	0.64	1.84	-	19	20.84	65	65
PM25	24-hour	Ft Laramie NHS	0.72	0.40	1.09	-	19	20.09	65	65
PM25	24-hour	Bighorn Canyon NRA	1.78	1.33	3.10	-	19	22.10	65	65
PM25	24-hour	Bridger WA	0.49	0.35	0.84	-	19	19.84	65	65
PM25	24-hour	Fitzpatrick WA	0.34	0.24	0.58	-	19	19.58	65	65
PM25	24-hour	Washakie WA	0.59	0.41	1.01	-	19	20.01	65	65
PM25	24-hour	N. Absaroka WA	0.61	0.44	1.05	-	19	20.05	65	65

E.1 Far-Field Impacts of Criteria Pollutants under Alternative 1 (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
NO2	Annual	Badlands NP	0.20	0.06	0.25	2.5	16.5	16.75	100	100
NO2	Annual	Black Elk WA	0.40	0.11	0.50	25	16.5	17.00	100	100
NO2	Annual	Mt Rushmore NM	0.39	0.10	0.49	25	16.5	16.99	100	100
NO2	Annual	Wind Cave NP	0.37	0.12	0.50	2.5	16.5	17.00	100	100
NO2	Annual	Jewel Cave NM	0.52	0.19	0.71	25	16.5	17.21	100	100
NO2	Annual	Devil's Tower NM	0.77	0.66	1.43	25	16.5	17.93	100	100
NO2	Annual	N. Cheyenne Reserv	0.22	0.22	0.45	2.5	16.5	16.95	100	100
NO2	Annual	Cloud Peak WA	0.08	0.11	0.19	25	16.5	16.69	100	100
NO2	Annual	Soldier Creek WA	0.36	0.08	0.43	25	16.5	16.93	100	100
NO2	Annual	Agate Fos Beds NM	0.16	0.08	0.24	25	16.5	16.74	100	100
NO2	Annual	Ft Laramie NHS	0.09	0.04	0.13	25	16.5	16.63	100	100
NO2	Annual	Bighorn Canyon NRA	0.04	0.03	0.07	25	16.5	16.57	100	100
NO2	Annual	Bridger WA	0.01	0.01	0.01	2.5	16.5	16.51	100	100
NO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	Washakie WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
CO	8-hour	Badlands NP	2.98	3.08	6.06	-	1500	1506	10000	10000
CO	8-hour	Black Elk WA	5.29	3.92	7.42	-	1500	1507	10000	10000
CO	8-hour	Mt Rushmore NM	4.93	3.20	6.03	-	1500	1506	10000	10000
CO	8-hour	Wind Cave NP	7.94	6.96	13.65	-	1500	1513	10000	10000
CO	8-hour	Jewel Cave NM	9.35	8.72	17.72	-	1500	1517	10000	10000
CO	8-hour	Devil's Tower NM	11.13	13.78	24.92	-	1500	1524	10000	10000
CO	8-hour	N. Cheyenne Reserv	11.71	15.04	26.76	-	1500	1526	10000	10000
CO	8-hour	Cloud Peak WA	5.82	6.86	10.48	-	1500	1510	10000	10000
CO	8-hour	Soldier Creek WA	3.38	3.25	6.64	-	1500	1506	10000	10000
CO	8-hour	Agate Fos Beds NM	5.30	4.61	9.91	-	1500	1509	10000	10000
CO	8-hour	Ft Laramie NHS	3.39	2.90	5.79	-	1500	1505	10000	10000
CO	8-hour	Bighorn Canyon NRA	4.05	4.75	8.80	-	1500	1508	10000	10000
CO	8-hour	Bridger WA	1.88	1.87	3.75	-	1500	1503	10000	10000
CO	8-hour	Fitzpatrick WA	1.07	1.24	2.31	-	1500	1502	10000	10000
CO	8-hour	Washakie WA	1.89	2.19	4.08	-	1500	1504	10000	10000
CO	8-hour	N. Absaroka WA	1.44	1.75	3.19	-	1500	1503	10000	10000
CO	1-hour	Badlands NP	4.38	4.76	9.05	-	3500	3509	40000	40000
CO	1-hour	Black Elk WA	31.46	8.15	32.17	-	3500	3532	40000	40000
CO	1-hour	Mt Rushmore NM	28.83	6.94	30.99	-	3500	3530	40000	40000
CO	1-hour	Wind Cave NP	33.85	8.33	38.21	-	3500	3538	40000	40000
CO	1-hour	Jewel Cave NM	43.25	11.56	45.93	-	3500	3545	40000	40000
CO	1-hour	Devil's Tower NM	18.64	21.01	37.09	-	3500	3537	40000	40000
CO	1-hour	N. Cheyenne Reserv	39.84	30.87	54.18	-	3500	3554	40000	40000
CO	1-hour	Cloud Peak WA	24.36	11.98	27.15	-	3500	3527	40000	40000
CO	1-hour	Soldier Creek WA	5.98	5.71	11.36	-	3500	3511	40000	40000
CO	1-hour	Agate Fos Beds NM	7.61	6.64	14.25	-	3500	3514	40000	40000
CO	1-hour	Ft Laramie NHS	5.79	5.91	11.25	-	3500	3511	40000	40000
CO	1-hour	Bighorn Canyon NRA	8.76	8.10	14.89	-	3500	3514	40000	40000
CO	1-hour	Bridger WA	2.19	2.40	4.56	-	3500	3504	40000	40000
CO	1-hour	Fitzpatrick WA	1.53	1.97	3.49	-	3500	3503	40000	40000
CO	1-hour	Washakie WA	2.89	3.69	6.57	-	3500	3506	40000	40000
CO	1-hour	N. Absaroka WA	2.35	2.80	5.04	-	3500	3505	40000	40000

[a] A hyphen indicates no standard exists.

E.2 Far-Field Impacts of Criteria Pollutants under Alternative 2a

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
SO2	Annual	Badlands NP	0.06	0.00	0.06	2	3	3.06	60	80
SO2	Annual	Black Elk WA	0.14	0.01	0.15	20	3	3.15	60	80
SO2	Annual	Mt Rushmore NM	0.12	0.01	0.13	20	3	3.13	60	80
SO2	Annual	Wind Cave NP	0.12	0.01	0.13	2	3	3.13	60	80
SO2	Annual	Jewel Cave NM	0.18	0.01	0.19	20	3	3.19	60	80
SO2	Annual	Devil's Tower NM	0.14	0.04	0.19	20	3	3.19	60	80
SO2	Annual	N. Cheyenne Reserv	0.04	0.01	0.05	2	3	3.05	60	80
SO2	Annual	Cloud Peak WA	0.03	0.01	0.03	20	3	3.03	60	80
SO2	Annual	Soldier Creek WA	0.07	0.00	0.08	20	3	3.08	60	80
SO2	Annual	Agate Fos Beds NM	0.05	0.00	0.06	20	3	3.06	60	80
SO2	Annual	Ft Laramie NHS	0.03	0.00	0.04	20	3	3.04	60	80
SO2	Annual	Bighorn Canyon NRA	0.01	0.00	0.01	20	3	3.01	60	80
SO2	Annual	Bridger WA	0.01	0.00	0.01	2	3	3.01	60	80
SO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	Washakie WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	24-hour	Badlands NP	0.56	0.03	0.57	5	8	8.57	260	365
SO2	24-hour	Black Elk WA	1.11	0.07	1.12	91	8	9.12	260	365
SO2	24-hour	Mt Rushmore NM	0.84	0.07	0.85	91	8	8.85	260	365
SO2	24-hour	Wind Cave NP	1.20	0.12	1.21	5	8	9.21	260	365
SO2	24-hour	Jewel Cave NM	1.48	0.15	1.51	91	8	9.51	260	365
SO2	24-hour	Devil's Tower NM	0.73	0.33	0.95	91	8	8.95	260	365
SO2	24-hour	N. Cheyenne Reserv	1.22	0.17	1.38	5	8	9.38	260	365
SO2	24-hour	Cloud Peak WA	0.88	0.14	0.90	91	8	8.90	260	365
SO2	24-hour	Soldier Creek WA	0.45	0.08	0.45	91	8	8.45	260	365
SO2	24-hour	Agate Fos Beds NM	0.49	0.13	0.62	91	8	8.62	260	365
SO2	24-hour	Ft Laramie NHS	0.54	0.10	0.55	91	8	8.55	260	365
SO2	24-hour	Bighorn Canyon NRA	0.46	0.10	0.54	91	8	8.54	260	365
SO2	24-hour	Bridger WA	0.68	0.02	0.70	5	8	8.70	260	365
SO2	24-hour	Fitzpatrick WA	0.07	0.01	0.08	5	8	8.08	260	365
SO2	24-hour	Washakie WA	0.14	0.01	0.14	5	8	8.14	260	365
SO2	24-hour	N. Absaroka WA	0.10	0.01	0.11	5	8	8.11	260	365
SO2	3-hour	Badlands NP	1.79	0.08	1.81	25	8	9.81	1300	1300
SO2	3-hour	Black Elk WA	3.70	0.42	3.70	512	8	11.70	1300	1300
SO2	3-hour	Mt Rushmore NM	2.96	0.35	3.00	512	8	11.00	1300	1300
SO2	3-hour	Wind Cave NP	2.94	0.67	3.61	25	8	11.61	1300	1300
SO2	3-hour	Jewel Cave NM	4.62	0.39	4.63	512	8	12.63	1300	1300
SO2	3-hour	Devil's Tower NM	1.88	1.16	2.26	512	8	10.26	1300	1300
SO2	3-hour	N. Cheyenne Reserv	3.19	0.75	3.69	25	8	11.69	1300	1300
SO2	3-hour	Cloud Peak WA	2.10	0.55	2.11	512	8	10.11	1300	1300
SO2	3-hour	Soldier Creek WA	1.63	0.25	1.74	512	8	9.74	1300	1300
SO2	3-hour	Agate Fos Beds NM	1.70	0.46	1.79	512	8	9.79	1300	1300
SO2	3-hour	Ft Laramie NHS	2.17	0.51	2.18	512	8	10.18	1300	1300
SO2	3-hour	Bighorn Canyon NRA	1.46	0.50	1.93	512	8	9.93	1300	1300
SO2	3-hour	Bridger WA	1.51	0.08	1.53	25	8	9.53	1300	1300
SO2	3-hour	Fitzpatrick WA	0.27	0.03	0.31	25	8	8.31	1300	1300
SO2	3-hour	Washakie WA	0.52	0.05	0.57	25	8	8.57	1300	1300
SO2	3-hour	N. Absaroka WA	0.43	0.05	0.48	25	8	8.48	1300	1300
PM10	Annual	Badlands NP	0.14	0.05	0.18	4	17	17.18	50	50
PM10	Annual	Black Elk WA	0.23	0.07	0.30	17	17	17.30	50	50
PM10	Annual	Mt Rushmore NM	0.22	0.07	0.28	17	17	17.28	50	50
PM10	Annual	Wind Cave NP	0.22	0.07	0.30	4	17	17.30	50	50
PM10	Annual	Jewel Cave NM	0.31	0.09	0.40	17	17	17.40	50	50
PM10	Annual	Devil's Tower NM	0.38	0.23	0.61	17	17	17.61	50	50
PM10	Annual	N. Cheyenne Reserv	0.17	0.11	0.27	4	17	17.27	50	50
PM10	Annual	Cloud Peak WA	0.07	0.07	0.14	17	17	17.14	50	50

E.2 Far-Field Impacts of Criteria Pollutants under Alternative 2a (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
PM10	Annual	Soldier Creek WA	0.16	0.06	0.22	17	17	17.22	50	50
PM10	Annual	Agate Fos Beds NM	0.16	0.06	0.22	17	17	17.22	50	50
PM10	Annual	Ft Laramie NHS	0.15	0.04	0.19	17	17	17.19	50	50
PM10	Annual	Bighorn Canyon NRA	0.16	0.03	0.17	17	17	17.17	50	50
PM10	Annual	Bridger WA	0.01	0.01	0.02	4	17	17.02	50	50
PM10	Annual	Fitzpatrick WA	0.00	0.00	0.01	4	17	17.01	50	50
PM10	Annual	Washakie WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	Annual	N. Absaroka WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	24-hour	Badlands NP	1.26	0.62	1.76	8	42	43.76	150	150
PM10	24-hour	Black Elk WA	1.61	0.72	2.31	30	42	44.31	150	150
PM10	24-hour	Mt Rushmore NM	1.48	0.66	2.13	30	42	44.13	150	150
PM10	24-hour	Wind Cave NP	2.06	0.96	2.87	8	42	44.87	150	150
PM10	24-hour	Jewel Cave NM	2.28	1.10	3.24	30	42	45.24	150	150
PM10	24-hour	Devil's Tower NM	2.70	1.92	3.80	30	42	45.80	150	150
PM10	24-hour	N. Cheyenne Reserv	2.78	1.83	4.61	8	42	46.61	150	150
PM10	24-hour	Cloud Peak WA	1.38	0.95	2.15	30	42	44.15	150	150
PM10	24-hour	Soldier Creek WA	1.27	0.54	1.70	30	42	43.70	150	150
PM10	24-hour	Agate Fos Beds NM	1.50	0.86	2.21	30	42	44.21	150	150
PM10	24-hour	Ft Laramie NHS	0.94	0.42	1.35	30	42	43.35	150	150
PM10	24-hour	Bighorn Canyon NRA	2.08	1.34	3.41	30	42	45.41	150	150
PM10	24-hour	Bridger WA	0.54	0.34	0.89	8	42	42.89	150	150
PM10	24-hour	Fitzpatrick WA	0.39	0.23	0.62	8	42	42.62	150	150
PM10	24-hour	Washakie WA	0.68	0.40	1.08	8	42	43.08	150	150
PM10	24-hour	N. Absaroka WA	0.71	0.43	1.13	8	42	43.13	150	150
PM25	Annual	Badlands NP	0.11	0.04	0.15	- [a]	7.6	7.75	15	15
PM25	Annual	Black Elk WA	0.16	0.05	0.22	-	7.6	7.82	15	15
PM25	Annual	Mt Rushmore NM	0.16	0.05	0.21	-	7.6	7.81	15	15
PM25	Annual	Wind Cave NP	0.15	0.06	0.21	-	7.6	7.81	15	15
PM25	Annual	Jewel Cave NM	0.19	0.07	0.26	-	7.6	7.86	15	15
PM25	Annual	Devil's Tower NM	0.25	0.15	0.40	-	7.6	8.00	15	15
PM25	Annual	N. Cheyenne Reserv	0.10	0.07	0.16	-	7.6	7.76	15	15
PM25	Annual	Cloud Peak WA	0.06	0.05	0.11	-	7.6	7.71	15	15
PM25	Annual	Soldier Creek WA	0.12	0.05	0.17	-	7.6	7.77	15	15
PM25	Annual	Agate Fos Beds NM	0.11	0.05	0.15	-	7.6	7.75	15	15
PM25	Annual	Ft Laramie NHS	0.09	0.03	0.12	-	7.6	7.72	15	15
PM25	Annual	Bighorn Canyon NRA	0.04	0.02	0.05	-	7.6	7.65	15	15
PM25	Annual	Bridger WA	0.01	0.01	0.02	-	7.6	7.62	15	15
PM25	Annual	Fitzpatrick WA	0.00	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	Washakie WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	N. Absaroka WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	24-hour	Badlands NP	1.06	0.57	1.57	-	19	20.57	65	65
PM25	24-hour	Black Elk WA	1.26	0.57	1.79	-	19	20.79	65	65
PM25	24-hour	Mt Rushmore NM	1.21	0.53	1.73	-	19	20.73	65	65
PM25	24-hour	Wind Cave NP	1.26	0.63	1.81	-	19	20.81	65	65
PM25	24-hour	Jewel Cave NM	1.58	0.74	2.32	-	19	21.32	65	65
PM25	24-hour	Devil's Tower NM	2.24	1.12	3.20	-	19	22.20	65	65
PM25	24-hour	N. Cheyenne Reserv	2.07	1.31	3.37	-	19	22.37	65	65
PM25	24-hour	Cloud Peak WA	1.13	0.87	1.99	-	19	20.99	65	65
PM25	24-hour	Soldier Creek WA	1.18	0.47	1.53	-	19	20.53	65	65
PM25	24-hour	Agate Fos Beds NM	1.20	0.55	1.75	-	19	20.75	65	65
PM25	24-hour	Ft Laramie NHS	0.72	0.36	1.04	-	19	20.04	65	65
PM25	24-hour	Bighorn Canyon NRA	1.78	1.16	2.93	-	19	21.93	65	65
PM25	24-hour	Bridger WA	0.49	0.31	0.80	-	19	19.80	65	65
PM25	24-hour	Fitzpatrick WA	0.34	0.21	0.55	-	19	19.55	65	65
PM25	24-hour	Washakie WA	0.59	0.36	0.95	-	19	19.95	65	65
PM25	24-hour	N. Absaroka WA	0.61	0.39	0.99	-	19	19.99	65	65

E.2 Far-Field Impacts of Criteria Pollutants under Alternative 2a (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration (μg/m³) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
NO2	Annual	Badlands NP	0.20	0.05	0.25	2.5	16.5	16.75	100	100
NO2	Annual	Black Elk WA	0.40	0.10	0.49	25	16.5	16.99	100	100
NO2	Annual	Mt Rushmore NM	0.39	0.09	0.48	25	16.5	16.98	100	100
NO2	Annual	Wind Cave NP	0.37	0.11	0.49	2.5	16.5	16.99	100	100
NO2	Annual	Jewel Cave NM	0.52	0.17	0.69	25	16.5	17.19	100	100
NO2	Annual	Devil's Tower NM	0.77	0.60	1.37	25	16.5	17.87	100	100
NO2	Annual	N. Cheyenne Reserv	0.22	0.20	0.43	2.5	16.5	16.93	100	100
NO2	Annual	Cloud Peak WA	0.08	0.10	0.18	25	16.5	16.68	100	100
NO2	Annual	Soldier Creek WA	0.36	0.07	0.43	25	16.5	16.93	100	100
NO2	Annual	Agate Fos Beds NM	0.16	0.07	0.23	25	16.5	16.73	100	100
NO2	Annual	Ft Laramie NHS	0.09	0.04	0.13	25	16.5	16.63	100	100
NO2	Annual	Bighorn Canyon NRA	0.04	0.03	0.07	25	16.5	16.57	100	100
NO2	Annual	Bridger WA	0.01	0.00	0.01	2.5	16.5	16.51	100	100
NO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	Washakie WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
CO	8-hour	Badlands NP	2.98	2.32	5.31	-	1500	1505	10000	10000
CO	8-hour	Black Elk WA	5.29	2.99	6.49	-	1500	1506	10000	10000
CO	8-hour	Mt Rushmore NM	4.93	2.44	5.27	-	1500	1505	10000	10000
CO	8-hour	Wind Cave NP	7.94	5.29	11.98	-	1500	1511	10000	10000
CO	8-hour	Jewel Cave NM	9.35	6.78	15.77	-	1500	1515	10000	10000
CO	8-hour	Devil's Tower NM	11.13	10.78	21.91	-	1500	1521	10000	10000
CO	8-hour	N. Cheyenne Reserv	11.71	11.33	23.04	-	1500	1523	10000	10000
CO	8-hour	Cloud Peak WA	5.82	5.14	8.75	-	1500	1508	10000	10000
CO	8-hour	Soldier Creek WA	3.38	2.46	5.84	-	1500	1505	10000	10000
CO	8-hour	Agate Fos Beds NM	5.30	3.52	8.82	-	1500	1508	10000	10000
CO	8-hour	Ft Laramie NHS	3.39	2.21	5.11	-	1500	1505	10000	10000
CO	8-hour	Bighorn Canyon NRA	4.05	3.57	7.62	-	1500	1507	10000	10000
CO	8-hour	Bridger WA	1.88	1.41	3.30	-	1500	1503	10000	10000
CO	8-hour	Fitzpatrick WA	1.07	0.94	2.02	-	1500	1502	10000	10000
CO	8-hour	Washakie WA	1.89	1.66	3.55	-	1500	1503	10000	10000
CO	8-hour	N. Absaroka WA	1.44	1.33	2.77	-	1500	1502	10000	10000
CO	1-hour	Badlands NP	4.38	3.59	7.88	-	3500	3507	40000	40000
CO	1-hour	Black Elk WA	31.46	7.32	32.10	-	3500	3532	40000	40000
CO	1-hour	Mt Rushmore NM	28.83	6.22	30.27	-	3500	3530	40000	40000
CO	1-hour	Wind Cave NP	33.85	7.16	37.54	-	3500	3537	40000	40000
CO	1-hour	Jewel Cave NM	43.25	8.73	45.70	-	3500	3545	40000	40000
CO	1-hour	Devil's Tower NM	18.64	17.10	33.19	-	3500	3533	40000	40000
CO	1-hour	N. Cheyenne Reserv	39.84	23.28	47.34	-	3500	3547	40000	40000
CO	1-hour	Cloud Peak WA	24.36	8.93	26.86	-	3500	3526	40000	40000
CO	1-hour	Soldier Creek WA	5.98	4.31	10.03	-	3500	3510	40000	40000
CO	1-hour	Agate Fos Beds NM	7.61	6.08	13.69	-	3500	3513	40000	40000
CO	1-hour	Ft Laramie NHS	5.79	4.50	9.93	-	3500	3509	40000	40000
CO	1-hour	Bighorn Canyon NRA	8.76	7.14	14.09	-	3500	3514	40000	40000
CO	1-hour	Bridger WA	2.19	1.81	3.98	-	3500	3503	40000	40000
CO	1-hour	Fitzpatrick WA	1.53	1.49	3.01	-	3500	3503	40000	40000
CO	1-hour	Washakie WA	2.89	2.78	5.67	-	3500	3505	40000	40000
CO	1-hour	N. Absaroka WA	2.35	2.12	4.38	-	3500	3504	40000	40000

[a] A hyphen indicates no standard exists.

E.3 Far-Field Impacts of Criteria Pollutants under Alternative 2b

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
SO2	Annual	Badlands NP	0.06	0.00	0.06	2	3	3.06	60	80
SO2	Annual	Black Elk WA	0.14	0.01	0.15	20	3	3.15	60	80
SO2	Annual	Mt Rushmore NM	0.12	0.01	0.13	20	3	3.13	60	80
SO2	Annual	Wind Cave NP	0.12	0.01	0.13	2	3	3.13	60	80
SO2	Annual	Jewel Cave NM	0.18	0.01	0.19	20	3	3.19	60	80
SO2	Annual	Devil's Tower NM	0.14	0.04	0.19	20	3	3.19	60	80
SO2	Annual	N. Cheyenne Reserv	0.04	0.01	0.05	2	3	3.05	60	80
SO2	Annual	Cloud Peak WA	0.03	0.01	0.03	20	3	3.03	60	80
SO2	Annual	Soldier Creek WA	0.07	0.00	0.08	20	3	3.08	60	80
SO2	Annual	Agate Fos Beds NM	0.05	0.00	0.06	20	3	3.06	60	80
SO2	Annual	Ft Laramie NHS	0.03	0.00	0.04	20	3	3.04	60	80
SO2	Annual	Bighorn Canyon NRA	0.01	0.00	0.01	20	3	3.01	60	80
SO2	Annual	Bridger WA	0.01	0.00	0.01	2	3	3.01	60	80
SO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	Washakie WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	24-hour	Badlands NP	0.56	0.03	0.57	5	8	8.57	260	365
SO2	24-hour	Black Elk WA	1.11	0.07	1.12	91	8	9.12	260	365
SO2	24-hour	Mt Rushmore NM	0.84	0.07	0.85	91	8	8.85	260	365
SO2	24-hour	Wind Cave NP	1.20	0.12	1.21	5	8	9.21	260	365
SO2	24-hour	Jewel Cave NM	1.48	0.15	1.51	91	8	9.51	260	365
SO2	24-hour	Devil's Tower NM	0.73	0.33	0.95	91	8	8.95	260	365
SO2	24-hour	N. Cheyenne Reserv	1.22	0.17	1.38	5	8	9.38	260	365
SO2	24-hour	Cloud Peak WA	0.88	0.14	0.90	91	8	8.90	260	365
SO2	24-hour	Soldier Creek WA	0.45	0.08	0.45	91	8	8.45	260	365
SO2	24-hour	Agate Fos Beds NM	0.49	0.13	0.62	91	8	8.62	260	365
SO2	24-hour	Ft Laramie NHS	0.54	0.10	0.55	91	8	8.55	260	365
SO2	24-hour	Bighorn Canyon NRA	0.46	0.10	0.54	91	8	8.54	260	365
SO2	24-hour	Bridger WA	0.68	0.02	0.70	5	8	8.70	260	365
SO2	24-hour	Fitzpatrick WA	0.07	0.01	0.08	5	8	8.08	260	365
SO2	24-hour	Washakie WA	0.14	0.01	0.14	5	8	8.14	260	365
SO2	24-hour	N. Absaroka WA	0.10	0.01	0.11	5	8	8.11	260	365
SO2	3-hour	Badlands NP	1.79	0.08	1.81	25	8	9.81	1300	1300
SO2	3-hour	Black Elk WA	3.70	0.42	3.70	512	8	11.70	1300	1300
SO2	3-hour	Mt Rushmore NM	2.96	0.35	2.99	512	8	10.99	1300	1300
SO2	3-hour	Wind Cave NP	2.94	0.67	3.61	25	8	11.61	1300	1300
SO2	3-hour	Jewel Cave NM	4.62	0.39	4.63	512	8	12.63	1300	1300
SO2	3-hour	Devil's Tower NM	1.88	1.16	2.25	512	8	10.25	1300	1300
SO2	3-hour	N. Cheyenne Reserv	3.19	0.75	3.69	25	8	11.69	1300	1300
SO2	3-hour	Cloud Peak WA	2.10	0.55	2.11	512	8	10.11	1300	1300
SO2	3-hour	Soldier Creek WA	1.63	0.25	1.74	512	8	9.74	1300	1300
SO2	3-hour	Agate Fos Beds NM	1.70	0.46	1.79	512	8	9.79	1300	1300
SO2	3-hour	Ft Laramie NHS	2.17	0.51	2.18	512	8	10.18	1300	1300
SO2	3-hour	Bighorn Canyon NRA	1.46	0.50	1.93	512	8	9.93	1300	1300
SO2	3-hour	Bridger WA	1.51	0.08	1.53	25	8	9.53	1300	1300
SO2	3-hour	Fitzpatrick WA	0.27	0.03	0.31	25	8	8.31	1300	1300
SO2	3-hour	Washakie WA	0.52	0.05	0.57	25	8	8.57	1300	1300
SO2	3-hour	N. Absaroka WA	0.43	0.05	0.48	25	8	8.48	1300	1300
PM10	Annual	Badlands NP	0.14	0.04	0.18	4	17	17.18	50	50
PM10	Annual	Black Elk WA	0.23	0.06	0.29	17	17	17.29	50	50
PM10	Annual	Mt Rushmore NM	0.22	0.06	0.28	17	17	17.28	50	50
PM10	Annual	Wind Cave NP	0.22	0.07	0.29	4	17	17.29	50	50
PM10	Annual	Jewel Cave NM	0.31	0.09	0.39	17	17	17.39	50	50
PM10	Annual	Devil's Tower NM	0.38	0.21	0.59	17	17	17.59	50	50
PM10	Annual	N. Cheyenne Reserv	0.17	0.10	0.27	4	17	17.27	50	50
PM10	Annual	Cloud Peak WA	0.07	0.06	0.14	17	17	17.14	50	50

E.3 Far-Field Impacts of Criteria Pollutants under Alternative 2b (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
PM10	Annual	Soldier Creek WA	0.16	0.05	0.21	17	17	17.21	50	50
PM10	Annual	Agate Fos Beds NM	0.16	0.05	0.21	17	17	17.21	50	50
PM10	Annual	Ft Laramie NHS	0.15	0.03	0.18	17	17	17.18	50	50
PM10	Annual	Bighorn Canyon NRA	0.16	0.02	0.17	17	17	17.17	50	50
PM10	Annual	Bridger WA	0.01	0.01	0.02	4	17	17.02	50	50
PM10	Annual	Fitzpatrick WA	0.00	0.00	0.01	4	17	17.01	50	50
PM10	Annual	Washakie WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	Annual	N. Absaroka WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	24-hour	Badlands NP	1.26	0.54	1.70	8	42	43.70	150	150
PM10	24-hour	Black Elk WA	1.61	0.66	2.24	30	42	44.24	150	150
PM10	24-hour	Mt Rushmore NM	1.48	0.60	2.07	30	42	44.07	150	150
PM10	24-hour	Wind Cave NP	2.06	0.88	2.84	8	42	44.84	150	150
PM10	24-hour	Jewel Cave NM	2.28	1.03	3.15	30	42	45.15	150	150
PM10	24-hour	Devil's Tower NM	2.70	1.84	3.71	30	42	45.71	150	150
PM10	24-hour	N. Cheyenne Reserv	2.78	1.65	4.43	8	42	46.43	150	150
PM10	24-hour	Cloud Peak WA	1.38	0.88	2.05	30	42	44.05	150	150
PM10	24-hour	Soldier Creek WA	1.27	0.47	1.63	30	42	43.63	150	150
PM10	24-hour	Agate Fos Beds NM	1.50	0.82	2.16	30	42	44.16	150	150
PM10	24-hour	Ft Laramie NHS	0.94	0.37	1.30	30	42	43.30	150	150
PM10	24-hour	Bighorn Canyon NRA	2.08	1.17	3.25	30	42	45.25	150	150
PM10	24-hour	Bridger WA	0.54	0.30	0.84	8	42	42.84	150	150
PM10	24-hour	Fitzpatrick WA	0.39	0.20	0.59	8	42	42.59	150	150
PM10	24-hour	Washakie WA	0.68	0.35	1.03	8	42	43.03	150	150
PM10	24-hour	N. Absaroka WA	0.71	0.38	1.08	8	42	43.08	150	150
PM25	Annual	Badlands NP	0.11	0.03	0.14	- [a]	7.6	7.74	15	15
PM25	Annual	Black Elk WA	0.16	0.05	0.21	-	7.6	7.81	15	15
PM25	Annual	Mt Rushmore NM	0.16	0.04	0.20	-	7.6	7.80	15	15
PM25	Annual	Wind Cave NP	0.15	0.05	0.20	-	7.6	7.80	15	15
PM25	Annual	Jewel Cave NM	0.19	0.06	0.25	-	7.6	7.85	15	15
PM25	Annual	Devil's Tower NM	0.25	0.13	0.38	-	7.6	7.98	15	15
PM25	Annual	N. Cheyenne Reserv	0.10	0.06	0.16	-	7.6	7.76	15	15
PM25	Annual	Cloud Peak WA	0.06	0.04	0.10	-	7.6	7.70	15	15
PM25	Annual	Soldier Creek WA	0.12	0.04	0.16	-	7.6	7.76	15	15
PM25	Annual	Agate Fos Beds NM	0.11	0.04	0.15	-	7.6	7.75	15	15
PM25	Annual	Ft Laramie NHS	0.09	0.03	0.12	-	7.6	7.72	15	15
PM25	Annual	Bighorn Canyon NRA	0.04	0.02	0.05	-	7.6	7.65	15	15
PM25	Annual	Bridger WA	0.01	0.01	0.02	-	7.6	7.62	15	15
PM25	Annual	Fitzpatrick WA	0.00	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	Washakie WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	N. Absaroka WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	24-hour	Badlands NP	1.06	0.49	1.50	-	19	20.50	65	65
PM25	24-hour	Black Elk WA	1.26	0.51	1.70	-	19	20.70	65	65
PM25	24-hour	Mt Rushmore NM	1.21	0.47	1.65	-	19	20.65	65	65
PM25	24-hour	Wind Cave NP	1.26	0.56	1.73	-	19	20.73	65	65
PM25	24-hour	Jewel Cave NM	1.58	0.65	2.23	-	19	21.23	65	65
PM25	24-hour	Devil's Tower NM	2.24	1.03	3.05	-	19	22.05	65	65
PM25	24-hour	N. Cheyenne Reserv	2.07	1.12	3.19	-	19	22.19	65	65
PM25	24-hour	Cloud Peak WA	1.13	0.74	1.87	-	19	20.87	65	65
PM25	24-hour	Soldier Creek WA	1.18	0.40	1.46	-	19	20.46	65	65
PM25	24-hour	Agate Fos Beds NM	1.20	0.47	1.67	-	19	20.67	65	65
PM25	24-hour	Ft Laramie NHS	0.72	0.31	1.00	-	19	20.00	65	65
PM25	24-hour	Bighorn Canyon NRA	1.78	0.99	2.77	-	19	21.77	65	65
PM25	24-hour	Bridger WA	0.49	0.27	0.76	-	19	19.76	65	65
PM25	24-hour	Fitzpatrick WA	0.34	0.18	0.53	-	19	19.53	65	65
PM25	24-hour	Washakie WA	0.59	0.31	0.91	-	19	19.91	65	65
PM25	24-hour	N. Absaroka WA	0.61	0.34	0.94	-	19	19.94	65	65

E.3 Far-Field Impacts of Criteria Pollutants under Alternative 2b (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
NO2	Annual	Badlands NP	0.20	0.04	0.24	2.5	16.5	16.74	100	100
NO2	Annual	Black Elk WA	0.40	0.09	0.48	25	16.5	16.98	100	100
NO2	Annual	Mt Rushmore NM	0.39	0.08	0.47	25	16.5	16.97	100	100
NO2	Annual	Wind Cave NP	0.37	0.10	0.47	2.5	16.5	16.97	100	100
NO2	Annual	Jewel Cave NM	0.52	0.15	0.67	25	16.5	17.17	100	100
NO2	Annual	Devil's Tower NM	0.77	0.54	1.31	25	16.5	17.81	100	100
NO2	Annual	N. Cheyenne Reserv	0.22	0.18	0.41	2.5	16.5	16.91	100	100
NO2	Annual	Cloud Peak WA	0.08	0.08	0.16	25	16.5	16.66	100	100
NO2	Annual	Soldier Creek WA	0.36	0.06	0.42	25	16.5	16.92	100	100
NO2	Annual	Agate Fos Beds NM	0.16	0.06	0.22	25	16.5	16.72	100	100
NO2	Annual	Ft Laramie NHS	0.09	0.03	0.12	25	16.5	16.62	100	100
NO2	Annual	Bighorn Canyon NRA	0.04	0.02	0.06	25	16.5	16.56	100	100
NO2	Annual	Bridger WA	0.01	0.00	0.01	2.5	16.5	16.51	100	100
NO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	Washakie WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
CO	8-hour	Badlands NP	2.98	1.57	4.55	-	1500	1504	10000	10000
CO	8-hour	Black Elk WA	5.29	2.07	5.56	-	1500	1505	10000	10000
CO	8-hour	Mt Rushmore NM	4.93	1.67	5.12	-	1500	1505	10000	10000
CO	8-hour	Wind Cave NP	7.94	3.61	10.30	-	1500	1510	10000	10000
CO	8-hour	Jewel Cave NM	9.35	4.84	13.83	-	1500	1513	10000	10000
CO	8-hour	Devil's Tower NM	11.13	7.78	18.91	-	1500	1518	10000	10000
CO	8-hour	N. Cheyenne Reserv	11.71	7.62	19.33	-	1500	1519	10000	10000
CO	8-hour	Cloud Peak WA	5.82	3.42	7.03	-	1500	1507	10000	10000
CO	8-hour	Soldier Creek WA	3.38	1.66	5.04	-	1500	1505	10000	10000
CO	8-hour	Agate Fos Beds NM	5.30	2.44	7.74	-	1500	1507	10000	10000
CO	8-hour	Ft Laramie NHS	3.39	1.53	4.42	-	1500	1504	10000	10000
CO	8-hour	Bighorn Canyon NRA	4.05	2.39	6.44	-	1500	1506	10000	10000
CO	8-hour	Bridger WA	1.88	0.96	2.84	-	1500	1502	10000	10000
CO	8-hour	Fitzpatrick WA	1.07	0.65	1.72	-	1500	1501	10000	10000
CO	8-hour	Washakie WA	1.89	1.13	3.01	-	1500	1503	10000	10000
CO	8-hour	N. Absaroka WA	1.44	0.91	2.35	-	1500	1502	10000	10000
CO	1-hour	Badlands NP	4.38	2.42	6.71	-	3500	3506	40000	40000
CO	1-hour	Black Elk WA	31.46	6.49	32.03	-	3500	3532	40000	40000
CO	1-hour	Mt Rushmore NM	28.83	5.50	29.55	-	3500	3529	40000	40000
CO	1-hour	Wind Cave NP	33.85	6.57	36.86	-	3500	3536	40000	40000
CO	1-hour	Jewel Cave NM	43.25	5.92	45.47	-	3500	3545	40000	40000
CO	1-hour	Devil's Tower NM	18.64	13.20	29.28	-	3500	3529	40000	40000
CO	1-hour	N. Cheyenne Reserv	39.84	15.74	46.99	-	3500	3546	40000	40000
CO	1-hour	Cloud Peak WA	24.36	5.88	26.58	-	3500	3526	40000	40000
CO	1-hour	Soldier Creek WA	5.98	2.90	8.71	-	3500	3508	40000	40000
CO	1-hour	Agate Fos Beds NM	7.61	5.51	13.13	-	3500	3513	40000	40000
CO	1-hour	Ft Laramie NHS	5.79	3.26	8.61	-	3500	3508	40000	40000
CO	1-hour	Bighorn Canyon NRA	8.76	6.17	13.59	-	3500	3513	40000	40000
CO	1-hour	Bridger WA	2.19	1.23	3.39	-	3500	3503	40000	40000
CO	1-hour	Fitzpatrick WA	1.53	1.01	2.53	-	3500	3502	40000	40000
CO	1-hour	Washakie WA	2.89	1.87	4.76	-	3500	3504	40000	40000
CO	1-hour	N. Absaroka WA	2.35	1.44	3.74	-	3500	3503	40000	40000

[a] A hyphen indicates no standard exists.

E.4 Far-Field Impacts of Criteria Pollutants under Alternative 3

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
SO2	Annual	Badlands NP	0.06	0.00	0.06	2	3	3.06	60	80
SO2	Annual	Black Elk WA	0.14	0.00	0.14	20	3	3.14	60	80
SO2	Annual	Mt Rushmore NM	0.12	0.00	0.13	20	3	3.13	60	80
SO2	Annual	Wind Cave NP	0.12	0.00	0.12	2	3	3.12	60	80
SO2	Annual	Jewel Cave NM	0.18	0.00	0.19	20	3	3.19	60	80
SO2	Annual	Devil's Tower NM	0.14	0.02	0.16	20	3	3.16	60	80
SO2	Annual	N. Cheyenne Reserv	0.04	0.01	0.05	2	3	3.05	60	80
SO2	Annual	Cloud Peak WA	0.03	0.00	0.03	20	3	3.03	60	80
SO2	Annual	Soldier Creek WA	0.07	0.00	0.07	20	3	3.07	60	80
SO2	Annual	Agate Fos Beds NM	0.05	0.00	0.06	20	3	3.06	60	80
SO2	Annual	Ft Laramie NHS	0.03	0.00	0.04	20	3	3.04	60	80
SO2	Annual	Bighorn Canyon NRA	0.01	0.00	0.01	20	3	3.01	60	80
SO2	Annual	Bridger WA	0.01	0.00	0.01	2	3	3.01	60	80
SO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	Washakie WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2	3	3.00	60	80
SO2	24-hour	Badlands NP	0.56	0.01	0.57	5	8	8.57	260	365
SO2	24-hour	Black Elk WA	1.11	0.03	1.11	91	8	9.11	260	365
SO2	24-hour	Mt Rushmore NM	0.84	0.03	0.84	91	8	8.84	260	365
SO2	24-hour	Wind Cave NP	1.20	0.04	1.20	5	8	9.20	260	365
SO2	24-hour	Jewel Cave NM	1.48	0.06	1.49	91	8	9.49	260	365
SO2	24-hour	Devil's Tower NM	0.73	0.12	0.82	91	8	8.82	260	365
SO2	24-hour	N. Cheyenne Reserv	1.22	0.09	1.28	5	8	9.28	260	365
SO2	24-hour	Cloud Peak WA	0.88	0.05	0.89	91	8	8.89	260	365
SO2	24-hour	Soldier Creek WA	0.45	0.03	0.45	91	8	8.45	260	365
SO2	24-hour	Agate Fos Beds NM	0.49	0.05	0.54	91	8	8.54	260	365
SO2	24-hour	Ft Laramie NHS	0.54	0.04	0.54	91	8	8.54	260	365
SO2	24-hour	Bighorn Canyon NRA	0.46	0.04	0.49	91	8	8.49	260	365
SO2	24-hour	Bridger WA	0.68	0.01	0.69	5	8	8.69	260	365
SO2	24-hour	Fitzpatrick WA	0.07	0.00	0.08	5	8	8.08	260	365
SO2	24-hour	Washakie WA	0.14	0.01	0.14	5	8	8.14	260	365
SO2	24-hour	N. Absaroka WA	0.10	0.01	0.10	5	8	8.10	260	365
SO2	3-hour	Badlands NP	1.79	0.03	1.80	25	8	9.80	1300	1300
SO2	3-hour	Black Elk WA	3.70	0.17	3.70	512	8	11.70	1300	1300
SO2	3-hour	Mt Rushmore NM	2.96	0.15	2.98	512	8	10.98	1300	1300
SO2	3-hour	Wind Cave NP	2.94	0.24	3.18	25	8	11.18	1300	1300
SO2	3-hour	Jewel Cave NM	4.62	0.16	4.62	512	8	12.62	1300	1300
SO2	3-hour	Devil's Tower NM	1.88	0.42	1.89	512	8	9.89	1300	1300
SO2	3-hour	N. Cheyenne Reserv	3.19	0.38	3.31	25	8	11.31	1300	1300
SO2	3-hour	Cloud Peak WA	2.10	0.19	2.11	512	8	10.11	1300	1300
SO2	3-hour	Soldier Creek WA	1.63	0.09	1.67	512	8	9.67	1300	1300
SO2	3-hour	Agate Fos Beds NM	1.70	0.16	1.74	512	8	9.74	1300	1300
SO2	3-hour	Ft Laramie NHS	2.17	0.20	2.17	512	8	10.17	1300	1300
SO2	3-hour	Bighorn Canyon NRA	1.46	0.20	1.62	512	8	9.62	1300	1300
SO2	3-hour	Bridger WA	1.51	0.03	1.52	25	8	9.52	1300	1300
SO2	3-hour	Fitzpatrick WA	0.27	0.01	0.29	25	8	8.29	1300	1300
SO2	3-hour	Washakie WA	0.52	0.02	0.54	25	8	8.54	1300	1300
SO2	3-hour	N. Absaroka WA	0.43	0.02	0.45	25	8	8.45	1300	1300
PM10	Annual	Badlands NP	0.14	0.02	0.16	4	17	17.16	50	50
PM10	Annual	Black Elk WA	0.23	0.03	0.26	17	17	17.26	50	50
PM10	Annual	Mt Rushmore NM	0.22	0.03	0.25	17	17	17.25	50	50
PM10	Annual	Wind Cave NP	0.22	0.03	0.25	4	17	17.25	50	50
PM10	Annual	Jewel Cave NM	0.31	0.04	0.35	17	17	17.35	50	50
PM10	Annual	Devil's Tower NM	0.38	0.09	0.47	17	17	17.47	50	50
PM10	Annual	N. Cheyenne Reserv	0.17	0.06	0.23	4	17	17.23	50	50
PM10	Annual	Cloud Peak WA	0.07	0.04	0.11	17	17	17.11	50	50

E.4 Far-Field Impacts of Criteria Pollutants under Alternative 3 (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
PM10	Annual	Soldier Creek WA	0.16	0.02	0.18	17	17	17.18	50	50
PM10	Annual	Agate Fos Beds NM	0.16	0.02	0.18	17	17	17.18	50	50
PM10	Annual	Ft Laramie NHS	0.15	0.02	0.16	17	17	17.16	50	50
PM10	Annual	Bighorn Canyon NRA	0.16	0.01	0.17	17	17	17.17	50	50
PM10	Annual	Bridger WA	0.01	0.00	0.02	4	17	17.02	50	50
PM10	Annual	Fitzpatrick WA	0.00	0.00	0.01	4	17	17.01	50	50
PM10	Annual	Washakie WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	Annual	N. Absaroka WA	0.01	0.00	0.01	4	17	17.01	50	50
PM10	24-hour	Badlands NP	1.26	0.27	1.48	8	42	43.48	150	150
PM10	24-hour	Black Elk WA	1.61	0.31	1.91	30	42	43.91	150	150
PM10	24-hour	Mt Rushmore NM	1.48	0.28	1.76	30	42	43.76	150	150
PM10	24-hour	Wind Cave NP	2.06	0.39	2.37	8	42	44.37	150	150
PM10	24-hour	Jewel Cave NM	2.28	0.45	2.70	30	42	44.70	150	150
PM10	24-hour	Devil's Tower NM	2.70	0.66	3.21	30	42	45.21	150	150
PM10	24-hour	N. Cheyenne Reserv	2.78	0.91	3.54	8	42	45.54	150	150
PM10	24-hour	Cloud Peak WA	1.38	0.48	1.74	30	42	43.74	150	150
PM10	24-hour	Soldier Creek WA	1.27	0.23	1.45	30	42	43.45	150	150
PM10	24-hour	Agate Fos Beds NM	1.50	0.34	1.78	30	42	43.78	150	150
PM10	24-hour	Ft Laramie NHS	0.94	0.18	1.11	30	42	43.11	150	150
PM10	24-hour	Bighorn Canyon NRA	2.08	0.62	2.70	30	42	44.70	150	150
PM10	24-hour	Bridger WA	0.54	0.15	0.69	8	42	42.69	150	150
PM10	24-hour	Fitzpatrick WA	0.39	0.10	0.49	8	42	42.49	150	150
PM10	24-hour	Washakie WA	0.68	0.18	0.85	8	42	42.85	150	150
PM10	24-hour	N. Absaroka WA	0.71	0.19	0.89	8	42	42.89	150	150
PM25	Annual	Badlands NP	0.11	0.02	0.12	- [a]	7.6	7.72	15	15
PM25	Annual	Black Elk WA	0.16	0.02	0.19	-	7.6	7.79	15	15
PM25	Annual	Mt Rushmore NM	0.16	0.02	0.18	-	7.6	7.78	15	15
PM25	Annual	Wind Cave NP	0.15	0.02	0.18	-	7.6	7.78	15	15
PM25	Annual	Jewel Cave NM	0.19	0.03	0.22	-	7.6	7.82	15	15
PM25	Annual	Devil's Tower NM	0.25	0.06	0.31	-	7.6	7.91	15	15
PM25	Annual	N. Cheyenne Reserv	0.10	0.04	0.14	-	7.6	7.74	15	15
PM25	Annual	Cloud Peak WA	0.06	0.03	0.09	-	7.6	7.69	15	15
PM25	Annual	Soldier Creek WA	0.12	0.02	0.14	-	7.6	7.74	15	15
PM25	Annual	Agate Fos Beds NM	0.11	0.02	0.13	-	7.6	7.73	15	15
PM25	Annual	Ft Laramie NHS	0.09	0.01	0.10	-	7.6	7.70	15	15
PM25	Annual	Bighorn Canyon NRA	0.04	0.01	0.04	-	7.6	7.64	15	15
PM25	Annual	Bridger WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	Fitzpatrick WA	0.00	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	Washakie WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	Annual	N. Absaroka WA	0.01	0.00	0.01	-	7.6	7.61	15	15
PM25	24-hour	Badlands NP	1.06	0.25	1.26	-	19	20.26	65	65
PM25	24-hour	Black Elk WA	1.26	0.25	1.50	-	19	20.50	65	65
PM25	24-hour	Mt Rushmore NM	1.21	0.23	1.44	-	19	20.44	65	65
PM25	24-hour	Wind Cave NP	1.26	0.27	1.51	-	19	20.51	65	65
PM25	24-hour	Jewel Cave NM	1.58	0.33	1.91	-	19	20.91	65	65
PM25	24-hour	Devil's Tower NM	2.24	0.45	2.70	-	19	21.70	65	65
PM25	24-hour	N. Cheyenne Reserv	2.07	0.62	2.63	-	19	21.63	65	65
PM25	24-hour	Cloud Peak WA	1.13	0.37	1.50	-	19	20.50	65	65
PM25	24-hour	Soldier Creek WA	1.18	0.20	1.35	-	19	20.35	65	65
PM25	24-hour	Agate Fos Beds NM	1.20	0.25	1.44	-	19	20.44	65	65
PM25	24-hour	Ft Laramie NHS	0.72	0.15	0.84	-	19	19.84	65	65
PM25	24-hour	Bighorn Canyon NRA	1.78	0.54	2.32	-	19	21.32	65	65
PM25	24-hour	Bridger WA	0.49	0.14	0.62	-	19	19.62	65	65
PM25	24-hour	Fitzpatrick WA	0.34	0.09	0.44	-	19	19.44	65	65
PM25	24-hour	Washakie WA	0.59	0.16	0.75	-	19	19.75	65	65
PM25	24-hour	N. Absaroka WA	0.61	0.17	0.78	-	19	19.78	65	65

E.4 Far-Field Impacts of Criteria Pollutants under Alternative 3 (Continued)

Pollu-tant	Avg. Time	Receptor Area	Concentration ($\mu g/m^3$) Non-PRBO&G	PRBO&G	Cumula-tive	PSD	Base-line	Total	WAAQS	NAAQS
NO2	Annual	Badlands NP	0.20	0.02	0.22	2.5	16.5	16.72	100	100
NO2	Annual	Black Elk WA	0.40	0.04	0.44	25	16.5	16.94	100	100
NO2	Annual	Mt Rushmore NM	0.39	0.04	0.43	25	16.5	16.93	100	100
NO2	Annual	Wind Cave NP	0.37	0.05	0.42	2.5	16.5	16.92	100	100
NO2	Annual	Jewel Cave NM	0.52	0.07	0.60	25	16.5	17.10	100	100
NO2	Annual	Devil's Tower NM	0.77	0.25	1.02	25	16.5	17.52	100	100
NO2	Annual	N. Cheyenne Reserv	0.22	0.12	0.35	2.5	16.5	16.85	100	100
NO2	Annual	Cloud Peak WA	0.08	0.06	0.14	25	16.5	16.64	100	100
NO2	Annual	Soldier Creek WA	0.36	0.03	0.39	25	16.5	16.89	100	100
NO2	Annual	Agate Fos Beds NM	0.16	0.03	0.19	25	16.5	16.69	100	100
NO2	Annual	Ft Laramie NHS	0.09	0.02	0.11	25	16.5	16.61	100	100
NO2	Annual	Bighorn Canyon NRA	0.04	0.01	0.05	25	16.5	16.55	100	100
NO2	Annual	Bridger WA	0.01	0.00	0.01	2.5	16.5	16.51	100	100
NO2	Annual	Fitzpatrick WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	Washakie WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
NO2	Annual	N. Absaroka WA	0.00	0.00	0.00	2.5	16.5	16.50	100	100
CO	8-hour	Badlands NP	2.98	1.19	4.17	-	1500	1504	10000	10000
CO	8-hour	Black Elk WA	5.29	1.46	5.35	-	1500	1505	10000	10000
CO	8-hour	Mt Rushmore NM	4.93	1.20	4.99	-	1500	1504	10000	10000
CO	8-hour	Wind Cave NP	7.94	2.61	9.30	-	1500	1509	10000	10000
CO	8-hour	Jewel Cave NM	9.35	3.24	12.23	-	1500	1512	10000	10000
CO	8-hour	Devil's Tower NM	11.13	4.37	15.51	-	1500	1515	10000	10000
CO	8-hour	N. Cheyenne Reserv	11.71	5.61	17.10	-	1500	1517	10000	10000
CO	8-hour	Cloud Peak WA	5.82	2.30	6.40	-	1500	1506	10000	10000
CO	8-hour	Soldier Creek WA	3.38	1.20	4.59	-	1500	1504	10000	10000
CO	8-hour	Agate Fos Beds NM	5.30	1.84	7.14	-	1500	1507	10000	10000
CO	8-hour	Ft Laramie NHS	3.39	1.03	4.12	-	1500	1504	10000	10000
CO	8-hour	Bighorn Canyon NRA	4.05	2.04	5.94	-	1500	1505	10000	10000
CO	8-hour	Bridger WA	1.88	0.71	2.59	-	1500	1502	10000	10000
CO	8-hour	Fitzpatrick WA	1.07	0.49	1.56	-	1500	1501	10000	10000
CO	8-hour	Washakie WA	1.89	0.85	2.74	-	1500	1502	10000	10000
CO	8-hour	N. Absaroka WA	1.44	0.68	2.12	-	1500	1502	10000	10000
CO	1-hour	Badlands NP	4.38	1.81	6.10	-	3500	3506	40000	40000
CO	1-hour	Black Elk WA	31.46	3.18	31.63	-	3500	3531	40000	40000
CO	1-hour	Mt Rushmore NM	28.83	2.80	29.03	-	3500	3529	40000	40000
CO	1-hour	Wind Cave NP	33.85	3.21	35.67	-	3500	3535	40000	40000
CO	1-hour	Jewel Cave NM	43.25	4.28	44.32	-	3500	3544	40000	40000
CO	1-hour	Devil's Tower NM	18.64	6.37	22.45	-	3500	3522	40000	40000
CO	1-hour	N. Cheyenne Reserv	39.84	11.94	43.00	-	3500	3542	40000	40000
CO	1-hour	Cloud Peak WA	24.36	3.71	25.47	-	3500	3525	40000	40000
CO	1-hour	Soldier Creek WA	5.98	2.03	7.99	-	3500	3507	40000	40000
CO	1-hour	Agate Fos Beds NM	7.61	2.28	9.89	-	3500	3509	40000	40000
CO	1-hour	Ft Laramie NHS	5.79	1.99	7.64	-	3500	3507	40000	40000
CO	1-hour	Bighorn Canyon NRA	8.76	3.83	11.03	-	3500	3511	40000	40000
CO	1-hour	Bridger WA	2.19	0.89	3.06	-	3500	3503	40000	40000
CO	1-hour	Fitzpatrick WA	1.53	0.78	2.30	-	3500	3502	40000	40000
CO	1-hour	Washakie WA	2.89	1.44	4.32	-	3500	3504	40000	40000
CO	1-hour	N. Absaroka WA	2.35	1.08	3.36	-	3500	3503	40000	40000

[a] A hyphen indicates no standard exists.

Appendix F:

Estimated Far-Field Visibility Impacts at Sensitive Receptors – Screening Analysis

F.1 Non-PRBO&G Project Sources

F.2 PRBO&G Project Sources

F.3 Cumulative Sources

F-1

F.1 Non-PRBO&G Project Sources

Screening Procedure	Receptor Area	PSD Class	# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv
WY	Badlands NP	I	62	26	2.95
	Wind Cave NP	I	92	41	3.33
	Bridger WA	I	9	3	2.77
	Fitzpatrick WA	I	1	1	1.05
	Washakie WA	I	2	2	1.81
	North Absaroka WA	I	2	1	1.76
FLAG	Badlands NP	I	98	42	4.55
	Wind Cave NP	I	124	68	5.24
	Bridger WA	I	10	3	2.46
	Fitzpatrick WA	I	2	1	1.18
	Washakie WA	I	3	2	2.13
	North Absaroka WA	I	2	1	2.16
	Northern Cheyenne IR	I	77	27	8.57
	Devil's Tower NM	II	161	97	10.53
	Mt. Rushmore NM	II	127	61	5.90
	Jewel Cave NM	II	146	81	6.10
	Agate Fossil Beds NM	II	91	40	5.74
	Ft. Laramie NHS	II	64	27	3.39
	Black Elk WA	II	136	74	6.16
	Soldier Creek WA	II	102	44	5.06
	Cloud Peak WA	II	38	18	5.22
	Bighorn Canyon NRA	II	16	8	6.21

F.2 PRBO&G Project Sources

Screening Procedure	Receptor Area	PSD Class	Alternative 1			Alternative 2a			Alternative 2b			Alternative 3		
			# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv
WY	Badlands NP	I	22	7	1.77	17	4	1.55	11	2	1.33	3	0	0.69
	Wind Cave NP	I	32	8	1.82	23	6	1.57	17	3	1.35	5	0	0.69
	Bridger WA	I	7	1	1.95	6	1	1.71	6	1	1.48	1	0	0.74
	Fitzpatrick WA	I	1	0	0.71	1	0	0.62	1	0	0.54	0	0	0.28
	Washakie WA	I	2	2	1.22	2	2	1.07	2	0	0.92	0	0	0.47
	North Absaroka WA	I	1	1	1.25	1	1	1.10	1	0	0.95	0	0	0.49
FLAG	Badlands NP	I	38	13	2.88	32	9	2.52	27	8	2.17	8	1	1.12
	Wind Cave NP	I	44	18	2.48	40	14	2.16	32	8	1.87	8	0	0.98
	Bridger WA	I	7	1	1.73	7	1	1.52	6	1	1.32	1	0	0.66
	Fitzpatrick WA	I	1	0	0.79	1	0	0.69	1	0	0.60	0	0	0.31
	Washakie WA	I	2	2	1.43	2	2	1.25	2	2	1.08	2	0	0.56
	North Absaroka WA	I	1	1	1.54	1	1	1.35	1	1	1.17	1	0	0.60
	Northern Cheyenne IR	I	49	21	5.42	40	16	4.49	35	13	3.84	17	6	2.13
	Devil's Tower NM	II	105	45	5.01	96	37	4.24	81	30	3.57	23	2	2.03
	Mt. Rushmore NM	II	39	12	2.82	33	8	2.40	27	6	2.00	6	1	1.07
	Jewel Cave NM	II	52	17	3.07	44	16	2.66	37	11	2.30	12	1	1.21
	Agate Fossil Beds NM	II	41	16	2.92	35	10	2.50	26	8	2.12	9	1	1.13
	Ft. Laramie NHS	II	34	10	1.65	27	7	1.45	18	3	1.26	4	0	0.63
	Black Elk WA	II	42	12	2.88	37	9	2.44	31	7	2.04	7	1	1.09
	Soldier Creek WA	II	45	15	2.43	40	11	2.09	30	7	1.78	7	0	0.92
	Cloud Peak WA	II	32	17	3.04	30	13	2.62	29	11	2.24	16	3	1.20
	Bighorn Canyon NRA	II	14	7	4.51	13	7	3.91	13	6	3.36	7	1	1.85

F.3 Cumulative Sources

Screening Procedure	Receptor Area	PSD Class	Alternative 1			Alternative 2a			Alternative 2b			Alternative 3		
			# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 0.5	# Days Δdv > 1.0	Highest Δdv
WY	Badlands NP	I	92	39	4.56	88	37	4.33	84	37	4.12	76	31	3.48
	Wind Cave NP	I	115	63	5.05	112	63	4.80	111	60	4.57	99	52	3.92
	Bridger WA	I	11	9	4.71	11	7	4.48	11	7	4.24	11	5	3.51
	Fitzpatrick WA	I	4	1	1.76	4	1	1.67	3	1	1.59	2	1	1.33
	Washakie WA	I	5	2	3.03	5	2	2.87	5	2	2.73	3	2	2.28
	North Absaroka WA	I	2	1	2.99	2	1	2.84	2	1	2.70	2	1	2.25
FLAG	Badlands NP	I	134	69	7.39	128	66	7.04	123	64	6.69	111	52	5.65
	Wind Cave NP	I	153	85	7.59	152	83	7.27	146	82	6.99	136	73	6.14
	Bridger WA	I	11	9	4.19	11	8	3.98	11	8	3.77	11	5	3.12
	Fitzpatrick WA	I	4	2	1.97	3	1	1.87	3	1	1.78	2	1	1.49
	Washakie WA	I	6	2	3.56	6	2	3.38	5	2	3.21	4	2	2.68
	North Absaroka WA	I	3	2	3.67	3	2	3.48	3	2	3.31	2	1	2.75
	Northern Cheyenne IR	I	108	54	13.85	107	49	12.95	105	47	12.34	105	45	10.47
	Devil's Tower NM	II	206	139	15.38	205	130	14.64	205	127	13.99	188	117	12.50
	Mt. Rushmore NM	II	154	87	8.68	151	85	8.27	147	81	7.87	138	73	6.95
	Jewel Cave NM	II	177	98	9.12	175	97	8.72	171	96	8.37	158	90	7.29
	Agate Fossil Beds NM	II	115	66	8.65	111	65	8.23	110	60	7.85	102	49	6.86
	Ft. Laramie NHS	II	87	47	4.68	87	46	4.50	87	46	4.50	71	41	3.89
	Black Elk WA	II	166	97	8.97	166	96	8.55	162	94	8.15	146	83	7.23
	Soldier Creek WA	II	136	72	6.93	134	70	6.59	132	68	6.28	118	58	5.75
	Cloud Peak WA	II	52	39	8.11	50	35	7.66	47	34	7.26	47	26	6.39
	Bighorn Canyon NRA	II	24	15	10.38	23	15	9.85	23	15	9.34	20	14	7.95

Appendix G:

Estimated Far-Field Visibility Impacts at Sensitive Receptors – Refined Analysis

G.1 Non-PRBO&G Project Sources

G.2 PRBO&G Project Sources

G.3 Cumulative Sources

G-1

G.1 Non-PRBO&G Project Sources

Receptor Area	PSD Class	Year	# Days Δdv > 1.0	Highest Δdv
Badlands NP	I	1988	0	0.66
		1989	1	1.09
		1990	0	0.64
		1991	1	1.00
		1992	2	1.11
		1993	1	1.13
		1994	0	0.84
		1995	1	1.41
		1996	1	1.03
		1997	1	1.47
		1998	2	1.52
		1999	3	1.32
		Av/Max	1.1	1.52
Wind Cave NP	I	1988	1	1.04
		1989	3	1.61
		1990	0	0.78
		1991	3	1.46
		1992	3	1.18
		1993	1	1.03
		1994	0	0.81
		1995	1	1.01
		1996	0	0.67
		1997	1	1.47
		1998	1	1.24
		1999	3	1.88
		Av/Max	1.4	1.88
Bridger WA	I	1989	0	0.55
		1990	0	0.72
		1991	0	0.44
		1992	0	0.00
		1993	0	0.00
		1994	0	0.57
		1995	0	0.63
		1996	1	1.09
		1997	0	0.42
		1998	0	0.00
		1999	0	0.92
		Av/Max	0.1	1.09
Fitzpatrick WA	I	1989	0	0.50
		1990	0	0.50
		1991	0	0.40
		1992	0	0.00
		1993	0	0.00
		1994	0	0.41
		1995	0	0.57
		1996	0	0.00
		1997	0	0.39
		1998	0	0.00
		1999	0	0.55
		Av/Max	0.0	0.57

G.1 Non-PRBO&G Project Sources (Continued)

Receptor Area	PSD Class	Year	# Days Δdv > 1.0	Highest Δdv
Washakie WA	I	1989	0	0.86
		1990	0	0.86
		1991	0	0.69
		1992	0	0.61
		1993	0	0.00
		1994	0	0.70
		1995	0	0.98
		1996	0	0.00
		1997	0	0.66
		1998	0	0.72
		1999	0	0.94
		Av/Max	0.0	0.98
North Absaroka WA	I	1989	0	0.77
		1990	0	0.00
		1991	0	0.00
		1992	0	0.73
		1993	0	0.00
		1994	0	0.61
		1995	0	0.00
		1996	0	0.00
		1997	0	0.64
		1998	0	0.87
		1999	0	0.91
		Av/Max	0.0	0.91
Northern Cheyenne	I	1989	3	2.01
		1990	2	1.38
		1991	3	1.28
		1992	8	2.91
		1993	1	1.41
		1994	3	2.09
		1995	2	3.03
		1996	5	2.07
		1997	2	2.98
		1998	3	2.64
		1999	2	3.64
		Av/Max	3.1	3.64
Devil's Tower NM	II	1988	5	2.30
		1989	8	3.92
		1990	1	1.15
		1991	6	1.95
		1992	3	2.48
		1993	7	1.38
		1994	2	1.04
		1995	5	2.46
		1996	2	1.58
		1997	4	2.14
		1998	4	1.84
		1999	6	2.72
		Av/Max	4.4	3.92

G.1 Non-PRBO&G Project Sources (Continued)

Receptor Area	PSD Class	Year	# Days Δdv > 1.0	Highest Δdv
Mt. Rushmore NM	II	1988	1	1.28
		1989	2	2.18
		1990	0	0.97
		1991	1	1.83
		1992	2	1.38
		1993	0	0.84
		1994	0	0.78
		1995	1	1.37
		1996	0	0.88
		1997	2	1.50
		1998	1	1.27
		1999	3	1.81
		Av/Max	1.1	2.18
Jewel Cave NM	II	1988	3	1.28
		1989	3	2.19
		1990	0	0.93
		1991	3	1.43
		1992	2	1.39
		1993	1	1.22
		1994	0	0.95
		1995	2	1.37
		1996	0	0.93
		1997	2	1.20
		1998	1	1.08
		1999	6	1.91
		Av/Max	1.9	2.19
Agate Fossil Beds N	II	1988	0	0.66
		1989	0	0.83
		1990	0	0.88
		1991	2	1.40
		1992	1	1.08
		1993	1	1.20
		1994	0	0.61
		1995	2	2.17
		1996	0	0.80
		1997	0	0.95
		1998	0	0.81
		1999	1	1.62
		Av/Max	0.6	2.17
Ft. Laramie NHS	II	1988	0	0.64
		1989	0	0.84
		1990	0	0.99
		1991	0	0.83
		1992	0	0.86
		1993	1	1.27
		1994	0	0.45
		1995	1	1.28
		1996	0	0.58
		1997	0	0.61
		1998	0	0.58
		1999	0	0.95
		Av/Max	0.2	1.28

G.1 Non-PRBO&G Project Sources (Continued)

Receptor Area	PSD Class	Year	# Days Δdv > 1.0	Highest Δdv
Black Elk WA	II	1988	1	1.33
		1989	2	2.28
		1990	0	0.98
		1991	1	1.85
		1992	3	1.44
		1993	0	0.94
		1994	0	0.78
		1995	1	1.43
		1996	0	0.92
		1997	2	1.50
		1998	1	1.27
		1999	3	1.83
		Av/Max	1.2	2.28
Soldier Creek WA	II	1988	0	0.66
		1989	0	0.77
		1990	0	0.84
		1991	1	1.11
		1992	0	0.92
		1993	0	0.80
		1994	0	0.61
		1995	1	1.71
		1996	0	0.77
		1997	0	0.72
		1998	0	0.84
		1999	3	1.28
		Av/Max	0.4	1.71
Cloud Peak WA	II	1989	2	1.31
		1990	1	1.03
		1991	1	1.31
		1992	5	1.72
		1993	2	1.27
		1994	2	1.42
		1995	3	1.79
		1996	2	1.40
		1997	2	1.75
		1998	2	1.56
		1999	3	2.18
		Av/Max	2.3	2.18
Bighorn Canyon NR	II	1989	1	2.23
		1990	1	1.06
		1991	1	1.04
		1992	4	2.11
		1993	0	0.88
		1994	1	1.75
		1995	2	1.07
		1996	0	0.69
		1997	2	1.85
		1998	1	2.50
		1999	2	2.61
		Av/Max	1.4	2.61

G.2 PRBO&G Project Sources

Receptor Area	PSD Class	Year	Alternative 1		Alternative 2a		Alternative 2b		Alternative 3	
			# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv
Badlands NP	I	1988	0	0.42	0	0.37	0	0.32	0	0.00
		1989	0	0.62	0	0.52	0	0.44	0	0.00
		1990	0	0.48	0	0.42	0	0.36	0	0.00
		1991	0	0.49	0	0.35	0	0.30	0	0.00
		1992	0	0.70	0	0.61	0	0.53	0	0.27
		1993	0	0.46	0	0.41	0	0.35	0	0.18
		1994	0	0.53	0	0.47	0	0.40	0	0.21
		1995	0	0.90	0	0.78	0	0.67	0	0.35
		1996	0	0.65	0	0.57	0	0.49	0	0.25
		1997	0	0.34	0	0.29	0	0.24	0	0.00
		1998	0	0.96	0	0.84	0	0.73	0	0.38
		1999	0	0.87	0	0.77	0	0.67	0	0.13
		Av/Max	0.0	0.96	0.0	0.84	0.0	0.73	0.0	0.38
Wind Cave NP	I	1988	0	0.62	0	0.53	0	0.46	0	0.00
		1989	0	0.79	0	0.67	0	0.56	0	0.00
		1990	0	0.53	0	0.46	0	0.39	0	0.00
		1991	0	0.99	0	0.86	0	0.73	0	0.00
		1992	0	0.57	0	0.49	0	0.43	0	0.00
		1993	0	0.50	0	0.43	0	0.37	0	0.00
		1994	0	0.39	0	0.34	0	0.29	0	0.00
		1995	0	0.50	0	0.43	0	0.35	0	0.00
		1996	0	0.39	0	0.34	0	0.29	0	0.00
		1997	0	0.49	0	0.42	0	0.31	0	0.00
		1998	0	0.46	0	0.40	0	0.34	0	0.00
		1999	1	1.11	0	0.97	0	0.84	0	0.00
		Av/Max	0.1	1.11	0.0	0.97	0.0	0.84	0.0	0.00
Bridger WA	I	1989	0	0.00	0	0.00	0	0.00	0	0.00
		1990	0	0.51	0	0.45	0	0.39	0	0.00
		1991	0	0.00	0	0.00	0	0.00	0	0.00
		1992	0	0.00	0	0.00	0	0.00	0	0.00
		1993	0	0.00	0	0.00	0	0.00	0	0.00
		1994	0	0.41	0	0.36	0	0.31	0	0.00
		1995	0	0.00	0	0.00	0	0.00	0	0.00
		1996	0	0.77	0	0.68	0	0.59	0	0.00
		1997	0	0.00	0	0.00	0	0.00	0	0.00
		1998	0	0.00	0	0.00	0	0.00	0	0.00
		1999	0	0.65	0	0.57	0	0.49	0	0.00
		Av/Max	0.0	0.77	0.0	0.68	0.0	0.59	0.0	0.00
Fitzpatrick WA	I	1989	0	0.00	0	0.00	0	0.00	0	0.00
		1990	0	0.00	0	0.00	0	0.00	0	0.00
		1991	0	0.00	0	0.00	0	0.00	0	0.00
		1992	0	0.00	0	0.00	0	0.00	0	0.00
		1993	0	0.00	0	0.00	0	0.00	0	0.00
		1994	0	0.00	0	0.00	0	0.00	0	0.00
		1995	0	0.00	0	0.00	0	0.00	0	0.00
		1996	0	0.00	0	0.00	0	0.00	0	0.00
		1997	0	0.00	0	0.00	0	0.00	0	0.00
		1998	0	0.00	0	0.00	0	0.00	0	0.00
		1999	0	0.00	0	0.00	0	0.00	0	0.00
		Av/Max	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00

G.2 PRBO&G Project Sources (Continued)

Receptor Area	PSD Class	Year	Alternative 1 # Days Δdv > 1.0	Alternative 1 Highest Δdv	Alternative 2a # Days Δdv > 1.0	Alternative 2a Highest Δdv	Alternative 2b # Days Δdv > 1.0	Alternative 2b Highest Δdv	Alternative 3 # Days Δdv > 1.0	Alternative 3 Highest Δdv
Washakie WA	I	1989	0	0.58	0	0.51	0	0.44	0	0.00
		1990	0	0.58	0	0.51	0	0.44	0	0.00
		1991	0	0.47	0	0.41	0	0.35	0	0.00
		1992	0	0.48	0	0.42	0	0.37	0	0.00
		1993	0	0.00	0	0.00	0	0.00	0	0.00
		1994	0	0.48	0	0.42	0	0.36	0	0.00
		1995	0	0.67	0	0.58	0	0.50	0	0.00
		1996	0	0.00	0	0.00	0	0.00	0	0.00
		1997	0	0.45	0	0.39	0	0.34	0	0.00
		1998	0	0.57	0	0.50	0	0.43	0	0.00
		1999	0	0.64	0	0.56	0	0.48	0	0.00
		Av/Max	0.0	0.67	0.0	0.58	0.0	0.50	0.0	0.00
North Absaroka WA	I	1989	0	0.55	0	0.48	0	0.42	0	0.00
		1990	0	0.00	0	0.00	0	0.00	0	0.00
		1991	0	0.00	0	0.00	0	0.00	0	0.00
		1992	0	0.52	0	0.46	0	0.40	0	0.00
		1993	0	0.00	0	0.00	0	0.00	0	0.00
		1994	0	0.43	0	0.38	0	0.33	0	0.00
		1995	0	0.00	0	0.00	0	0.00	0	0.00
		1996	0	0.00	0	0.00	0	0.00	0	0.00
		1997	0	0.46	0	0.40	0	0.35	0	0.00
		1998	0	0.62	0	0.54	0	0.47	0	0.00
		1999	0	0.65	0	0.57	0	0.49	0	0.00
		Av/Max	0.0	0.65	0.0	0.57	0.0	0.49	0.0	0.00
Northern Cheyenne	I	1989	2	1.16	0	1.00	0	0.89	0	0.50
		1990	0	0.86	0	0.76	0	0.68	0	0.39
		1991	1	1.05	0	0.90	0	0.82	0	0.38
		1992	3	1.95	2	1.63	2	1.39	0	0.77
		1993	1	1.85	1	1.59	1	1.46	0	0.83
		1994	1	1.40	1	1.17	0	1.00	0	0.55
		1995	2	2.03	2	1.69	2	1.45	0	0.80
		1996	5	1.40	2	1.19	0	1.00	0	0.52
		1997	1	1.99	1	1.66	1	1.42	0	0.79
		1998	3	1.75	2	1.46	1	1.25	0	0.69
		1999	3	2.38	2	1.98	2	1.70	0	0.94
		Av/Max	2.0	2.38	1.2	1.98	0.8	1.70	0.0	0.94
Devil's Tower NM	II	1988	2	1.11	0	0.94	0	0.82	0	0.45
		1989	2	1.88	2	1.59	1	1.34	0	0.76
		1990	0	0.81	0	0.71	0	0.65	0	0.26
		1991	0	1.00	0	0.85	0	0.76	0	0.00
		1992	1	1.20	1	1.01	0	0.85	0	0.48
		1993	0	0.94	0	0.82	0	0.75	0	0.31
		1994	0	0.67	0	0.58	0	0.52	0	0.18
		1995	1	1.19	1	1.01	0	0.85	0	0.48
		1996	0	0.76	0	0.64	0	0.54	0	0.31
		1997	2	1.09	0	0.94	0	0.84	0	0.42
		1998	0	0.92	0	0.79	0	0.71	0	0.00
		1999	1	1.31	1	1.11	0	0.94	0	0.53
		Av/Max	0.8	1.88	0.4	1.59	0.1	1.34	0.0	0.76

G.2 PRBO&G Project Sources (Continued)

Receptor Area	PSD Class	Year	Alternative 1		Alternative 2a		Alternative 2b		Alternative 3	
			# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv
Mt. Rushmore NM	II	1988	0	0.62	0	0.53	0	0.44	0	0.23
		1989	1	1.05	0	0.90	0	0.75	0	0.40
		1990	0	0.56	0	0.49	0	0.41	0	0.12
		1991	1	1.06	0	0.92	0	0.78	0	0.00
		1992	0	0.67	0	0.57	0	0.47	0	0.25
		1993	0	0.44	0	0.39	0	0.34	0	0.10
		1994	0	0.35	0	0.31	0	0.27	0	0.00
		1995	0	0.66	0	0.56	0	0.47	0	0.25
		1996	0	0.43	0	0.36	0	0.30	0	0.16
		1997	0	0.58	0	0.49	0	0.41	0	0.22
		1998	0	0.49	0	0.43	0	0.36	0	0.00
		1999	1	1.04	0	0.90	0	0.77	0	0.28
		Av/Max	0.3	1.06	0.0	0.92	0.0	0.78	0.0	0.40
Jewel Cave NM	II	1988	0	0.65	0	0.56	0	0.49	0	0.00
		1989	0	0.88	0	0.75	0	0.63	0	0.00
		1990	0	0.51	0	0.45	0	0.38	0	0.00
		1991	0	0.96	0	0.84	0	0.72	0	0.00
		1992	0	0.71	0	0.62	0	0.54	0	0.28
		1993	0	0.63	0	0.55	0	0.47	0	0.25
		1994	0	0.49	0	0.43	0	0.37	0	0.19
		1995	0	0.55	0	0.48	0	0.42	0	0.00
		1996	0	0.38	0	0.33	0	0.28	0	0.00
		1997	0	0.56	0	0.49	0	0.43	0	0.00
		1998	0	0.55	0	0.48	0	0.42	0	0.22
		1999	1	1.17	1	1.02	0	0.89	0	0.00
		Av/Max	0.1	1.17	0.1	1.02	0.0	0.89	0.0	0.28
Agate Fossil Beds I	II	1988	0	0.39	0	0.35	0	0.28	0	0.13
		1989	0	0.55	0	0.35	0	0.31	0	0.00
		1990	0	0.59	0	0.53	0	0.31	0	0.11
		1991	0	0.72	0	0.62	0	0.53	0	0.28
		1992	0	0.56	0	0.48	0	0.41	0	0.22
		1993	0	0.61	0	0.53	0	0.46	0	0.00
		1994	0	0.35	0	0.30	0	0.27	0	0.00
		1995	1	1.11	0	0.95	0	0.80	0	0.43
		1996	0	0.53	0	0.47	0	0.42	0	0.00
		1997	0	0.56	0	0.50	0	0.45	0	0.00
		1998	0	0.56	0	0.49	0	0.45	0	0.00
		1999	0	0.84	0	0.72	0	0.61	0	0.32
		Av/Max	0.1	1.11	0.0	0.95	0.0	0.80	0.0	0.43
Ft. Laramie NHS	II	1988	0	0.23	0	0.20	0	0.00	0	0.00
		1989	0	0.48	0	0.42	0	0.37	0	0.00
		1990	0	0.31	0	0.27	0	0.24	0	0.00
		1991	0	0.36	0	0.31	0	0.27	0	0.00
		1992	0	0.56	0	0.48	0	0.15	0	0.00
		1993	0	0.73	0	0.64	0	0.56	0	0.00
		1994	0	0.25	0	0.22	0	0.18	0	0.00
		1995	0	0.49	0	0.42	0	0.27	0	0.00
		1996	0	0.35	0	0.31	0	0.27	0	0.00
		1997	0	0.33	0	0.28	0	0.25	0	0.00
		1998	0	0.34	0	0.30	0	0.26	0	0.00
		1999	0	0.38	0	0.33	0	0.23	0	0.00
		Av/Max	0.0	0.73	0.0	0.64	0.0	0.56	0.0	0.00

G.2 PRBO&G Project Sources (Continued)

Receptor Area	PSD Class	Year	Alternative 1 # Days Δdv > 1.0	Alternative 1 Highest Δdv	Alternative 2a # Days Δdv > 1.0	Alternative 2a Highest Δdv	Alternative 2b # Days Δdv > 1.0	Alternative 2b Highest Δdv	Alternative 3 # Days Δdv > 1.0	Alternative 3 Highest Δdv
Black Elk WA	II	1988	0	0.63	0	0.54	0	0.45	0	0.24
		1989	1	1.07	0	0.91	0	0.76	0	0.41
		1990	0	0.59	0	0.51	0	0.44	0	0.12
		1991	1	1.11	0	0.96	0	0.82	0	0.00
		1992	0	0.68	0	0.58	0	0.48	0	0.26
		1993	0	0.49	0	0.43	0	0.38	0	0.10
		1994	0	0.38	0	0.33	0	0.29	0	0.00
		1995	0	0.68	0	0.57	0	0.48	0	0.26
		1996	0	0.43	0	0.38	0	0.32	0	0.16
		1997	0	0.59	0	0.50	0	0.42	0	0.22
		1998	0	0.52	0	0.45	0	0.38	0	0.00
		1999	1	1.09	0	0.95	0	0.81	0	0.28
		Av/Max	0.3	1.11	0.0	0.96	0.0	0.82	0.0	0.41
Soldier Creek WA	II	1988	0	0.38	0	0.33	0	0.28	0	0.00
		1989	0	0.55	0	0.39	0	0.18	0	0.00
		1990	0	0.50	0	0.31	0	0.26	0	0.00
		1991	0	0.62	0	0.54	0	0.47	0	0.00
		1992	0	0.47	0	0.40	0	0.34	0	0.00
		1993	0	0.38	0	0.33	0	0.28	0	0.00
		1994	0	0.36	0	0.31	0	0.27	0	0.00
		1995	0	0.92	0	0.79	0	0.68	0	0.00
		1996	0	0.34	0	0.26	0	0.19	0	0.00
		1997	0	0.37	0	0.32	0	0.27	0	0.00
		1998	0	0.35	0	0.28	0	0.24	0	0.00
		1999	0	0.70	0	0.60	0	0.51	0	0.00
		Av/Max	0.0	0.92	0.0	0.79	0.0	0.68	0.0	0.00
Cloud Peak WA	II	1989	1	1.01	0	0.92	0	0.83	0	0.35
		1990	0	0.79	0	0.72	0	0.65	0	0.23
		1991	1	1.13	0	0.99	0	0.85	0	0.42
		1992	3	1.18	1	1.08	0	0.97	0	0.46
		1993	1	1.09	0	0.96	0	0.82	0	0.41
		1994	1	1.22	1	1.06	0	0.91	0	0.46
		1995	4	1.56	3	1.29	2	1.07	0	0.62
		1996	3	1.34	1	1.14	0	0.98	0	0.44
		1997	2	1.15	1	1.00	0	0.86	0	0.43
		1998	1	1.15	1	1.01	0	0.86	0	0.43
		1999	4	1.57	2	1.37	1	1.18	0	0.59
		Av/Max	1.9	1.57	0.9	1.37	0.3	1.18	0.0	0.62
Bighorn Canyon NF	II	1989	1	1.63	1	1.42	1	1.22	0	0.67
		1990	0	0.71	0	0.66	0	0.62	0	0.00
		1991	0	0.89	0	0.78	0	0.67	0	0.00
		1992	4	1.55	2	1.34	1	1.15	0	0.63
		1993	0	0.68	0	0.65	0	0.61	0	0.00
		1994	1	1.28	1	1.11	0	0.95	0	0.53
		1995	1	1.07	1	1.02	0	0.97	0	0.00
		1996	0	0.67	0	0.58	0	0.50	0	0.00
		1997	2	1.35	1	1.18	1	1.01	0	0.56
		1998	1	1.83	1	1.59	1	1.37	0	0.75
		1999	1	1.91	1	1.66	1	1.42	0	0.78
		Av/Max	1.0	1.91	0.7	1.66	0.5	1.42	0.0	0.78

G.3 Cumulative Sources

Receptor Area	PSD Class	Year	Alternative 1 # Days Δdv > 1.0	Alternative 1 Highest Δdv	Alternative 2a # Days Δdv > 1.0	Alternative 2a Highest Δdv	Alternative 2b # Days Δdv > 1.0	Alternative 2b Highest Δdv	Alternative 3 # Days Δdv > 1.0	Alternative 3 Highest Δdv
Badlands NP	I	1988	1	1.02	0	0.97	0	0.92	0	0.80
		1989	2	1.70	2	1.61	2	1.52	2	1.32
		1990	1	1.11	1	1.05	0	1.00	0	0.82
		1991	3	1.43	3	1.37	2	1.30	2	1.16
		1992	5	1.80	5	1.72	4	1.63	3	1.38
		1993	3	1.59	3	1.52	3	1.47	2	1.31
		1994	2	1.37	2	1.31	2	1.24	1	1.05
		1995	4	2.30	4	2.19	3	2.08	2	1.76
		1996	2	1.67	2	1.59	2	1.51	2	1.28
		1997	1	1.80	1	1.76	1	1.72	1	1.60
		1998	4	2.47	4	2.35	4	2.24	3	1.89
		1999	7	2.03	7	1.92	7	1.82	5	1.53
		Av/Max	2.9	2.47	2.8	2.35	2.5	2.24	1.9	1.89
Wind Cave NP	I	1988	6	1.65	6	1.57	6	1.50	4	1.27
		1989	5	2.39	4	2.28	4	2.16	3	1.91
		1990	2	1.29	2	1.22	1	1.15	0	0.97
		1991	4	2.42	3	2.29	3	2.17	3	1.83
		1992	5	1.72	5	1.65	5	1.58	4	1.39
		1993	3	1.51	3	1.44	3	1.39	1	1.21
		1994	1	1.17	1	1.12	1	1.08	0	0.95
		1995	5	1.50	4	1.43	4	1.36	3	1.20
		1996	1	1.03	0	0.99	0	0.94	0	0.81
		1997	3	1.91	3	1.85	3	1.80	2	1.64
		1998	3	1.61	3	1.56	3	1.52	2	1.38
		1999	8	2.99	7	2.84	7	2.71	6	2.30
		Av/Max	3.8	2.99	3.4	2.84	3.3	2.71	2.3	2.30
Bridger WA	I	1989	0	0.89	0	0.85	0	0.81	0	0.68
		1990	1	1.22	1	1.16	1	1.10	0	0.91
		1991	0	0.72	0	0.68	0	0.65	0	0.55
		1992	0	0.92	0	0.87	0	0.82	0	0.67
		1993	0	0.61	0	0.58	0	0.55	0	0.45
		1994	0	0.98	0	0.93	0	0.88	0	0.73
		1995	1	1.02	0	0.97	0	0.93	0	0.78
		1996	1	1.85	1	1.76	1	1.67	1	1.38
		1997	0	0.69	0	0.66	0	0.63	0	0.53
		1998	0	0.65	0	0.61	0	0.57	0	0.44
		1999	1	1.57	1	1.49	1	1.41	1	1.17
		Av/Max	0.4	1.85	0.3	1.76	0.3	1.67	0.2	1.38
Fitzpatrick WA	I	1989	0	0.83	0	0.79	0	0.75	0	0.63
		1990	0	0.83	0	0.79	0	0.75	0	0.63
		1991	0	0.67	0	0.64	0	0.61	0	0.51
		1992	0	0.54	0	0.00	0	0.00	0	0.00
		1993	0	0.36	0	0.00	0	0.00	0	0.00
		1994	0	0.68	0	0.65	0	0.62	0	0.52
		1995	0	0.96	0	0.91	0	0.86	0	0.72
		1996	0	0.18	0	0.00	0	0.00	0	0.00
		1997	0	0.65	0	0.61	0	0.58	0	0.49
		1998	0	0.23	0	0.00	0	0.00	0	0.00
		1999	0	0.92	0	0.87	0	0.83	0	0.69
		Av/Max	0.0	0.96	0.0	0.91	0.0	0.86	0.0	0.72

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G.3 Cumulative Sources (Continued)

Receptor Area	PSD Class	Year	Alternative 1		Alternative 2a		Alternative 2b		Alternative 3	
			# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv
Washakie WA	I	1989	2	1.44	2	1.36	2	1.30	1	1.08
		1990	1	1.44	1	1.36	1	1.30	1	1.08
		1991	1	1.16	1	1.10	1	1.04	0	0.87
		1992	1	1.09	1	1.03	0	0.97	0	0.80
		1993	0	0.00	0	0.00	0	0.00	0	0.00
		1994	1	1.18	1	1.12	1	1.06	0	0.89
		1995	1	1.65	1	1.57	1	1.49	1	1.24
		1996	0	0.00	0	0.00	0	0.00	0	0.00
		1997	1	1.11	1	1.06	1	1.00	0	0.84
		1998	1	1.29	1	1.22	1	1.15	0	0.95
		1999	2	1.58	2	1.50	2	1.43	1	1.19
		Av/Max	1.0	1.65	1.0	1.57	0.9	1.49	0.4	1.24
North Absaroka WA	I	1989	1	1.32	1	1.25	1	1.19	0	0.99
		1990	0	0.42	0	0.41	0	0.39	0	0.00
		1991	0	0.34	0	0.33	0	0.32	0	0.00
		1992	1	1.25	1	1.19	1	1.13	0	0.94
		1993	0	0.00	0	0.00	0	0.00	0	0.00
		1994	1	1.04	0	0.98	0	0.94	0	0.78
		1995	0	0.48	0	0.47	0	0.45	0	0.00
		1996	0	0.00	0	0.00	0	0.00	0	0.00
		1997	1	1.09	1	1.04	0	0.99	0	0.82
		1998	1	1.48	1	1.41	1	1.34	1	1.11
		1999	1	1.54	1	1.46	1	1.39	1	1.16
		Av/Max	0.5	1.54	0.5	1.46	0.4	1.39	0.2	1.16
Northern Cheyenne	I	1989	6	3.16	6	3.00	6	2.89	4	2.41
		1990	6	2.15	6	2.05	5	1.96	3	1.66
		1991	10	1.92	9	1.87	9	1.83	7	1.52
		1992	13	4.82	13	4.50	12	4.28	9	3.60
		1993	8	3.12	8	2.86	6	2.72	4	2.01
		1994	11	3.46	8	3.23	8	3.07	4	2.58
		1995	9	5.02	8	4.69	8	4.46	6	3.75
		1996	14	3.38	14	3.18	14	3.01	9	2.61
		1997	12	4.93	10	4.61	10	4.38	5	3.68
		1998	11	4.35	11	4.06	10	3.86	6	3.25
		1999	14	5.97	13	5.58	9	5.31	7	4.48
		Av/Max	10.4	5.97	9.6	5.58	8.8	5.31	5.8	4.48
Devil's Tower NM	II	1988	15	3.37	14	3.21	12	3.06	8	2.73
		1989	12	5.75	10	5.47	10	5.23	10	4.66
		1990	6	1.74	5	1.63	5	1.57	4	1.37
		1991	9	2.90	8	2.78	8	2.67	7	2.32
		1992	9	3.64	8	3.47	8	3.31	4	2.96
		1993	15	2.04	14	1.95	14	1.85	9	1.64
		1994	9	1.70	9	1.61	8	1.55	3	1.24
		1995	16	3.62	14	3.44	12	3.29	6	2.93
		1996	9	2.32	9	2.21	7	2.11	3	1.88
		1997	9	3.15	8	3.00	7	2.86	5	2.55
		1998	12	2.63	10	2.53	10	2.45	8	2.16
		1999	17	3.99	14	3.80	13	3.63	12	3.24
		Av/Max	11.5	5.75	10.3	5.47	9.5	5.23	6.6	4.66

G.3 Cumulative Sources (Continued)

Receptor Area	PSD Class	Year	Alternative 1		Alternative 2a		Alternative 2b		Alternative 3	
			# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv	# Days Δdv > 1.0	Highest Δdv
Mt. Rushmore NM	II	1988	3	1.89	2	1.80	2	1.71	2	1.51
		1989	3	3.23	3	3.07	2	2.92	2	2.58
		1990	2	1.51	2	1.44	1	1.37	1	1.18
		1991	2	2.84	1	2.70	1	2.57	1	2.22
		1992	4	2.04	4	1.94	4	1.85	3	1.63
		1993	2	1.28	1	1.23	1	1.19	1	1.01
		1994	2	1.03	0	0.99	0	0.97	0	0.88
		1995	4	2.02	4	1.93	4	1.83	3	1.62
		1996	2	1.30	2	1.24	1	1.18	1	1.04
		1997	2	1.97	2	1.91	2	1.86	2	1.69
		1998	4	1.66	4	1.61	4	1.57	2	1.42
		1999	8	2.79	8	2.66	8	2.53	4	2.19
		Av/Max	3.2	3.23	2.8	3.07	2.5	2.92	1.8	2.58
Jewel Cave NM	II	1988	8	1.79	7	1.72	6	1.65	6	1.48
		1989	4	3.07	4	2.94	3	2.82	3	2.54
		1990	5	1.31	4	1.26	3	1.21	2	1.08
		1991	5	2.35	5	2.23	5	2.12	4	1.79
		1992	7	2.10	7	2.00	7	1.92	3	1.67
		1993	4	1.84	4	1.76	3	1.69	1	1.47
		1994	1	1.44	1	1.37	1	1.32	1	1.15
		1995	5	1.92	5	1.84	5	1.77	3	1.59
		1996	2	1.28	2	1.23	2	1.19	2	1.06
		1997	3	1.69	3	1.62	3	1.56	2	1.38
		1998	3	1.62	3	1.55	2	1.49	2	1.29
		1999	10	3.08	10	2.93	10	2.80	8	2.36
		Av/Max	4.8	3.08	4.6	2.94	4.2	2.82	3.1	2.54
Agate Fossil Beds NM	II	1988	2	1.03	0	0.98	0	0.94	0	0.80
		1989	3	1.38	2	1.31	2	1.25	1	1.04
		1990	3	1.47	3	1.41	3	1.35	1	1.11
		1991	3	2.12	3	2.02	3	1.93	2	1.68
		1992	3	1.64	3	1.56	3	1.49	1	1.30
		1993	3	1.75	3	1.68	3	1.61	1	1.41
		1994	0	0.95	0	0.91	0	0.87	0	0.74
		1995	3	3.27	3	3.11	3	2.97	2	2.59
		1996	3	1.33	1	1.27	1	1.22	1	1.01
		1997	5	1.39	4	1.34	4	1.28	2	1.12
		1998	4	1.37	3	1.30	2	1.26	1	1.03
		1999	6	2.45	6	2.33	5	2.23	3	1.94
		Av/Max	3.2	3.27	2.6	3.11	2.4	2.97	1.3	2.59
Ft. Laramie NHS	II	1988	0	0.82	0	0.80	0	0.80	0	0.72
		1989	2	1.32	2	1.26	2	1.26	1	1.02
		1990	1	1.26	1	1.22	1	1.22	1	1.11
		1991	1	1.15	1	1.10	1	1.10	0	0.95
		1992	2	1.42	2	1.34	2	1.34	1	1.06
		1993	1	2.00	1	1.91	1	1.91	1	1.55
		1994	0	0.64	0	0.61	0	0.61	0	0.52
		1995	1	1.77	1	1.70	1	1.70	1	1.47
		1996	0	0.93	0	0.88	0	0.88	0	0.71
		1997	0	0.93	0	0.89	0	0.89	0	0.73
		1998	0	0.91	0	0.87	0	0.87	0	0.71
		1999	2	1.32	2	1.27	2	1.27	1	1.10
		Av/Max	0.8	2.00	0.8	1.91	0.8	1.91	0.5	1.55

G.3 Cumulative Sources (Continued)

Receptor Area	PSD Class	Year	Alternative 1 # Days Δdv > 1.0	Alternative 1 Highest Δdv	Alternative 2a # Days Δdv > 1.0	Alternative 2a Highest Δdv	Alternative 2b # Days Δdv > 1.0	Alternative 2b Highest Δdv	Alternative 3 # Days Δdv > 1.0	Alternative 3 Highest Δdv
Black Elk WA	II	1988	4	1.95	4	1.86	2	1.77	2	1.57
		1989	3	3.33	3	3.17	3	3.02	2	2.68
		1990	3	1.53	2	1.46	2	1.39	1	1.19
		1991	3	2.88	2	2.74	2	2.61	1	2.25
		1992	4	2.11	4	2.01	4	1.91	3	1.70
		1993	3	1.42	1	1.37	1	1.31	1	1.13
		1994	2	1.11	1	1.07	1	1.03	0	0.88
		1995	4	2.09	4	1.99	4	1.90	3	1.68
		1996	3	1.35	3	1.28	3	1.22	1	1.08
		1997	2	1.98	2	1.92	2	1.86	2	1.69
		1998	5	1.67	5	1.62	4	1.57	2	1.42
		1999	8	2.84	8	2.70	8	2.57	6	2.22
		Av/Max	3.7	3.33	3.3	3.17	3.0	3.02	2.0	2.68
Soldier Creek WA	II	1988	1	1.04	0	0.99	0	0.94	0	0.81
		1989	3	1.23	2	1.17	2	1.10	0	0.90
		1990	2	1.13	1	1.08	1	1.03	0	0.90
		1991	4	1.71	4	1.63	3	1.55	2	1.34
		1992	2	1.36	2	1.31	2	1.26	2	1.09
		1993	2	1.12	1	1.08	1	1.05	0	0.93
		1994	0	0.91	0	0.86	0	0.82	0	0.69
		1995	5	2.63	4	2.50	4	2.38	2	2.05
		1996	0	0.92	0	0.90	0	0.88	0	0.83
		1997	0	0.97	0	0.93	0	0.89	0	0.82
		1998	1	1.12	1	1.07	1	1.03	0	0.95
		1999	5	1.98	5	1.88	5	1.79	3	1.54
		Av/Max	2.1	2.63	1.7	2.50	1.6	2.38	0.8	2.05
Cloud Peak WA	II	1989	4	2.28	4	2.19	4	2.10	2	1.67
		1990	3	1.79	3	1.72	3	1.65	2	1.31
		1991	6	2.41	4	2.27	3	2.14	1	1.73
		1992	12	2.70	11	2.57	10	2.47	6	2.11
		1993	7	2.33	5	2.20	5	2.07	3	1.68
		1994	6	2.59	5	2.45	4	2.30	2	1.86
		1995	8	2.92	7	2.66	7	2.55	5	2.20
		1996	9	2.68	9	2.49	7	2.34	6	1.89
		1997	7	2.76	6	2.61	5	2.47	3	2.16
		1998	6	2.46	5	2.32	4	2.19	2	1.92
		1999	10	3.41	10	3.22	10	3.05	7	2.67
		Av/Max	7.1	3.41	6.3	3.22	5.6	3.05	3.5	2.67
Bighorn Canyon NF	II	1989	4	3.75	3	3.55	3	3.37	1	2.86
		1990	3	1.75	3	1.67	3	1.59	2	1.34
		1991	3	1.82	3	1.71	3	1.60	3	1.26
		1992	6	3.55	6	3.37	6	3.19	6	2.71
		1993	4	1.33	4	1.28	4	1.22	1	1.06
		1994	5	2.94	4	2.79	3	2.65	1	2.25
		1995	4	1.78	4	1.65	4	1.59	4	1.29
		1996	3	1.36	2	1.28	1	1.20	0	0.93
		1997	5	3.11	5	2.95	5	2.80	3	2.38
		1998	5	4.21	4	3.99	4	3.78	3	3.21
		1999	6	4.38	5	4.15	5	3.94	3	3.35
		Av/Max	4.4	4.38	3.9	4.15	3.7	3.94	2.5	3.35

Appendix H:

Estimated Far-Field Acid Deposition Impacts at Sensitive Lakes

		Annual Deposition Rate (kg/ha/yr)								
		Sulfur			Nitrogen			Percent ANC Change		
Alternative	Receptor Area	Non-PRBO&G	PRBO&G	Cumula-tive	Non-PRBO&G	PRBO&G	Cumula-tive	Non-PRBO&G	PRBO&G	Cumula-tive
Alt. 1	Black Joe Lake	0.0033	0.0002	0.0035	0.0070	0.0047	0.0118	0.52	0.26	0.78
	Deep Lake	0.0034	0.0002	0.0036	0.0070	0.0047	0.0118	0.60	0.29	0.89
	Hobbs Lake	0.0012	0.0001	0.0012	0.0030	0.0022	0.0052	0.21	0.12	0.34
	Upper Frozen Lake	0.0036	0.0002	0.0038	0.0072	0.0048	0.0120	- a	-	-
	Emerald Lake	0.0107	0.0012	0.0119	0.0311	0.0256	0.0567	2.47	1.63	4.10
	Florence Lake	0.0124	0.0014	0.0138	0.0345	0.0292	0.0637	4.68	3.13	7.81
	Ross Lake	0.0011	0.0001	0.0012	0.0031	0.0025	0.0056	0.24	0.15	0.39
	Lower Saddlebag Lake	0.0054	0.0002	0.0057	0.0096	0.0061	0.0157	0.94	0.41	1.35
Alt. 2a	Black Joe Lake	0.0033	0.0002	0.0035	0.0070	0.0042	0.0112	0.52	0.23	0.75
	Deep Lake	0.0034	0.0002	0.0036	0.0070	0.0042	0.0112	0.60	0.26	0.85
	Hobbs Lake	0.0012	0.0001	0.0012	0.0030	0.0020	0.0049	0.21	0.11	0.32
	Upper Frozen Lake	0.0036	0.0002	0.0038	0.0072	0.0042	0.0114			
	Emerald Lake	0.0107	0.0012	0.0119	0.0311	0.0228	0.0539	2.47	1.45	3.92
	Florence Lake	0.0124	0.0014	0.0138	0.0345	0.0260	0.0605	4.68	2.80	7.48
	Ross Lake	0.0011	0.0001	0.0012	0.0031	0.0022	0.0053	0.24	0.13	0.38
	Lower Saddlebag Lake	0.0054	0.0002	0.0057	0.0096	0.0054	0.0150	0.94	0.37	1.30
Alt. 2b	Black Joe Lake	0.0033	0.0002	0.0035	0.0070	0.0036	0.0106	0.52	0.20	0.72
	Deep Lake	0.0034	0.0002	0.0036	0.0070	0.0036	0.0107	0.60	0.22	0.82
	Hobbs Lake	0.0012	0.0001	0.0012	0.0030	0.0017	0.0047	0.21	0.10	0.31
	Upper Frozen Lake	0.0036	0.0002	0.0038	0.0072	0.0037	0.0109	-	-	-
	Emerald Lake	0.0107	0.0012	0.0119	0.0311	0.0199	0.0511	2.47	1.28	3.75
	Florence Lake	0.0124	0.0014	0.0138	0.0345	0.0228	0.0573	4.68	2.47	7.15
	Ross Lake	0.0011	0.0001	0.0012	0.0031	0.0019	0.0050	0.24	0.12	0.36
	Lower Saddlebag Lake	0.0054	0.0002	0.0057	0.0096	0.0047	0.0142	0.94	0.32	1.25
Alt. 3	Black Joe Lake	0.0033	0.0001	0.0034	0.0070	0.0019	0.0089	0.52	0.10	0.63
	Deep Lake	0.0034	0.0001	0.0035	0.0070	0.0019	0.0089	0.60	0.12	0.71
	Hobbs Lake	0.0012	0.0000	0.0012	0.0030	0.0009	0.0039	0.21	0.05	0.26
	Upper Frozen Lake	0.0036	0.0001	0.0036	0.0072	0.0019	0.0091	-	-	-
	Emerald Lake	0.0107	0.0005	0.0112	0.0311	0.0115	0.0427	2.47	0.73	3.20
	Florence Lake	0.0124	0.0006	0.0130	0.0345	0.0131	0.0476	4.68	1.40	6.08
	Ross Lake	0.0011	0.0000	0.0012	0.0031	0.0010	0.0042	0.24	0.06	0.31
	Lower Saddlebag Lake	0.0054	0.0001	0.0055	0.0096	0.0024	0.0120	0.94	0.17	1.10

[a] Percent ANC change was not calculated because ANC data for the lake were not available

WY BLM AR for PRB EIS CD#2 of 20 1047

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