AIR QUALITY MODELING APPENDIX

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This appendix contains the Air Quality Modeling Appendix included in the 2003 EIS (Air Quality Modeling Appendix – Part 1) and the Air Quality Modeling Report for the recently (2006) completed air modeling conducted for the SEIS (Air Quality Modeling Appendix - Part 2). The SEIS Air Modeling Appendix - Part 2 contains attachments for information on Health Effects and Mitigation Measures.

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AIR QUALITY MODELING APPENDIX – PART 1

QUANTITATIVE REVIEW OF

AMBIENT AIR QUALITY IMPACTS

Final Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans

Prepared for

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2003 EIS AIR QUALITY MODELING APPENDIX

Air Quality Impact Technical Support Document

The following technical support document describes the processes used to conduct the air quality impact assessment, and provides summaries of relevant analysis data:

Argonne National Laboratory.
2002. Technical Support Document - Air Quality Impact Assessment for the Montana Statewide Final Oil and Gas EIS and Amendment of the Powder River and Billings Resource Management Plans and the Wyoming Final EIS and Planning Amendment for the Powder River Basin Oil and Gas Development Project. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Montana and Wyoming State Offices, by the Environmental Assessment Division, Argonne National Laboratory. Argonne, Illinois.

Copies of this technical support document are available upon request from:

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1.0 Introduction

Air pollution impacts are limited by local, state, tribal and federal air quality regulations, standards, and implementation plans established under the CAA and administered by the MDEQ and the EPA. Although not applicable to the proposed Alternatives, the WYDEQ has similar jurisdiction over potential air pollutant emission sources in Wyoming, which can have a cumulative impact with MDEQ approved sources. Air quality regulations require certain proposed new, or modified existing, air pollutant emission sources (including CBM compression facilities) undergo a permitting review before their construction can begin. Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation.

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (i.e., well operations, field [booster] and sales [pipeline] compressor engines, etc.), are potential causes of air quality impacts. These issues are more likely to generate public concern where natural gas development activities occur near residential areas. The FS, NPS, and the FWS have also expressed concerns regarding potential atmospheric deposition (acid rain) and visibility impacts within distant downwind PSD Class I and PSD Class II areas under their administration, located throughout Montana, Wyoming, southwestern North Dakota, western South Dakota, and northwestern Nebraska.

2.0 Existing Air Quality

As described in **Chapter 3 - Affected Environment (Air Quality)**, specific air quality monitoring is not conducted throughout most of the CBM emphasis area, but air quality conditions are likely to be very good, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches) and good atmospheric dispersion conditions, resulting in relatively low air pollutant concentrations. Air quality monitoring is the appropriate tool for determining compliance with the NAAQS for both particulate matter with an aerodynamic diameter equal to or less than ten microns in diameter (PM_{10}) and nitrogen dioxide (NO_2). As part of the Air Quality Impact Assessment prepared by Argonne National Laboratory (Argonne 2002), monitoring data measured throughout the southeastern Montana and northeastern Wyoming were assembled and reviewed. Although monitoring is primarily conducted in urban or industrial areas, the data selected are considered to be the best available representation of background air pollutant concentrations throughout the CBM emphasis area. Specific values presented in Table AQ-1 were used to define background conditions in the air quality impact analysis. The selected background pollutant concentrations are below applicable ambient air quality standards for all pollutants and averaging times. These National and Montana standards, and the PSD increment values, are also presented in Table AQ-1.

TABLE AQ-1
ASSUMED BACKGROUND CONCENTRATIONS, APPLICABLE AMBIENT AIR QUALITY STANDARDS, AND PSD INCREMENT VALUES (IN (μG/M³)

Pollutant	Averaging Time [a]	Background Concentration	National Ambient Air Quality Standards	Montana Ambient Air Quality Standards	PSD Class I Increment	PSD Class II Increment
Carbon Monoxide	1-hour	15,000	40,000	40,000	N/A	N/A
	8-hours	6,600	10,000	10,000	N/A	N/A
Lead	Quarterly	N/A	1.5	1.5	N/A	N/A
Nitrogen Dioxide	1-hour	117	N/A	566	N/A	N/A
	Annual	11	100	100	2.5	25
Ozone	1-hour	N/A	235	196	N/A	N/A
	8-hours	100	157	N/A	N/A	N/A
$PM_{2.5}$	24-hours	20	65	N/A	N/A	N/A
	Annual	8	15	N/A	N/A	N/A
PM_{10}	24-hours	105	150	150	8	30
	Annual	30	50	50	4	17
Sulfur Dioxide	1-hour	666	N/A	1,300	N/A	N/A
	3-hours	291	1,300	N/A	25	512
	24-hours	73	365	260	5	91
	Annual	16	80	60	2	20

Source: Argonne (2002)
Notes:
$\mu g/m^3$ - micrograms per cubic meter
[a] Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
N/A – data not available

Note that for evaluating consumption of the PM_{10} and NO_2 increments in Montana and Wyoming, as well as on Indian Reservations, modeling performed by an air quality regulatory agency is the appropriate tool (emissions solely from surface coal mines being the only exception). It should be noted that the BLM model used to identify and analyze impacts in this EIS is not intended or designed to be a regulatory PSD increment consumption modeling process.

Monitoring should be used to supplement modeling efforts, to:

1. Determine if identified levels of concern are exceeded, triggering the need to implement additional mitigation measures in order to avoid regulatory action
2. Provide additional indication of the need for regulatory modeling to determine if increments are being exceeded and an updated State Implementation Plan needed

The States of Wyoming and Montana will work with EPA to develop monitoring plans, which will consider population areas, modeled hot spots and other potential areas of concern. EPA will work with the Crow Tribe and Northern Cheyenne Tribe to identify the need for and to deploy additional monitoring as needed. The EIS predicts that full development of the Coal Bed Methane resource in Montana, in culmination with non-project and RFFA sources, may generate criteria air pollutants (PM, VOCs and NOx) in sufficient quantities to require regulatory action on the part of MDEQ to protect both the PSD increments and the Montana and National Ambient Air Quality Standards. MDEQ will need to accurately predict the impacts of proposed projects during the New Source Review process and assure that both the ambient standards and the increments are protected. Once projects are up and running MDEQ will also require ambient monitoring data from appropriately sited monitors to verify the permit analysis projections and provide a feedback loop of current ambient data to make sure that future permitting decisions continue to protect the standards and increments. MDEQ can and will require ambient monitoring as a permit condition for major sources.

Additionally, much of the permit analysis for sources of this nature requires good ambient data to accurately predict project impacts. Permitting sources of NO_2 and Ozone (O_3-) precursors (VOCs)), requires representative monitoring data to adequately analyze the expected impact of new emissions. Prediction of NO_2 is highly dependant on some knowledge of NO to NO_2 conversion rates. This information is supposed to come from either an analysis of actual NO/NO_2 ratios determined by monitoring results (preferred method), the use of a default value (very conservative and has recently resulted in predicted violations of the annual standard), or by the use of ambient Ozone data to predict conversion rates. Permitting large VOC sources raises similar questions. Ozone analysis requires at least some knowledge of atmospheric chemistry conversion rates in the area of analysis. At this time MDEQ does not have reliable data on the actual chemistry that is occurring in the development area and doesn't have any reliable background Ozone values.

Therefore, MDEQ will need NO/NO_2, O_3 and PM data for the development area from a regionally scaled ambient monitoring station. MDEQ has reviewed the modeling done for the EIS and a monitor sited in the Birney/Ashland area would be the best choice. Provided that funds become available, MDEQ would establish and maintain a monitoring station in this area.

It is important that monitors be deployed before CBM development occurs, or as early in the development cycle as possible, in order to provide baseline information and trend data.

3.0 Regulatory Framework

The National and Montana ambient air quality standards set the absolute upper limits for specific air pollutant concentrations at all locations where the public has access. The analysis of the proposed Alternatives must demonstrate continued compliance with all applicable local, state, tribal and federal air quality standards. Existing air quality throughout most of the CBM emphasis area is in attainment with all ambient air quality standards, as demonstrated by the relatively low concentration levels presented in Table AQ-1. However, three areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Lame Deer (PM_{10} - moderate) and Laurel (sulfur dioxide (SO_2) - primary), Montana; and Sheridan, Wyoming (PM_{10} - moderate). Specific monitoring data collected by the Northern Cheyenne Tribe are presented in Table AQ-2.

Air quality regulations require certain proposed new, or modified existing, air pollutant emission sources (including CBM compression facilities) to undergo a permitting review before their construction can begin. Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation. In addition, the U.S. Congress (through the CAA Section 116) authorized local, state and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements. Also, under FLPMA and the CAA, BLM cannot authorize any activity which would not conform to all applicable local, state, tribal and federal air quality laws, regulations, standards, and implementation plans.

Given most the CBM emphasis area’s current attainment status, future development projects which have the potential to emit more than 250 tons per year of any criteria pollutant (or certain listed sources that have the potential to emit more than 100 tons per year) would be required to undergo a site-specific regulatory PSD Increment Consumption analysis under the federal New Source Review and permitting regulations. Development projects subject to the PSD regulations may also be required by the applicable air quality regulatory agencies to incorporate additional emission control measures (including a BACT analysis and determination) to ensure protection of air quality resources, and demonstrate that the combined impacts of all PSD sources will not exceed the allowable incremental air quality impacts for NO_2, PM_{10}, and SO_2.

The NEPA analysis compares potential air quality impacts from the proposed alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts, and do not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. The Montana DEQ will perform the required regulatory PSD increment analysis during the new sources review process. This formal regulatory process will include analysis of impacts on Class I and II air quality areas by existing and proposed emission sources. The activities are not allowed to cause incremental effects greater than the stringent Class I thresholds to occur inside any PSD Class I Area. Stringent emission controls (BACT – Best Available Control Technology) and emission limits may be stipulated in air quality permits as a result of this review, or a permit could be denied.

Sources subject to the PSD permit review procedure are also required to demonstrate potential impacts to air quality related values (AQRV). These include visibility impacts, degradation of mountain lakes from atmospheric deposition (acid rain), and effects on sensitive flora and fauna in the Class I areas. The CAA also provides specific visibility protection procedures for the mandatory federal Class I areas designated by the U.S. Congress on August 7, 1977, which included wilderness areas greater than 5,000 acres in size, and national parks and national memorial parks greater than 6,000 acres in size as of that date. The Fort Peck and Northern Cheyenne tribes have also designated their lands as PSD Class I, although the national visibility regulations do not apply in these areas. The allowable incremental impacts for NO_2, PM_{10}, and SO_2 within these PSD Class I areas are very limited. The remainder of the CBM emphasis area is designated PSD Class II with less stringent requirements.

TABLE AQ-2
AMBIENT AIR QUALITY MONITORING DATA COLLECTED BY THE NORTHERN CHEYENNE TRIBE (IN (μG/M³)

Pollutant	Averaging Time [a]	Year	Morningstar	Garfield Peak	Badger Peak	Lame Deer # 1	Lame Deer # 2	Lame Deer # 3	Lame Deer "PM10A"	Lame Deer "TEOM"
nitrogen dioxide	Annual	1996	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		1997	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		1998	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		1999	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		2000	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
PM_{10}	Annual	1996	6	N/A	N/A	20	N/A	N/A	N/A	N/A
		1997	N/A	N/A	N/A	18	26	N/A	N/A	N/A
		1998	N/A	N/A	N/A	23	32	32	N/A	N/A
		1999	N/A	N/A	N/A	19	33	32	[22] [b]	32 [b]
		2000	N/A	N/A	N/A	18	29	N/A	17 [b]	28 [b]
		2001	N/A	N/A	N/A	16	36	N/A	N/A	N/A
	24-hours	1996	19	N/A	N/A	120	N/A	N/A	N/A	N/A
		1997	N/A	N/A	N/A	106	75	N/A	N/A	N/A
		1998	N/A	N/A	N/A	55	**153**	**153**	N/A	N/A
		1999	N/A	N/A	N/A	41	106	107	[36] [b]	93 [b]
		2000	N/A	N/A	N/A	40	124	N/A	39 [b]	93 [b]
		2001	N/A	N/A	N/A	33	135	N/A	N/A	N/A

TABLE AQ-2
AMBIENT AIR QUALITY MONITORING DATA COLLECTED BY THE NORTHERN CHEYENNE TRIBE (IN (μG/M³)

Pollutant	Averaging Time [a]	Year	Morningstar	Garfield Peak	Badger Peak	Lame Deer # 1	Lame Deer # 2	Lame Deer # 3	Lame Deer "PM10A"	Lame Deer "TEOM"
sulfur dioxide	Annual	1996	2.7	2.7	2.7	N/A	N/A	N/A	N/A	N/A
		1997	2.7	2.7	2.7	N/A	N/A	N/A	N/A	N/A
		1998	2.7	2.7	2.7	N/A	N/A	N/A	N/A	N/A
		1999	2.7	2.7	2.7	N/A	N/A	N/A	N/A	N/A
		2000	2.7	2.7	2.7	N/A	N/A	N/A	N/A	N/A
	24-hours	1996	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		1997	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		1998	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		1999	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
		2000	5.7	5.7	5.7	N/A	N/A	N/A	N/A	N/A
	3-hours	1996	5.2	7.8	5.2	N/A	N/A	N/A	N/A	N/A
		1997	5.2	7.8	5.2	N/A	N/A	N/A	N/A	N/A
		1998	10.4	10.4	10.4	N/A	N/A	N/A	N/A	N/A
		1999	7.8	7.8	5.2	N/A	N/A	N/A	N/A	N/A
		2000	5.2	5.2	5.2	N/A	N/A	N/A	N/A	N/A

Source: EPA (2002b)
Notes: μg/m³ - micrograms per cubic meter
N/A - data not available
[a] Short-term averages are reported as the second maximum values.
[b] Supplemental data provided by (Littlewolf 2002).

[data] - data in brackets are not reliable due to the small number of samples collected.

4.0 Agency Roles and Authorities

4.1 Environmental Protection Agency

The Environmental Protection Agency (EPA) administers the Federal Clean Air Act (CAA), (42 U.S.C. 7401 et seq.) to maintain the National Ambient Air Quality Standards (NAAQS) that protect human health and to preserve the rural air quality in the region by assuring the Prevention of Significant Deterioration Class I and Class II increments for SO_2, NO_2, and PM_{10}, are not exceeded. EPA has delegated this CAA authority to the States of Montana and Wyoming.

Until the Tribes have an EPA-approved Tribal program, EPA will administer air quality requirements within Indian country. EPA is responsible for assuring that NAAQS are attained and that the Tribally-designated Northern Cheyenne Class I sensitive airshed is protected, as well as the Class II increment limits that apply on the Crow Reservation. EPA will implement an air permitting program for major sources within Indian country, including BACT analysis, where appropriate. At this time, there is no federal minor source permitting program. Therefore, EPA cannot regulate minor sources in Indian country directly unless EPA decides to implement a Federal Implementation Plan (FIP). Mitigation of particulate emissions from unimproved roads in Indian country may be necessary to protect the Class I and Class II PM_{10} increments.

4.2 Montana DEQ

The MDEQ has been delegated Federal Clean Air Act (CAA) authority from the United States Environmental Protection Agency (EPA) to manage the New Source Review—Prevention of Significant Deterioration (PSD) permit program for listed major sources with the potential to emit (PTE) greater than 100 tons per year (tpy) of any regulated pollutant and all other sources with a PTE greater than 250 tpy of any regulated pollutant. Further, the MDEQ, under the Clean Air Act of Montana (MCA 75-2-101 et seq.) and the Administrative Rules of Montana (ARM) administers a minor source air quality permitting program for sources with a PTE greater than 25 tons per year unless otherwise noted in the ARM. This program requires, among other things, that Best Available Control Technology (BACT) apply to regulated air pollutant emission sources. MDEQ also has delegated responsibility to operate an approved ambient air quality monitoring network for the purpose of demonstrating compliance with the National and Montana Ambient Air Quality Standards (NAAQS/ MAAQS).

Currently, the MDEQ imposes a minor source permit limitation on gas compressor engines on a permit-by-permit basis for sources exceeding the Montana minor source permitting threshold (ARM Chapter 17.8, Subchapter 7). Under the authority of ARM 17.8.715, Emission Control Requirements, the MDEQ establishes BACT on a case-by-case basis for natural gas compressor engines, such as those sources indicated for coal bed methane (CBM) development. In general, the Department has required NO_2 emission limits of around 2 grams per brake horsepower hour (g/bhp-hr), a CO emission limit of around 3 g/bhp-hr, and a volatile organic compound (VOC) emission limit of around 1 g/bhp-hr for these sources. Again, as part of the minor source permitting program, Montana applies pollutant specific BACT to compressor engines on a case-by-case basis with limits as described above. However, should future regulatory modeling indicate potential NAAQS/MAAQS or increment consumption exceedances, the MDEQ may require more stringent limits to protect applicable standards.

In addition to the applicable point source BACT emission limits described above, under the authority of ARM 17.8.308, the MDEQ requires that a permitted source use reasonable precautions to limit fugitive particulate emissions from haul roads, access roads, parking lots, or the general plant property. In general, the MDEQ requires that a source have fresh water and/or chemical dust suppressant available on site and used as necessary to maintain compliance with applicable limits, including, but not limited to, the reasonable precautions and opacity limits. Further, the MDEQ could establish more stringent BACT limits for permitted sources and require that counties apply BACM to unimproved roads or other control measures sufficient to avoid exceeding applicable standards and the Class I and Class II increment limits for PM_{10}. Further, the ARM establishes generally applicable air quality rules pertaining to all sources of air pollution, including sources not subject to air quality permitting. These rules include, but are not limited to, the requirements contained in ARM 17.8, Subchapter 1 and ARM 17.8, Subchapter 3.

4.3 Bureau of Indian Affairs

BIA is responsible for approval of any lease, agreement, permit, or document that could encumber lands and minerals owned by either Tribes or allottees. Under the Indian Mineral Development Act (IMDA), the Secretary of Interior is responsible, based upon BIA recommendation, for approving any contractual arrangement to develop CBM resources. Specific discussion of tribal air quality management issues are addressed separately.

4.4 Bureau of Land Management

NEPA requires that federal agencies consider mitigation of direct and cumulative impacts during their preparation of an EIS. (BLM Land Use Planning Manual 1601.) Under the CAA, federal agencies are to comply with State Implementation Plans regarding the control and abatement of air pollution. Prior to approval of Resource Management Plans (RMPs) or Amendments to RMPs, the State Director is to submit any known inconsistencies with State Implementation Plan (SIP) to the Governor of that state. If the Governor of the State recommends changes in the proposed RMP or Amendment to meet SIP requirements, the State Director shall provide the public an opportunity to comment on those recommendations. (BLM Land Use Planning Manual at Section 1610.3-2.)

4.5 Forest Service

The Forest Service administers nine wilderness areas (WAs) that could be affected by direct effects associated with project and non-project sources: Bridger WA; Fitzpatrick WA; North Absaroka, Absaroka-Beartooth, and Washakie WAs, next to Yellowstone NP; Teton WA; U.L. Bend WA; Cloud Peak WA; and Popo Agie WA with mandatory Class I designation. As federal land mangers, the Forest Service could act in a consultative role to stipulate that the BLM modeling results, or any future EPA or State-administered PSD refined modeling results (if justified), triggers adverse impairment status. Should the Forest Service determine impairment of WAs, then BLM, the State, and/or EPA may need to mitigate this predicted adverse air quality effect.

4.6 National Park Service

Three areas administered by the National Park Service—Yellowstone National Park, Devils Tower National Monument, and Bighorn Canyon National Recreation Area—could be affected by direct effects associated with project and non-project sources. (Note: Additional Park Service Class I and II areas may be impacted by the non-project sources evaluated, without significant impact from project sources.) As federal land mangers, the Park Service could act in a consultative role to stipulate that the BLM modeling results, or any future EPA or State-administered PSD refined modeling results (if justified), triggers adverse impairment status. Should the Park Service determine impairment of NPS-administered Class I areas, then BLM, the State, and/or EPA may need to mitigate this predicted adverse air quality effect.

5.0 Air Quality Management on Tribal Lands

The 1990 Clean Air Act (CAA) Amendments (Section 301(d)) provided tribes the authority to implement CAA programs for their reservations. The Tribal Authority Rule (TAR), promulgated February 12, 1998, reiterates that tribes have direct implementation authority for the CAA. However, until such time as the tribe assumes such responsibility to implement its own program, EPA must implement Federal air quality laws for them. The TAR also requires under §49.11 that EPA promulgate a Federal Implementation Plan (FIP) as necessary or appropriate to protect air quality on the reservations.

EPA has the authority to implement two permitting programs and three source specific programs. EPA has regulatory authority to issue pre-construction permits to major air pollution emissions sources under the Prevention of Significant Deterioration (PSD) program at 40 CFR part 52 and operating permits to major sources under the Title V program at 40 CFR part 71. The PSD program requires that subject sources conduct an air quality analysis to determine the impact on the National Ambient Air Quality Standards (NAAQS) and the PSD increments for NO_2, SO_2, and PM_{10} for three different area classifications (Class I, Class II, and Class III). Under the PSD program, Class I status was assigned to pristine areas, such as national parks and forest lands. Several tribes have been redesignated from a Class II status to a Class I status. The rest of the country is Class II and there are no Class III areas. EPA also has regulatory authority to implement the New Source Performance Standards (NSPS) at 40 CFR part 60, the National Emission Standards for Hazardous Air Pollutants (NESHAP) at 40 CFR part 61, and the Maximum Achievable Control Technology (MACT) standards at 40 CFR part 63.

EPA does not have a rule for a minor source pre-construction permitting program for permitting new and modified sources. A minor source rule is being addressed by the Agency, but such a rule will not be final for 2-3 years. A minor source rule could give EPA the authority to implement a minor source Best Available Control Technology (BACT) requirement for engines. Nor does EPA have a FIP in place for Indian country to address measures for controlling fugitive dust or control technologies for engines.

In 1977, the Northern Cheyenne Indian Tribe's Reservation was redesignated as a Class I airshed under the PSD program. The Tribe has implemented an air quality monitoring program, delivering air quality data to AIRS-AQS since 1981. Currently, the Tribe does not have any EPA approved CAA programs for issuing permits, nor is there a Tribal Implementation Plan (TIP) with general source or source specific requirements or any of the federal NSPS, MACT, or NESHAP standards. At this time, if permitting of major air pollution sources was required, EPA would be the permitting authority.

The Crow Indian Reservation is a Class II airshed. Currently, the Tribe does not have any EPA approved CAA programs for issuing permits, nor is there a TIP with general source or source specific requirements, or any of the federal NSPS, MACT, or NESHAP standards. The Tribe was approved for a CAA Section 103 grant in 2001 to conduct an emissions inventory of the sources on the Reservation. The Tribe is not currently implementing an air quality monitoring program. At this time, if permitting of major air pollution sources were required, EPA would be the permitting authority.

The preferred method to determine the mitigation required to prevent exceedances of ambient air quality standards and to prevent significant deterioration is modeling. EPA will work with the states of Wyoming and Montana along with the tribes to see that, wherever possible, tribal air quality issues are addressed in regional modeling efforts related to coal bed methane development. Additional modeling efforts addressing specific tribal concerns, as necessary, can be undertaken by EPA and the tribal air quality agencies.

Ambient air monitoring can be used to augment and validate modeled results. The Northern Cheyenne Tribe currently conducts ambient air PM_{10} and particulate matter with an aerodynamic diameter equal to or less than 2.5 microns ($PM_{2.5}$) monitoring in the Lame Deer PM_{10} non-attainment area on the Northern Cheyenne Reservation. In order to track the impacts of nearby industrial activities on air quality, the tribe also conducts IMPROVE protocol speciated $PM_{2.5}$ monitoring at the Morningstar site, and PM_{10}, SO_2 and NO_2 monitoring at the Morningstar, Badger Peak and Garfield Peak monitoring stations. These monitoring stations also have collocated meteorological monitors. With updates to emission inventories as a result of coal bed methane development on or outside the Northern Cheyenne Reservation, the monitoring network may need revision or augmentation.

The Crow Tribe does not currently have an air monitoring program and has never had one that submitted data to AIRS-AQS. The Crow tribe has the same rights and potential capabilities as the Northern Cheyenne Tribe. If regional emission increases are sufficient to threaten the NAAQS or other relevant air quality standard on Crow lands, EPA would work with the tribe to encourage them to initiate monitoring activities. To this end, the Tribe can build the capability necessary to conduct ambient air quality monitoring. In the event the tribe chooses not to conduct monitoring, EPA can choose to conduct monitoring using either EPA personnel or contract assistance under Section 301 of the Clean Air Act.

In addition to point source emissions, fugitive dust controls for coal bed methane sources will likely be needed for development on tribal lands. The Tribes can use contractual relationships with developers to require necessary construction phase dust controls on wells on Tribal lands. EPA will work with Tribal, BIA and county agencies as needed to develop and implement necessary mitigation on unpaved roads used for development related traffic.

6.0 Air Quality Impact Assessment

As described in **Chapter 4, Environmental Consequences (Air Quality)**, an extensive air quality impact assessment technical support document was prepared by Argonne National Laboratory (Argonne 2002) and is available for review. Argonne analyzed potential impacts from: individual proposed Alternatives A, B/C/E, and D (project sources); "Non-project" emission sources (existing sources, RFFA and Wyoming PRBO&G Alternative 1; RFFA emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest; and all sources cumulatively by Alternative. Since Alternatives B, C and E have very similar emission inventories, a single air quality impact analysis represents all of these three Alternatives. For example, under Alternative C the number of wells connected to a field (booster) compressor would not be limited but the number was assumed to be the same as in Alternative B, and under Alternative E electrical field (booster) compressors would be required where noise is an issue although all compressors were assumed to be gas-fired.

The air quality impact assessment was based on the best available engineering data and assumptions, meteorology data, and dispersion modeling procedures, as well as professional and scientific judgment. However, where specific data or procedures were not available, reasonable assumptions were made. Note that these assumptions could result in under or over-estimates of impacts. It is difficult to ascertain the overall bias of the emission estimates and modeling; no sensitivity or probabilities of occurrence analyses were performed.

Air quality impacts for various air pollutants are determined by the use of air dispersion models using specific source emission rates. For natural gas compressors, the emissions of nitrogen oxides are determined by the assumed permitted emission rate allowed by the state. For fugitive dust impacts, emission rates are obtained from EPA's AP-42 document that is titled "Compilation of Air Pollutant Emission Factors". An AP-42 emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors may be appropriate to use in a number of situations such as making source-specific emission estimates for area-wide inventories. These inventories have many purposes including ambient dispersion modeling and analysis, control strategy development, and in screening sources for compliance investigations. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all sources in a specific category.

Potential air pollutant emissions from the proposed Alternatives emission sources (denoted as "project" sources) were calculated separately to determine potential impacts. These emissions were then combined with existing sources, proposed non-PRBO&G developments and reasonably foreseeable future actions (RFFA) emissions (denoted as "non-project" sources) and RFFA emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest to determine the total potential cumulative air quality impacts. All of the tables in this Air Quality Modeling Appendix display impacts from: 1) the project sources only; 2) the project sources combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest (denoted as "Project + RFFA Sources); 3) the non-project sources; and 4) cumulative totals.

The non-project sources include development permitted: 1) by the MDEQ; 2) by the WYDEQ; and 3) within the states of North Dakota, South Dakota, and Nebraska; and projections for the Wyoming Powder River Basin Oil and Gas Project DEIS Alternative sources (BLM 2002a); and other RFFA sources from states within the geographic area covered by the model.

Potential direct, indirect and cumulative air quality impacts were analyzed and reported solely under the requirements of NEPA, in order to assess and disclose reasonably foreseeable impacts to both the public and the BLM decision maker before a Record of Decision is issued. Due to the preliminary nature of this NEPA analysis, it should be considered a reasonable estimate of predicted impacts. Actual impacts at the time of development (subject to air pollutant emission source permitting) could be different. To the extent that impacts are predicted to be greater than regulatory thresholds, appropriate mitigation efforts would be undertaken.

Given the lack of representative wind measurements throughout the CBM emphasis area, the EPA CALPUFF dispersion model was used with regional wind speed and direction values derived from the 1996 MM5 (mesoscale model) and CALMET meteorological models (Argonne 2002). Meteorological information was assembled to characterize atmospheric transport and dispersion from several 1996 data sources, including: 36 km gridded MM5 (mesoscale model) values with continuous four-dimensional data assimilation; and hourly surface observations (wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity, and precipitation.)

Potential air quality impacts were predicted using the EPA CALPUFF dispersion model. The meteorology data and air pollutant emission values were combined to predict maximum potential direct, indirect, and cumulative near-field air quality impacts in the vicinity of assumed well and compressor engine emission sources for comparison with applicable air quality standards and PSD Class II increments. Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad construction were used to predict the maximum annual and 24-hour average $PM_{2.5}$, PM_{10}, and SO_2 impacts. Maximum air pollutant emissions from each CBM well would be temporary (i.e., occurring during a 12-day construction period) and would occur in isolation, without significantly interacting with adjacent well locations. Particulate matter emissions from well pad and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants was computed at 50 per cent during construction. During well completion testing, natural gas could be burned (flared) up to 24 hours.

Air pollutant dispersion modeling was also performed to quantify CO, NO_2, $PM_{2.5}$, PM_{10}, and HAP impacts during operation. Operation emissions would primarily occur due to increased compression requirements, including field (booster) and sales (pipeline) compressor stations. Since produced natural gas is nearly pure methane, with little or no liquid hydrocarbons or sulfur compounds, direct VOC emissions or objectionable odors are not likely to occur. HAP impacts were predicted based on an assumed 9,900 horsepower, six-unit, reciprocating compressor engine station operating at full load with emissions generated by a single stack.

The significance criteria for potential air quality impacts include local, state, tribal and federally enforced legal requirements to ensure air pollutant concentrations will remain within specific allowable levels. These requirements and legal limits were presented in Table AQ-1. Where legal limits have not been established, the BLM uses the best available scientific information to identify thresholds of significant adverse impacts. Thresholds have been identified for hazardous air pollutant (HAP) exposure, potential acid neutralizing capacity (ANC) changes to sensitive lake water chemistry, and a 1.0 dv "just noticeable change" in potential visibility impacts.

Since neither the MDEQ nor EPA have established HAP standards, predicted 8-hour HAP concentrations were compared to a range of 8-hour state maximum Acceptable Ambient Concentration Levels (EPA 1997a). Pollutants which were predicted to exceed these state threshold levels were also analyzed to determine the possible incremental cancer-risk for a most likely exposure (MLE) to residents, and to a maximally exposed individual (MEI), such as compressor station workers. These cancer risks were calculated based on the maximum predicted annual concentrations, EPA's unit risk factors for carcinogenic compounds (EPA 1997b), and an adjustment for time spent at home or on the job.

The EPA CALPUFF dispersion model was also used to determine maximum far-field ambient air quality impacts at downwind mandatory federal PSD Class I areas, and other sensitive receptors, to: 1) determine if the PSD Class I increments might be exceeded; 2) calculate potential total sulfur and nitrogen deposition, and their related impacts to in sensitive lakes; and 3) predict potential visibility impacts (regional haze) within distant sensitive receptors.

Several lakes within five FS designated wilderness areas were identified as being sensitive to atmospheric deposition and for which the most recent and complete data have been collected. The FS (Fox et al. 1989) has identified the following total deposition (wet plus dry) thresholds below which no adverse impacts are likely: five kg/ha-yr for sulfur, and three kg/ha-yr for nitrogen. The FS (2000) has also developed a screening method which identifies the following Limit of Acceptable Change regarding potential changes in lake chemistry: no more than a ten per cent change in ANC for those water bodies where the existing ANC is at or above 25 μeq/l, and no more than a one μeq/l change for those extremely sensitive water bodies where the existing ANC is below 25 μeq/l. No sensitive lakes were identified by either the NPS or FWS.

Since the potential air pollutant emission sources constitute many small sources spread out over a very large area, discrete visible plumes are not likely to impact the distant sensitive areas, but the potential for cumulative visibility impacts (increased regional haze) is a concern. Regional haze degradation is caused by fine particles and gases scattering and absorbing light. Potential changes to regional haze are calculated in terms of a perceptible "just noticeable change" (1.0 dv) in visibility when compared to background conditions. A 1.0 dv change is considered potentially significant in mandatory federal PSD Class I areas as described in the EPA Regional Haze Regulations (40 CFR 51.300 et seq.), and as originally presented in Pitchford and Malm (1994). A 1.0 dv change is defined as about a ten per cent change in the extinction coefficient (corresponding to a two to five per cent change in contrast, for black target against a clear sky, at the most optically sensitive distance from an observer), which is a small but noticeable change in haziness under most circumstances when viewing scenes in mandatory federal Class I areas.

It should be noted that a 1.0 dv change is not a "just noticeable change" in all cases for all scenes. Visibility changes less than 1.0 dv are likely to be perceptible in some cases, especially where the scene being viewed is highly sensitive to small amounts of pollution, such as due to preferential forward light scattering. Under other view-specific conditions, such as where the sight path to a scenic feature is less than the maximum visual range, a change greater than 1.0 dv might be required to be a "just noticeable change." However, this NEPA analysis is not designed to predict specific visibility impacts for specific views in specific mandatory federal PSD Class I areas based on specific project designs, but to characterize reasonably foreseeable visibility conditions that are representative of a fairly broad geographic region, based on reasonable emission source assumptions. This approach is consistent with both the nature of regional haze and the requirements of NEPA. At the time of a pre-construction air quality permit review, the applicable air quality regulatory agency may require a much more detailed visibility impact analysis. Factors such as the magnitude of change, frequency, time of the year, and the meteorological conditions during times when predicted visibility impacts are above the 1.0 dv threshold (as well as inherent conservatism in the modeling analyses) should all be considered when assessing the significance of predicted impacts.

The FS, NPS and FWS have published their "Final FLAG Phase I Report" (Federal Register, Vol. 66 No. 2, dated January 3, 2001), providing "a consistent and predictable process for assessing the impacts of new and existing sources on AQRVs" including visibility. For example, the FLAG report states "A cumulative effects analysis of new growth (defined as all PSD increment-consuming sources) on visibility impairment should be performed," and further, "If the visibility impairment from the proposed action, in combination with cumulative new source growth, is less than a change in extinction of 10% [1.0 dv] for all time periods, the Federal Land Managers (FLM) will not likely object to the proposed action."

The FLAG report also recommends a two-step analysis process to evaluate potential visibility impacts from either a single proposed air pollutant emission source (the seasonal FLAG screening method) or potential cumulative visibility impacts from a group of air pollutant emission sources (the daily FLAG refined method). As described in Argonne (2002), this NEPA analysis first used the seasonal FLAG screening method (based on both the FLAG and WYDEQ-AQD "natural background" reference levels) to exclude those sensitive areas where visibility impacts were not likely to occur. Since no areas were excluded using the seasonal FLAG screening method, this NEPA analysis then applied the daily FLAG refined method (based on hourly background optical extinction and relative humidity values measured in both the Badlands and Bridger wilderness areas between 1989 and 1999) to determine the average number of days a 1.0 dv "just noticeable change" would be reached annually in each sensitive area. Although the use of observed hourly optical extinction and relative humidity values is appropriate in this NEPA analysis (where the potential visibility impacts are predicted to occur under the Alternatives based on the reasonably foreseeable background conditions), EPA's Regional Haze Regulations are based on optical conditions reconstructed from $PM_{2.5}$ and PM_{10} data collected every third day under the IMPROVE program.

7.0 Modeling Assumptions

When reviewing the predicted near- and far-field air quality impacts, it is important to understand that assumptions were made regarding development, emissions, meteorology, atmospheric transport and chemistry, and atmospheric deposition. For example, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations of wells, etc.).

The following assumptions were used in the analysis:

- Total predicted short-term air pollutant impact concentrations were assumed to be the sum of the assumed background concentration, plus the predicted maximum cumulative modeled concentrations, which may occur under different meteorological conditions.
- Assumed background air pollution concentrations were assumed to occur throughout the 20-year life of project (LOP) at all locations in the region, even though monitoring is primarily conducted in urban or industrial areas, rather than rural areas. The uniform background PM_{10} levels for each state are assumed to be representative of the background conditions for the entire modeled area of the PRB, based on monitoring data gathered throughout northeastern Wyoming and southeastern Montana.
- The maximum predicted air quality impacts occur only in the vicinity of the anticipated emission sources. Actual impacts would likely be less at distances beyond the predicted points of maximum impact.
- All emission sources were assumed to operate at their reasonably foreseeable maximum emission rates simultaneously throughout the LOP. Given the number of sources included in this analysis, the probability of such a scenario actually occurring over an entire year is small.
- In developing the emissions inventory and model, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations, etc.) Most (90 per cent) proposed CBM wells and 30 per cent of conventional wells were assumed to be fully operational and remain operating (no shut ins) throughout the LOP.
- The total proposed booster (field) and pipeline (sales) compression engines were assumed to operate at their rated capacities continuously throughout the LOP (no phased increases or

reductions). In reality, compression equipment would be added or removed incrementally as required by the well field operation, compressor engines would operate below full horsepower ratings, and it is unlikely all compressor stations would operate at maximum levels simultaneously.

- The HAP analyses assumed a six-unit, 1,650 hp each, reciprocating compressor engine station would operate at full load and at maximum emission levels continuously throughout the LOP.
- The emissions inventory and model use peak years of construction and peak years of operations, which would not occur throughout the entire development region at the same time. However, these conditions may occur in some areas.
- The emissions inventory and model assumed that a reasonably foreseeable emission rate for compressor engines of 1.5 g/hp-hr of nitrogen oxides (NO_x)is achievable in Montana. Since BACT is decided on a case-by-case basis, actual emission rates could be decided to be less or more than this level by the Departments of Environmental Quality in Montana or Wyoming, and on Indian lands by EPA, for field and sales compressor engines. Reasonable NO_x emission rates may range from 0.7 to 2 g/hp-hr.
- There are no applicable local, state, tribal or federal acid deposition standards. In the absence of applicable standards, the acid deposition analysis assumed that a “limit of acceptable change” is: a 10 per cent change in acid neutralizing capacity (ANC) for lakes with a background ANC greater than 25 μeq/l; or a 1 μeq/l change in ANC for lakes with a background ANC less than 25 μeq/l, and would be a reasonably foreseeable significant adverse impact. Further, the atmospheric deposition impact analysis assumed no other ecosystem components would affect lake chemistry for a full year (assuming no chemical buffering due to interaction with vegetation or soil materials).
- The visibility impact analysis assumed that a 1.0 dv “just noticeable change” would be a reasonably foreseeable significant adverse impact, although there are no applicable local, state, tribal or federal regulatory visibility standards. However, some FLMs are using 0.5 dv as a screening threshold for significance.
- Mitigation measures are included in the emissions inventory and model that may not be achievable in all circumstances. However, actual mitigation decided by the developers and local and state authorities may be greater or less than those assumed in the analysis. For example, maintaining a construction road speed limit of 15 mph may be reasonable in a construction zone but difficult to enforce elsewhere. Full (100%) mitigation of fugitive dust from disturbed lands may not be achievable. Further, 50% reduction in fugitive emissions is assumed based on construction road wetting on the unimproved access road to the pad and at the pad, but this level of effectiveness is characterized as the maximum possible. In the air quality modeling, no specific road wetting or other emissions controls were assumed to be used during the operations phase of the development (e.g., for maintenance vehicle traffic). However, during the review of proposed projects (Applications for Permit to Drill) the BLM would require specific mitigation measures in certain areas during the operational phase of development.
- Induced or secondary growth related to increases in vehicle miles traveled (VMT) (believed to be on the order of 10 per cent overall) is not included in the emissions inventory and model. Not all fugitive dust emissions (including county and other collector roads) have been included in the emissions inventory and model.
- Fugitive dust emissions from roads are treated as area sources rather than line sources in the model, which may thereby reduce or increase the predicted ambient concentrations at maximum concentration receptor points near the source, depending on the inputs to the model (meteorology, terrain, etc.) By not placing modeled receptors close to emission sources (e.g. wells and roads), the model may not capture higher ambient concentrations near these sources. A more refined, regulatory model may yield higher concentrations at locations near fugitive dust sources.
- For comparisons to the PSD Class I and II increments, the emissions inventory and model included only CBM and RFFA sources. Other existing increment consuming sources such as Campbell County, Wyoming coal mines were not included in this comparison, as the air quality analysis does not represent a regulatory PSD increment consumption analysis. A regulatory PSD increment consumption analysis needs to identify and consider all PSD increment consuming sources to determine the level of PSD Class II increment consumption. Monitoring data in Wyoming has indicated an upward trend in PM concentrations in Campbell County since 1999,

which coincides with CBM development but is also exacerbated by prolonged drought in the region.

It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including the state, tribe or EPA) would review specific air pollutant emissions pre-construction permit applications that examine potential project-specific air quality impacts for some source categories. As part of these permit reviews (depending on source size), the air quality regulatory agencies could require additional air quality impact analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality.

8.0 Modeling Results

The following Tables present the detailed atmospheric dispersion modeling results which are summarized in **Chapter 4, Environmental Consequences (Air Quality)**.

TABLE AQ-3
PREDICTED HAZARDOUS AIR POLLUTANT IMPACTS AND SIGNIFICANCE THRESHOLDS (IN (μG/M^3)

Pollutant	Averaging Time	Direct Modeled Impact	Range of State Acceptable Ambient Concentration Levels
formaldehyde	8-hours	**11.9**	**4.5** (FL07) - 71 (NV01)
n-hexane	8-hours	0.6	1,800 (FL07) - 36,000 (CT01)
benzene	8-hours	0.7	30 (FL04) - 714 (NV01)
toluene	8-hours	4.6	1,870 (IN03) - 8,930 (NV01)
ethyl benzene	8-hours	< 0.1	4,340 (ND01) - 43,500 (VT01)
xylene	8-hours	0.2	2,170 (IN01) - 10,400 (NV01)

Source: Argonne (2002)

Agencies: CT01 - Connecticut Department of Environmental Protection; Air Compliance Unit
FL04 - Broward County Department of Natural Resource Protection (Florida)
FL07 - Pinellas County Air Pollution Control Board (Florida)
IN01 - Indiana Department of Environmental Management
IN03 - Indianapolis Air Pollution Control Division (Indiana)
ND01 - North Dakota Dept. of Health; Division of Environmental Engineering
NV01 - Nevada Division of Environmental Protection; Air Quality Control
VT01 - Vermont Dept. of Environmental Conservation; Air Pollution Control Division

TABLE AQ-4
ALTERNATIVE A—PREDICTED CRITERIA POLLUTANT IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS (IN (μG/M^3)

Pollutant	Avg Time [a]	Location	PSD Increment	Alt A Project	Non-Project	Cum	Background	Total	NAAQS	MAAQS
carbon monoxide	1-hour	near-field	- - -	49	540	540	15,000	15,540	40,000	26,000
		far-field [1]	- - -	1	100	100	15,000	15,100	40,000	26,000
	8-hours	near-field	- - -	30	311	314	6,600	6,914	10,000	10,000
		far-field [1]	- - -	<1	52	52	6,600	6,652	10,000	10,000
nitrogen dioxide	1-hour	near-field	- - -	21	181	187	117	304	- - -	566
		far-field [1]	- - -	2.0	36	36	117	153	- - -	566
	Annual	near-field	25	1.9	4.8	6.0	11	17	100	100
		far-field [3]	25	1.2	1.1	2.0	11	13	100	100
		far-field [2]	2.5	0.2	0.5	0.7	11	12	100	100
$PM_{2.5}$	24-hours	near-field	- - -	1.0	44.1	44.4	20	64	65	- - -
		far-field [4]	- - -	0.1	12.7	12.7	20	33	65	- - -
	Annual	near-field	- - -	0.3	5.6	5.8	8	14	15	- - -
		far-field [4]	- - -	0.0	1.2	1.2	8	9	15	- - -
PM_{10}	24-hours	near-field	**30** [b]	1.8	**104** [b]	**105** [b]	105	**210** [c]	**150** [c]	**150** [c]
		far-field [4]	30	0.1	29.7	29.7	105	135	150	150
		far-field [2]	**8** [b]	0.5	**8.4** [b]	**8.7** [b]	105	114	150	150
		far-field [5]	8	0.2	7.2	7.4	105	112	150	150
	Annual	near-field	17	0.5	13.1	13.4	30	43	50	50
		far-field [4]	17	0.0	2.7	2.7	30	33	50	50
sulfur dioxide	1-hour	near-field	- - -	1.9	27.4	28.0	666	694	- - -	1,300
		far-field [3]	- - -	1.2	29.6	29.6	666	696	- - -	1,300
	3-hours	near-field	512	1.5	22.6	23.3	291	314	1,300	- - -
		far-field [3]	512	1.0	17.1	17.1	291	308	1,300	- - -
	24-hours	near-field	91	0.9	9.8	10.2	73	83	365	260
		far-field [3]	91	0.6	5.3	5.3	73	78	365	260
	Annual	near-field	20	0.3	1.0	1.1	16	17	80	60
		far-field [3]	20	0.2	0.4	0.4	16	16	80	60

Source: Argonne (2002)

Notes:
[a] Annual impacts are the first maximum value; short-term impacts are the second maximum value. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.
[b] It is possible that Non-Project and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, as well as the PSD Class II increment near the maximum assumed development; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate air quality regulatory agency.
[c] Two receptor locations just south of the Spring Creek Coal Mine when combined with an assumed background concentration of 105 $\mu g/m^2$ were predicted to exceed the National and Montana ambient air quality standards due to Non-Project and **Cum** emission sources.

Alt A Project - Direct modeled Alternative A project sources impacts.
Non-Project - Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alt A**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS Alternative 1 sources. Potential impacts from Wyoming Alternatives 2A, 2B and 3 would be less.
Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt A** Project and Non-Project impacts, which can occur at different locations.
Total - The sum of the cumulative modeled impact and the assumed background concentration.
NAAQS - Applicable National Ambient Air Quality Standard.
MAAQS - Applicable Montana Ambient Air Quality Standard.

Locations:
1 – Absaroka-Beartooth Wilderness Area
2 – Northern Cheyenne Indian Reservation
3 – Crow Indian Reservation
4 – Fort Belknap Indian Reservation
5 – Washakie Wilderness Area

TABLE AQ-5
ALTERNATIVE A - PREDICTED ATMOSPHERIC DEPOSITION IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

			Total Sulfur Deposition (kg/ha-yr)				**Total Nitrogen Deposition (kg/ha-yr)**				**Acid Neutralizing Capacity (per cent)**				
Location	**PSD Class**	**Lake**	**Alt A Project**	**Non-Project**	**Cum**	**Thld**	**Alt A Project**	**Non-Project**	**Cum**	**Thld**	**Bkgd (µeq/l)**	**Alt A Project**	**Non-Project**	**Cum**	**Thld**
Bridger WA	I	Black Joe	<0.01	0.01	0.01	5	<0.01	0.03	0.03	3	69.0	0.1	2.2	2.3	10
		Deep	<0.01	0.01	0.01	5	<0.01	0.03	0.03	3	61.0	0.1	2.5	2.6	10
		Hobbs	<0.01	0.01	0.01	5	<0.01	0.02	0.02	3	68.0	<0.1	1.2	1.3	10
		Upper Frozen	<0.01	0.01	0.01	5	<0.01	0.03	0.03	3	5.8	<0.1 [a]	**1.6** [a]	**1.6** [a]	**1** [a]
Fitzpatrick WA	I	Ross	<0.01	0.01	0.01	5	<0.01	0.02	0.02	3	61.4	0.1	1.7	1.7	10
Absaroka-Beartooth WA	II	Stepping Stone	<0.01	0.02	0.02	5	<0.01	0.02	0.03	3	27.0	0.1	2.0	2.1	10
		Twin Island	<0.01	0.01	0.02	5	<0.01	0.02	0.03	3	36.0	0.1	1.4	1.5	10
Cloud Peak WA	II	Emerald	<0.01	0.03	0.03	5	<0.01	0.07	0.08	3	53.3	0.2	4.4	4.6	10
		Florence	<0.01	0.03	0.03	5	<0.01	0.08	0.08	3	32.7	0.3	8.1	8.4	10
Popo Agie WA	II	Lower Saddlebag	<0.01	0.01	0.01	5	<0.01	0.03	0.03	3	55.5	0.1	3.2	3.2	10

Source: Argonne (2002)

Notes: **Alt A** Project - Direct modeled Alternative A impacts.

Non-Project - Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alt A**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS Alternative 1 sources. Potential impacts from Wyoming Alternatives 2A, 2B and 3 would be less.

Cum – Cumulative modeled impacts. Since these values represent the maximum cumulative impact at a specific location, they are the sum of the maximum direct **Alt A Project** and **Non-Project** impacts. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.

Thld – Impact threshold. Total sulfur and nitrogen thresholds from Fox, et al. (1989); acid neutralizing capacity thresholds from FS (2000).

WA – Wilderness Area.

a - Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 µeq/l, the applicable significance threshold is less than a 1 µeq/l change. This threshold is exceeded by Non-Project and **Cum** emission sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

TABLE AQ-6
ALTERNATIVE A—DAILY FLAG REFINED METHOD—VISIBILITY IMPACT ANALYSIS
(NUMBER OF DAYS Δ1.0 DV PER YEAR)

Sensitive Location	PSD Classification	Alt A Project	Non-Project	Cum
Badlands WA	mandatory federal Class I	0	17 to 25	18 to 25
Bridger WA	mandatory federal Class I	0	8 to 10	8 to 10
Fitzpatrick WA	mandatory federal Class I	0	7 to 9	8 to 10
Gates of the Mountains WA	mandatory federal Class I	0	3 to 4	3 to 4
Grand Teton NP	mandatory federal Class I	0	4 to 6	4 to 6
North Absaroka WA	mandatory federal Class I	0	10 to 12	11 to 12
Red Rock Lakes WA	mandatory federal Class I	0	0 to 1	0 to 1
Scapegoat WA	mandatory federal Class I	0	2 to 2	2 to 3
Teton WA	mandatory federal Class I	0	7 to 9	7 to 10
Theodore Roosevelt NP (North Unit)	mandatory federal Class I	0	1 to 2	1 to 2
Theodore Roosevelt NP (South Unit)	mandatory federal Class I	0	2 to 4	2 to 4
U.L. Bend WA	mandatory federal Class I	0	5 to 5	5 to 6
Washakie WA	mandatory federal Class I	0	11 to 14	12 to 15
Wind Cave NP	mandatory federal Class I	0	21 to 27	22 to 28
Yellowstone NP	mandatory federal Class I	0	9 to 11	9 to 11
Fort Peck IR	Tribal designated Class I	0	1 to 2	2 to 2
Northern Cheyenne IR	Tribal designated Class I	0	30 to 38	33 to 42
Absaroka-Beartooth WA	federal Class II	0	28 to 29	28 to 30
Agate Fossil Beds NM	federal Class II	0	10 to 15	10 to 15
Bighorn Canyon NRA	federal Class II	0	19 to 21	19 to 23
Black Elk WA	federal Class II	0	20 to 26	20 to 26
Cloud Peak WA	federal Class II	0	21 to 28	23 to 30
Crow IR	federal Class II	2	56 to 61	65 to 69
Devils Tower NM	federal Class II	0	24 to 38	26 to 39
Fort Belknap IR	federal Class II	0	60 to 61	61 to 61
Fort Laramie NHS	federal Class II	0	13 to 17	13 to 17

TABLE AQ-6
ALTERNATIVE A—DAILY FLAG REFINED METHOD—VISIBILITY IMPACT ANALYSIS
(NUMBER OF DAYS Δ1.0 DV PER YEAR)

Sensitive Location	PSD Classification	Alt A Project	Non-Project	Cum
Jewel Cave NM	federal Class II	0	24 to 31	24 to 32
Mount Rushmore NMem	federal Class II	0	17 to 22	17 to 22
Popo Agie WA	federal Class II	0	8 to 10	8 to 10
Soldier Creek WA	federal Class II	0	13 to 18	13 to 18

Source: Argonne (2002)

Notes: **Alt A** Project - Direct modeled Alternative 1 impacts.

Non-Project - Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alt A**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS sources. The range of values corresponds to including Wyoming Alternative 3 (low) to Wyoming Alternative 1 (high).

Cum - Cumulative modeled impacts. Since these values represent the maximum visibility impact anywhere within the sensitive location, they may not be a simple sum of the maximum direct **Alt A** Project and Non-Project impacts, which can occur at different locations. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.

Locations:

IR - Indian Reservation. **NHS** - National Historic Site. **NM** - National Monument
NMem - National Memorial. **NP** - National Park. **NRA** - National Recreation Area
WA - Wilderness Area.

TABLE AQ-7
ALTERNATIVES B/C/E - PREDICTED CRITERIA POLLUTANT IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS (IN (μG/M³)

Pollutant	Avg Time [a]	Location	PSD Increment	Alts B/C/E Project	Alts B/C/E Project + RFFA	Non-Project	Cum	Back-ground	Total	NAAQS	MAAQS
carbon monoxide	1-hour	near-field	- - -	109	112.6	540.0	548.2	15,000	15,548	40,000	26,000
		far-field [1]	- - -	6	7.3	100.0	100.0	15,000	15,100	40,000	26,000
	8-hours	near-field	- - -	74	77.2	311.3	337.2	6,600	6,937	10,000	10,000
		far-field [2]	- - -	56	57.8	28.9	78.0	6,600	6,677	10,000	10,000
nitrogen dioxide	1-hour	near-field	- - -	100	102.3	181.0	207.3	117	324.3	- - -	566
		far-field [3]	- - -	58	60.1	27.5	73.3	117	190.3	- - -	566
	Annual	near-field	25	9.1	9.4	4.8	10.7	11	21.7	100	100
		far-field [3]	25	3.9	4.7	1.1	5.4	11	16.4	100	100
		far-field [2]	**2.5**[c]	1.9	**3.7**[c]	0.5	**4.2**[c]	11	15.2	100	100
$PM_{2.5}$	24-hours	near-field	- - -	6.2	6.9	44.1	45.9	20	**65.9** [b]	**65** [b]	- - -
		far-field [3]	- - -	4.2	5.1	10.6	14.7	20	34.7	65	- - -
	Annual	near-field	- - -	1.4	1.5	5.6	6.3	8	14.3	15	- - -
		far-field [3]	- - -	0.7	0.8	0.5	1.2	8	9.2	15	- - -
PM_{10}	24-hours	near-field	**30** [c]	12.1	13.1	**103.8** [c]	**107.1** [c]	105	**212.1** [d]	**150** [d]	**150** [d]
		far-field [4]	30	0.3	0.4	29.7	29.7	105	134.7	150	150
		far-field [2]	**8** [c]	4.2	5.9	**8.4** [c]	**12.8** [c]	105	117.8	150	150
		far-field [5]	**8** [c]	1.4	2.0	7.2	**9.2** [c]	105	114.2	150	150
	Annual	near-field	17	3.6	3.7	13.1	14.3	30	44.3	50	50
		far-field [4]	17	<0.1	<0.1	2.7	2.7	30	32.7	50	50
sulfur dioxide	1-hour	near-field	- - -	4.6	4.6	27.4	28.2	666	694.2	- - -	1,300
		far-field [3]	- - -	2.2	2.2	29.6	29.6	666	695.6	- - -	1,300
	3-hours	near-field	512	3.5	3.5	22.6	23.6	291	314.6	1,300	- - -
		far-field [3]	512	1.7	1.8	17.1	17.1	291	308.1	1,300	- - -
	24-hours	near-field	91	2.1	2.1	9.8	10.5	73	83.5	365	260
		far-field [3]	91	1.0	1.1	5.3	5.3	73	78.3	365	260
	Annual	near-field	20	0.7	0.7	1.0	1.2	16	17.2	80	60
		far-field [3]	20	0.3	0.3	0.4	0.4	16	16.4	80	60

Source: Argonne (2002)

Notes:

[a] Annual impacts are the first maximum value; short-term impacts are the second maximum value. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.
[b] Two receptor locations just south of the Spring Creek Coal Mine when combined with an assumed background concentration of 20 $\mu g/m^2$ were predicted to exceed the National ambient air quality standards due to **Cum** emission sources.
[c] It is possible that **Alts B/C/E Project + RFFA**, Non-Project and/or **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation and the Washakie Wilderness Area, as well as the PSD Class II increment near the maximum assumed development; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate air quality regulatory agency.
[d] Two receptor locations just south of the Spring Creek Coal Mine when combined with an assumed background concentration of 105 $\mu g/m^2$ were predicted to exceed the National and Montana ambient air quality standards due to Non-Project and **Cum** emission sources.

Alts B/C/E Project - Direct modeled Alternatives' B/C/E impacts.
Alts B/C/E Project + RFFA - Direct modeled Alternatives' B/C/E impacts combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest.
Non-Project – Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alts B/C/E**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS Alternative 1 sources. Potential impacts from Wyoming Alternatives 2A, 2B and 3 would be less.
Cum – Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alts B/C/E** Project and Non-Project impacts, which can occur at different locations.
Total - The sum of the cumulative modeled impact and the assumed background concentration.
NAAQS – Applicable National Ambient Air Quality Standard.
MAAQS – Applicable Montana Ambient Air Quality Standard.

Locations:
1 – Absaroka-Beartooth Wilderness Area
2 – Northern Cheyenne Indian Reservation
3 – Crow Indian Reservation
4 – Fort Belknap Indian Reservation
5 – Washakie Wilderness Area

TABLE AQ-8
ALTERNATIVES B/C/E - PREDICTED ATMOSPHERIC DEPOSITION IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

			Total Sulfur Deposition (kg/ha-yr)					Total Nitrogen Deposition (kg/ha-yr)					Acid Neutralizing Capacity (per cent)					
Location	**PSD Class**	**Lake**	**Alts B/C/E Project**	**Alts B/C/E Project + RFFA**	**Non-Project**	**Cum**	**Thld**	**Alts B/C/E Project**	**Alts B/C/E Project + RFFA**	**Non-Project**	**Cum**	**Thld**	**Bkgd (µeq/l)**	**Alts B/C/E Project**	**Alts B/C/E Project + RFFA**	**Non-Project**	**Cum**	**Thld**
Bridger WA	I	Black Joe	<0.01	<0.01	0.01	0.01	5	<0.01	0.01	0.03	0.03	3	69.0	0.3	0.4	2.2	2.6	10
		Deep	<0.01	<0.01	0.01	0.01	5	<0.01	0.01	0.03	0.03	3	61.0	0.3	0.4	2.5	2.9	10
		Hobbs	<0.01	<0.01	0.01	0.01	5	<0.01	<0.01	0.02	0.02	3	68.0	0.2	0.3	1.2	1.5	10
		Upper Frozen	<0.01	<0.01	0.01	0.01	5	<0.01	0.01	0.03	0.03	3	5.8	0.2 [a]	0.25 [a]	**1.6 [a]**	**1.8 [a]**	**1 [a]**
Fitzpatrick WA	I	Ross	<0.01	<0.01	0.01	0.01	5	<0.01	0.01	0.02	0.02	3	61.4	0.3	0.4	1.7	2.1	10
Absaroka-Beartooth WA	II	Stepping Stone	<0.01	<0.01	0.02	0.02	5	0.01	0.01	0.02	0.03	3	27.0	0.4	0.6	2.0	2.5	10
		Twin Island	<0.01	<0.01	0.01	0.02	5	0.01	0.01	0.02	0.03	3	36.0	0.3	0.4	1.4	1.8	10
Cloud Peak WA	II	Emerald	<0.01	<0.01	0.03	0.03	5	0.02	0.03	0.07	0.10	3	53.3	1.1	1.4	4.4	5.9	10
		Florence	<0.01	<0.01	0.03	0.03	5	0.02	0.03	0.08	0.11	3	32.7	1.7	2.3	8.1	**10.4[b]**	**10[b]**
Popo Agie WA	II	Lower Saddlebag	<0.01	<0.01	0.01	0.01	5	<0.01	0.01	0.03	0.04	3	55.5	0.3	0.5	3.2	3.6	10

Source: Argonne (2002)

Notes: **Alts B/C/E** Project - Direct modeled Alternatives' B/C/E impacts.

Alts B/C/E Project + RFFA - Direct modeled Alternatives' B/C/E impacts combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest

Non-Project - Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alts B/C/E**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS Alternative 1 sources. Potential impacts from Wyoming Alternatives 2A, 2B and 3 would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact at a specific location, they are the sum of the maximum direct **Alts B/C/E** Project and Non-Project impacts. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.

Thld - Impact threshold. Total sulfur and nitrogen thresholds from Fox, et al. (1989); acid neutralizing capacity thresholds from FS (2000).

WA - Wilderness Area.

a - Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 μeq/l, the applicable significance threshold is less than a 1 μeq/l change. This threshold is exceeded by Non-Project and **Cum** emission sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

b – The potential cumulative impact of 10.4 μeq/l change would exceed the threshold level of 10 μeq/l for Florence Lake.

TABLE AQ-9
ALTERNATIVES B/C/E - DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS
(NUMBER OF DAYS Δ1.0 DV PER YEAR)

Sensitive Location	PSD Classification	Alts B/C/E Project	Alts B/C/E Project + RFFA	Non-Project	Cum
Badlands WA	mandatory federal Class I	0	0	17 to 25	21 to 28
Bridger WA	mandatory federal Class I	2	3	8 to 10	10 to 12
Fitzpatrick WA	mandatory federal Class I	2	3	7 to 9	10 to 12
Gates of the Mountains WA	mandatory federal Class I	0	0	3 to 4	4 to 4
Grand Teton NP	mandatory federal Class I	0	0	4 to 6	6 to 8
North Absaroka WA	mandatory federal Class I	2	4	10 to 12	13 to 15
Red Rock Lakes WA	mandatory federal Class I	0	0	0 to 1	2 to 3
Scapegoat WA	mandatory federal Class I	0	0	2 to 2	3 to 3
Teton WA	mandatory federal Class I	1	3	7 to 9	10 to 11
Theodore Roosevelt NP (North Unit)	mandatory federal Class I	0	0	1 to 2	2 to 3
Theodore Roosevelt NP (South Unit)	mandatory federal Class I	0	1	2 to 4	4 to 7
U.L. Bend WA	mandatory federal Class I	1	1	5 to 5	6 to 8
Washakie WA	mandatory federal Class I	3	5	11 to 14	16 to 18
Wind Cave NP	mandatory federal Class I	0	0	21 to 27	25 to 32
Yellowstone NP	mandatory federal Class I	1	3	9 to 11	12 to 13
Fort Peck IR	Tribal designated Class I	0	1	1 to 2	4 to 5
Northern Cheyenne IR	Tribal designated Class I	33	60	30 to 38	87 to 92
Absaroka-Beartooth WA	federal Class II	2	4	28 to 29	32 to 33
Agate Fossil Beds NM	federal Class II	0	0	10 to 15	14 to 19
Bighorn Canyon NRA	federal Class II	9	17	19 to 21	32 to 34
Black Elk WA	federal Class II	0	1	20 to 26	24 to 31
Cloud Peak WA	federal Class II	6	10	21 to 28	35 to 39
Crow IR	federal Class II	61	75	56 to 61	113 to 116

TABLE AQ-9
ALTERNATIVES B/C/E - DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS
(NUMBER OF DAYS Δ1.0 DV PER YEAR)

Sensitive Location	PSD Classification	Alts B/C/E Project	Alts B/C/E Project + RFFA	Non-Project	Cum
Devils Tower NM	federal Class II	1	3	24 to 38	34 to 47
Fort Belknap IR	federal Class II	1	1	60 to 61	61 to 62
Fort Laramie NHS	federal Class II	0	1	13 to 17	16 to 20
Jewel Cave NM	federal Class II	0	0	24 to 31	28 to 36
Mount Rushmore NMem	federal Class II	0	0	17 to 22	20 to 26
Popo Agie WA	federal Class II	2	3	8 to 10	11 to 13
Soldier Creek WA	federal Class II	0	0	13 to 18	16 to 21

Source: Argonne (2002)

Notes: **Alts B/C/E Project** - Direct modeled Alternatives' B/C/E impacts.

Alts B/C/E Project + RFFA - Direct modeled Alternatives' B/C/E impacts combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest.

Non-Project - Direct modelednon-project source impacts. The impact from all air pollutant emission sources not included in **Alts B/C/E**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS sources. The range of values corresponds to including Wyoming Alternative 3 (low) to Wyoming Alternative 1 (high).**Cum** - Cumulative modeled impacts. Since these values represent the maximum visibility impact anywhere within the sensitive location, they may not be a simple sum of the maximum direct **Alts B/C/E** Project and Non-Project impacts, which can occur at different locations. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.

Locations:

IR - Indian Reservation. **NHS** - National Historic Site. **NM** - National Monument

NMem - National Memorial. **NP** - National Park. **NRA** - National Recreation Area

WA - Wilderness Area.

TABLE AQ-10
ALTERNATIVE D - PREDICTED CRITERIA POLLUTANT IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS (IN (μG/M^3)

Pollutant	Avg Time [a]	Location	PSD Increment	Alt D Project	Alt D Project + RFFA	Non-Project	Cum	Back-ground	Total	NAAQS	MAAQS
carbon monoxide	1-hour	near-field	- - -	48	47.7	540	540.8	15,000	15,541	40,000	26,000
		far-field [1]	- - -	2	2.2	100	100.0	15,000	15,100	40,000	26,000
	8-hours	near-field	- - -	29	29.6	311.3	319.8	6,600	6,920	10,000	10,000
		far-field [1]	- - -	1	1.8	52	51.8	6,600	6,652	10,000	10,000
nitrogen dioxide	1-hour	near-field	- - -	50	59.6	181	195.1	117	312.1	- - -	566
		far-field [3]	- - -	33	32.7	27.5	43.9	117	160.1	- - -	566
	Annual	near-field	25	6.4	6.5	4.8	7.8	11	18.814.	100	100
		far-field [3]	25	2.4	2.8	1.1	3.5	11	5	100	100
		far-field [2]	2.5	1.1	2.0	0.5	**2.5**[e]	11	13.5	100	100
$PM_{2.5}$	24-hours	near-field	- - -	4.3	4.7	44.1	45.3	20	**65.3** [b]	**65** [b]	- - -
		far-field [3]	- - -	2.6	2.9	10.6	12.8	20	32.8	65	- - -
	Annual	near-field	- - -	1.2	1.2	5.6	6.0	8	14.0	15	- - -
		far-field [4]	- - -	<0.1	<0.1	1.2	1.2	8	9.2	15	- - -
PM_{10}	24-hours	near-field	**30** [c]	10.8	11.5	**103.8** [c]	**106.5** [c]	105	**211.5** [d]	**150** [d]	**150** [d]
		far-field [4]	30	0.1	0.2	29.7	29.7	105	134.7	150	150
		far-field [2]	**8** [c]	3.3	4.4	**8.4** [c]	**11.1** [c]	105	116.1	150	150
		far-field [5]	**8** [c]	0.6	0.9	7.2	**8.1** [c]	105	113.1	150	150
	Annual	near-field	17	3.3	3.4	13.1	14.1	30	44.1	50	50
		far-field [4]	17	<0.1	<0.1	2.7	2.7	30	32.7	50	50
sulfur dioxide	1-hour	near-field	- - -	4.5	4.5	27.4	28.2	666	694.2	- - -	1,300
		far-field [3]	- - -	2.2	2.2	29.6	29.6	666	695.6	- - -	1,300
	3-hours	near-field	512	3.5	3.5	22.6	23.6	291	314.6	1,300	- - -
		far-field [3]	512	1.7	1.8	17.1	17.1	291	308.1	1,300	- - -
	24-hours	near-field	91	2.1	2.1	9.8	10.5	73	83.5	365	260
		far-field [3]	91	1.0	1.1	5.3	5.3	73	78.3	365	260
	Annual	near-field	20	0.7	0.7	1.0	1.2	16	17.1	80	60
		far-field [3]	20	0.3	0.3	0.4	0.4	16	16.4	80	60

Source: Argonne (2002)

Notes: [a] Annual impacts are the first maximum value; short-term impacts are the second maximum value. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.

[b] Two receptor locations just south of the Spring Creek Coal Mine when combined with an assumed background concentration of 20 $\mu g/m^2$ were predicted to exceed the National ambient air quality standards due to **Cum** emission sources.

[c] It is possible that Non-Project and/or **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation and Washakie Wilderness Area, as well as the PSD Class II increment near the maximum assumed development; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate air quality regulatory agency.

[d] Two receptor locations just south of the Spring Creek Coal Mine when combined with an assumed background concentration of 105 $\mu g/m^2$ were predicted to exceed the National and Montana ambient air quality standards due to **Cum** emission sources.

[e] Actual model results equal to 2.45 $\mu g/m^3$. See Argonne (2002) Appendix C, Table C.1.2.3.

Alt D Project - Direct modeled Alternative D impacts.

Alts D Project + RFFA - Direct modeled Alternatives' D impacts combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest.

Non-Project - Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alt D**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS Alternative 1 sources. Potential impacts from Wyoming Alternatives 2A, 2B and 3 would be less.

Cum – Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt D** Project and Non-Project impacts, which can occur at different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

NAAAQS - Applicable National Ambient Air Quality Standard.

MAAQS - Applicable Montana Ambient Air Quality Standard.

Locations:

1 – Absaroka-Beartooth Wilderness Area

2 – Northern Cheyenne Indian Reservation

3 – Crow Indian Reservation

4 – Fort Belknap Indian Reservation

5 – Washakie Wilderness Area

TABLE AQ-11
ALTERNATIVE D - PREDICTED ATMOSPHERIC DEPOSITION IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

			Total Sulfur Deposition (kg/ha-yr)					Total Nitrogen Deposition (kg/ha-yr)					Acid Neutralizing Capacity (per cent)					
Location	**PSD Class**	**Lake**	**Alt D Project**	**Alt D Project + RFFA**	**Non-Project**	**Cum**	**Thld**	**Alt D Project**	**Alt D Project + RFFA**	**Non-Project**	**Cum**	**Thld**	**Bkgd (μeq/l)**	**Alt D Project**	**Alt D Project + RFFA**	**Non-Project**	**Cum**	**Thld**
Bridger WA	I	Black Joe	<0.01	<0.01	0.01	0.01	5	<0.01	<0.01	0.03	0.03	3	69.0	0.2	0.2	2.2	2.4	10
		Deep	<0.01	<0.01	0.01	0.01	5	<0.01	<0.01	0.03	0.03	3	61.0	0.2	0.2	2.5	2.7	10
		Hobbs	<0.01	<0.01	0.01	0.01	5	<0.01	<0.01	0.02	0.02	3	68.0	0.1	0.2	1.2	1.4	10
		Upper Frozen	<0.01	<0.01	0.01	0.01	5	<0.01	<0.01	0.03	0.03	3	5.8	0.1 [a]	0.13 [a]	**1.6** [a]	**1.7** [a]	**1** [a]
Fitzpatrick WA	I	Ross	<0.01	<0.01	0.01	0.01	5	<0.01	<0.01	0.02	0.02	3	61.4	0.2	0.2	1.7	1.9	10
Absaroka-Beartooth WA	II	Stepping Stone	<0.01	<0.01	0.02	0.02	5	<0.01	0.01	0.02	0.03	3	27.0	0.3	0.3	2.0	2.3	10
		Twin Island	<0.01	<0.01	0.01	0.02	5	<0.01	0.01	0.02	0.03	3	36.0	0.2	0.2	1.4	1.6	10
Cloud Peak WA	II	Emerald	<0.01	<0.01	0.03	0.03	5	0.01	0.02	0.07	0.09	3	53.3	0.6	0.7	4.4	5.2	10
		Florence	<0.01	<0.01	0.03	0.03	5	0.01	0.02	0.08	0.09	3	32.7	0.9	1.1	8.1	9.2	10
Popo Agie WA	II	Lower Saddlebag	<0.01	<0.01	0.01	0.01	5	<0.01	<0.01	0.03	0.03	3	55.5	0.2	0.2	3.2	3.4	10

Source: Argonne (2002)

Notes: **Alt D** Project - Direct modeled Alternative D impacts.

Alts D Project + RFFA - Direct modeled Alternatives' D impacts combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest.

Non-Project - Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alt D**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS Alternative 1 sources. Potential impacts from Wyoming Alternatives 2A, 2B and 3 would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact at a specific location, they are the sum of the maximum direct **Alt D** Project and Non-Project impacts. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.

Thld - Impact threshold. Total sulfur and nitrogen thresholds from Fox, et al. (1989); acid neutralizing capacity thresholds from FS (2000).

WA - Wilderness Area.

a - Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 μeq/l, the applicable significance threshold is less than a 1 μeq/l change. This threshold is exceeded by Non-Project and **Cum** emission sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

TABLE AQ-12
ALTERNATIVE D - DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS (NUMBER OF DAYS >1.0 DV PER YEAR)

Sensitive Location	PSD Classification	Alt D Project	Alt D Project + RFFA	Non-Project	Cum
Badlands WA	mandatory federal Class I	0	0	17 to 25	20 to 26
Bridger WA	mandatory federal Class I	0	1	8 to 10	9 to 11
Fitzpatrick WA	mandatory federal Class I	0	0	7 to 9	8 to 10
Gates of the Mountains WA	mandatory federal Class I	0	0	3 to 4	3 to 4
Grand Teton NP	mandatory federal Class I	0	0	4 to 6	5 to 7
North Absaroka WA	mandatory federal Class I	0	1	10 to 12	12 to 14
Red Rock Lakes WA	mandatory federal Class I	0	0	0 to 1	1 to 2
Scapegoat WA	mandatory federal Class I	0	0	2 to 2	2 to 3
Teton WA	mandatory federal Class I	0	0	7 to 9	9 to 10
Theodore Roosevelt NP (North Unit)	mandatory federal Class I	0	0	1 to 2	1 to 2
Theodore Roosevelt NP (South Unit)	mandatory federal Class I	0	0	2 to 4	3 to 5
U.L. Bend WA	mandatory federal Class I	0	0	5 to 5	5 to 6
Washakie WA	mandatory federal Class I	1	1	11 to 14	14 to 16
Wind Cave NP	mandatory federal Class I	0	0	21 to 27	23 to 29
Yellowstone NP	mandatory federal Class I	0	0	9 to 11	11 to 12
Fort Peck IR	Tribal designated Class I	0	0	1 to 2	2 to 3
Northern Cheyenne IR	Tribal designated Class I	17	38	30 to 38	70 to 76
Absaroka-Beartooth WA	federal Class II	0	1	28 to 29	30 to 31
Agate Fossil Beds NM	federal Class II	0	0	10 to 15	12 to 17
Bighorn Canyon NRA	federal Class II	3	7	19 to 21	2 to 28
Black Elk WA	federal Class II	0	0	20 to 26	22 to 28
Cloud Peak WA	federal Class II	1	2	21 to 28	28 to 35
Crow IR	federal Class II	42	56	56 to 61	102 to 105
Devils Tower NM	federal Class II	0	0	24 to 38	29 to 42

TABLE AQ-12
ALTERNATIVE D - DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS (NUMBER OF DAYS >1.0 DV PER YEAR)

Sensitive Location	PSD Classification	Alt D Project	Alt D Project + RFFA	Non-Project	Cum
Fort Belknap IR	federal Class II	0	0	60 to 61	61 to 61
Fort Laramie NHS	federal Class II	0	0	13 to 17	15 to 18
Jewel Cave NM	federal Class II	0	0	24 to 31	26 to 34
Mount Rushmore NMem	federal Class II	0	0	17 to 22	18 to 23
Popo Agie WA	federal Class II	0	1	8 to 10	9 to 11
Soldier Creek WA	federal Class II	0	0	13 to 18	14 to 20

Source: Argonne (2002)

Notes: **Alt D** Project - Direct modeled Alternative D impacts.
Alts D Project + RFFA - Direct modeled Alternatives' D impacts combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest.
Non-Project - Direct modeled non-project source impacts. The impact from all air pollutant emission sources not included in **Alt D**, including the Wyoming "Powder River Basin Oil and Gas Project" DEIS sources. The range of values corresponds to including Wyoming Alternative 3 (low) to Wyoming Alternative 1 (high).
Cum - Cumulative modeled impacts. Since these values represent the maximum visibility impact anywhere within the sensitive location, they may not be a simple sum of the maximum direct **Alt D** Project and Non-Project impacts, which can occur at different locations. There are uncertainties, unquantified at this point, associated with the modeled values. Actual maximum impacts may be larger or smaller than those shown.

Locations:
IR - Indian Reservation. **NHS** - National Historic Site. **NM** - National Monument
NMem - National Memorial. **NP** - National Park. **NRA** - National Recreation Area
WA - Wilderness Area.

9.0 Thresholds For Triggering Mitigation

9.1 Clean Air Act Regulatory Thresholds

For Prevention of Significant Deterioration (PSD) of air quality, modeled and monitored results for $PM_{10}$and NO_2 will be evaluated against the Class I and Class II increments to determine if additional mitigation will be required (see Table AQ-1).

Monitoring data only will be used to determine if the NAAQS PM_{10} and NO_2 standards (see Table AQ-1) have been exceeded. For federal lands with Class I areas, the Clean Air Act sets a 60-year goal of clear vistas. Clear vistas are defined as reduction in visibility not to exceed 1.0 deciview/year for more than 1 day. Where this threshold is exceeded from a single project, this could be the basis for the federal land managers' designation of visibility impairment. Such a designation could necessitate mitigation. Where the threshold is exceeded based on cumulative actions (i.e. RFFA), this also could be the basis for the federal land managers' designation of visibility impairment. In this instance, Congress directed federal land managers to implement mitigation pursuant to the Regional Haze Rule, in a manner that results in a 25% reduction in impairment every 15-year period to meet the 60-year clear vistas goal.

In order to prevent violations of national and local air quality standards, emission controls need to be implemented before standards are violated. For an analytic approach, implementation of control adequate to lead to no predicted cumulative violations are adequate, since all known and anticipated emissions will presumably be modeled within model uncertainties. NO_2 modeling of this well understood gas should be accurate enough to base mitigation decisions.

9.2 "Levels of Concern"

If mitigation measures are not fully implemented until regulatory thresholds are exceeded, then a regulatory process is triggered to resolve the exceedances. Such a process may be lengthy, costly and administratively burdensome. Agencies may wish to avoid such a process by establishing a "level of concern" short of regulatory thresholds, which would trigger implementation of control measures of a type and quantity sufficient to avoid reaching regulatory thresholds.

Where predictive capability is well-developed, as is the case with modeling of NO_2, an LOC might more closely approach the regulatory threshold. However, with a pollutant such as PM_{10}, greater uncertainties exist in the prediction of ambient concentrations due to such factors as differential particle settling. In such a case, an LOC may need to be established at a lower level to achieve the objective of avoiding regulatory exceedances.

9.3 Mitigation Measures

If air quality mitigation applied by all parties in the Powder River Basin are proven to be inadequate, cumulatively, to maintain these Class I and Class II increment limits based on regulatory air quality modeling or monitored conditions, Montana, Wyoming, or the Tribes may impose either a State or Tribal Implementation Plan (SIP or TIP) to assure preservation of the rural air quality. EPA may itself impose a Federal Implementation Plan (FIP) to obtain controls on all regulated pollutant emission sources in order to assure preservation of the rural air quality.

9.4 Mitigation

Tables AQ-13 and AQ-14 include the array of measures available to mitigate potential PM_{10} and NO_x impacts and the effectiveness of each measure.

TABLE AQ-13
FUGITIVE DUST MITIGATION MEASURES (PM10), EFFECTIVENESS AND COST

	Dust Sources					
	Disturbed Areas	**Unpaved Roads[1]**				
Mitigation Options	Establish plant cover for all disturbed lands by certain time (re-vegetation)	Water roads to attain certain percent moisture	Apply soil stabilizer	Set and enforce speed limit	Gravel roads	Pave road
Effectiveness	Level proportional to percentage of land cover	0 – 50% reduction in uncontrolled dust emissions	33 to 100% control efficiency	80% for 15 mph 65% for 20 mph 25% for 30 mph [2]	30% reduction	90% reduction
Estimated Cost	$/acre	$4000/mile	$2,000 to $4,000/mile per year	Unknown	$9,000/mile	$11,000 to $60,000/mile

[1]Improved and County roads
[2]Reductions assume 40 mile per hour base speed.

TABLE AQ-14
NITROGEN OXIDES (NOX) MITIGATION MEASURES EFFICIENCY

	No_x Emissions Sources[1]			
	Field Compressors	**Sales Compressors**	**Temporary Diesel Generators [2]**	**Heavy Equipment**
Mitigation Options/Efficiency	Implement Best Available Control Technology Typically results in a NO_x emission rate of about 1 g/bhp-hr	Implement Best Available Control Technology Typically results in a NO_x emission rate of about 1 g/bhp-hr	Register with State; will regulate as appropriate	Voluntary use of diesel engines

1 Using electric – powered compressor motors in place of the typical natural-gas fired compressor engines could eliminate direct NO_x emissions from compressor station locations.
[2]Wyoming is currently registering these generators to determine if No_x emissions are significant.

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AIR QUALITY MODELING APPENDIX – PART 2

QUANTITATIVE REVIEW OF

AMBIENT AIR QUALITY IMPACTS

Supplement to Statewide Final Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans

Prepared for

U.S. BUREAU OF LAND MANAGEMENT
Miles City Field Office
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November 2006

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1.0 INTRODUCTION AND BACKGROUND

The Powder River Basin (PRB) of Montana and Wyoming is a major coal resource region in the United States. It has also produced large quantities of natural gas and oil, and has experienced significant development of coal bed natural gas from its coal seams. The region also has a diverse set of environmental values, including proximity to some of the most pristine areas in the United States. Sensitive areas that were evaluated include the identified Class I areas, for air quality regulatory purposes, and other selected Class II sensitive areas, based on previous studies of coal development and coal bed natural gas development in the region.

A Montana Statewide Oil and Gas Environmental Impact Statement (EIS) had been developed in January 2003. This report provides a supplemental analysis of potential impacts related to air quality for Coal Bed Natural Gas Development in the Powder River Basin area. The potential air quality impacts have recently been analyzed as part of two different studies:

- Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans, prepared by the Bureau of Land Management Miles City Field Office and the Billings Field Office, and the State of Montana Board of Oil and Gas Conservation and the Montana Department of Environmental Quality (BLM and Montana, 2003); The bulk of the technical review was based on data included in the Technical Support Document (Argonne 2002) that was applied to both the Montana Statewide Oil and Gas EIS, and;
- Task 1A and 3A Reports for the Powder River Basin Coal Review, Cumulative Air Quality Effects, prepared for the BLM Casper Field Office, and the Wyoming State Office (ENSR 2005a, b).

A series of dispersion modeling exercises were conducted for each of the cited studies and analyses. In this report, the studies will be referred to as the Oil and Gas EIS and the Coal Review, respectively. Additional impact analyses have been carried out for the Tongue River Railroad expansion and the Proposed Roundup Power Plant in Musselshell County, Montana. The results of these proposed projects are also incorporated into this report.

This study provides a further evaluation of the air quality-related environmental impacts of continued development of coal bed natural gas resources in the region. The evaluation includes estimating emissions and potential impacts for a base year (2004), and estimating comparative potential impacts for peak development for three separate development scenarios. This report describes the emissions development, summarizes those data, discusses the modeling efforts, and presents results for the base year and alternative development plans.

The purpose of the study was to evaluate the regional changes in air quality potential impacts resulting from three separate development scenarios. The study is not designed to provide specific air permitting data for a specific project. The focus is on potential impacts in the Powder River Basin "region," which is characterized as the near-field grid, and on the sensitive receptor groups surrounding the region. Details of the analysis are provided for all groups, but emphasized for the near-field and for the sensitive areas that have the highest modeled potential impacts from the sources in the region.

Finally, a word should be said regarding dispersion modeling analyses and their use in planning and decision-making. All dispersion models, regardless of their level of complexity, are mathematical approximations (based largely on fluid dynamics) of the behavior of the atmosphere. Therefore, particularly given the uncertain nature of the number and placement of the RFD Alternative sources used in this analysis, the results need to be viewed appropriately as estimates of possible future concentrations and not exact predictions in time and space.

Because of this, dispersion modeling is generally conducted in a somewhat conservative manner, attempting to insure that the final results do not underestimate the actual or future impacts, so that appropriate planning decisions can be made. For example, sources may be assumed to operate for longer times or emit more pollutants than might be reasonable to expect to insure that health-based air standards are protected. On the other hand, analyses are not conducted assuming the worst-case conditions across the board, which could lead to a "false-positive" result. Hence, dispersion modeling analyses are a balancing act, using the best available information and methods (EPA-approved models, emission factors, etc.) when possible, and the best scientific and professional judgment otherwise, trying to shade the analysis so that the final results do not under-predict the actual concentrations.

Oil and Gas EIS

The Oil and Gas EIS included evaluations of the full range of environmental issues for development in the Montana and Wyoming Project Areas. Figure 1-1 depicts the EIS study area and the receptor grids. For comparison to this study, the EIS included three separate model runs to address potential impacts on air quality for several development alternatives that included no action, a preferred development alternative, and three other alternatives that addressed varying development limitations or emphases. The study addressed potential impacts from project sources and from non-project sources in a five-state region. It predicted potential impacts on ambient air quality standards (NO_2, SO_2, PM_{10}, $PM_{2.5}$, and CO), PSD Class I increments, sulfur and nitrogen deposition, visibility in Class I areas, and potential impacts on sensitive lakes.

Among the analyzed alternatives, the common cumulative impacts for all alternatives included potential exceedances of the 24-hour PM_{10} standard in the near-field receptors in Montana. The exceedances were generally due to PM_{10} sources near mining operations; however, the method of analysis was not sufficiently detailed to provide a regulatory estimate of actual exceedances. The EIS analysis also reviewed PSD increments and noted potential impacts above the PSD levels, but did not specifically sort PSD increment consuming sources into their specific potential impacts The EIS noted that potential impacts among the alternatives are generally similar (Alternatives B, C, and E were stated to have similar potential impacts). The potential impacts of the alternatives under consideration were generally below applicable standards and increments, as well as having minimal potential impacts on visibility and acid deposition. The potential impacts of concern resulted from cumulative impacts of non-project sources that were analyzed in the study. All alternatives cumulative modeling showed visibility impacts at Class I areas, with the greatest potential impacts at the Northern Cheyenne Indian Reservation. Among the Class II areas reviewed, greatest potential impacts were at the Crow Indian Reservation, just west of the Northern Cheyenne Indian Reservation.

The Oil and Gas EIS identified existing air quality conditions in the region at the Morningstar, Badger Peak, and Lame Deer monitoring sites. The summary stated that The Oil and Gas EIS first identified existing air quality conditions in the region at the Morningstar, Badger Peak, and Lame Deer monitoring sites. The summary further stated that one monitor has shown that some 24-hour PM_{10} potential impacts exceed the ambient air quality standard of 150 $\mu g/m^3$, specifically at the Lame Deer monitoring site on the Northern Cheyenne Indian Reservation. Additionally, modeled near-field potential impacts in Wyoming showed the possibility of exceedences of the 24-hour PM_{10} standard and Class II PSD increments. Air quality levels of NO_2 and SO_2 were well below the ambient standards at all monitoring sites in the region.

The key emissions input data were based on emissions from the proposed alternatives along with other selected non-alternative sources in the region. A review of the database used in the study prepared by Argonne National Labs (Argonne 2002) indicated that actual emissions data that were modeled included: those sources operating after the monitoring period used to establish baseline air quality conditions; the changes in emission rates for some existing projects associated with the period of development of any of the alternatives; and project RFD scenarios and reasonably foreseeable future actions. Only those sources with changes in emissions, as reported by regulatory agencies, including WDEQ were included in the modeling. As a result, the modeling effort focused on potential impacts from new and altered permitted sources in the region. A series of alternatives was evaluated including Alternative A (which projected limited development under existing management prescriptions) and Alternatives B and D, which addressed various development scenarios and different measures that would influence air quality emissions. Other un-modified sources or potential emission rates were not modeled. The potential impacts from these sources were addressed by adding a background concentration to any analyses of the ambient air quality impacts for comparison to National and Montana Ambient Air Quality Standards.

Montana Near-field Receptors: For Alternative A, the projected potential impacts were modeled to be below the associated ambient air quality standards for all criteria pollutants except for the cumulative analysis of potential impacts on the 24-hour PM_{10} standard. The cumulative impact on the annual PM_{10} standard was estimated to be about 86 percent of the applicable standard (50 $\mu g/m^3$) for near-field and 66 percent at far-field receptors. Potential impacts from other pollutants were evaluated to be only a few percent of the applicable ambient standard, and potential impacts from the proposed development were also well below the applicable Class II PSD increments. The potential impacts from Alternatives B-D showed slight increases in the PM_{10} impacts, but did not change the fact that the predicted 24-hour PM_{10} impact was above the established national and state ambient air quality standards. The potential impacts of other pollutants increased slightly, but did not exceed the ambient standards. Those impacts remained at just a few percent of the established standards.

Class I and Class II Sensitive Receptor Areas: The Oil and Gas EIS evaluated air quality potential impacts from criteria pollutants in the Class I and Class II areas with national and state ambient air quality standards and PSD increments. The results for Alternative A showed cumulative potential impacts exceeding the 24-hour PM_{10} ambient air quality standard in the near-field and the PSD increments in the near-field Crow Indian Reservation Class II area and the Northern Cheyenne Indian Reservation Class I area. The cumulative potential impacts from Alternatives B-D indicated similar exceedances of the 24-hour PM_{10} ambient air quality standard in near-field and PSD increment in near-field and Northern Cheyenne Indian Reservation receptors and the Washakie WSA. However, under Alternatives B and C, cumulative potential impacts were also predicted to exceed the annual NO_2 PSD increment on Northern Cheyenne Indian Reservation receptors. The air quality analysis does not represent a regulatory PSD increment consumption analysis.

The Oil and Gas EIS also addressed potential impacts on the Class I – Air Quality Related Values (AQRVs) including visibility, acid deposition, and acid neutralizing capacity at sensitive lakes. Potential impacts on visibility were evaluated in accord with the FLAG (2000) method which tabulated the number of days in which increased visibility impairment was greater than 10 percent of the background value at each receptor group. The results for Alternative A showed almost no impact from project development sources only; however potential impacts associated with non-project sources and cumulative impacts led to modeled impacts up to 25 and 28 days per year at Class I receptors to the east (predominately downwind) of the project area (Badlands National Park and Wind Cave National Park, respectively). Although the Northern Cheyenne Indian Reservation is designated as Class I for air quality, national visibility regulations do not apply to the Northern Cheyenne Indian Reservation Class I area because such regulations only apply to mandatory Class I areas. The maximum potential impacts on visibility show up to 42 days in which potential impacts were modeled at the Northern Cheyenne Indian Reservation. Among the Class II areas evaluated, the maximum potential impacts were noted for up to 69 days or more at the Crow Indian Reservation and up to 61 days at the Fort Belknap Indian Reservation.

The results for the other full development alternatives show modeled potential impacts at mandatory Class I areas for only 0-4 more days per year when emissions from all sources are considered. Potential impacts at the Northern Cheyenne Indian Reservation are up to 92 days per year and up to 116 days per year at the Crow Indian Reservation.

Acid Deposition: The Oil and Gas EIS evaluated potential impacts at identified sensitive lakes. The acid neutralizing capacity of each of the lakes was tabulated, and the predicted deposition of nitrogen and sulfur compounds was used to evaluate changes in acid neutralizing capacity at each lake. The guideline indicates that if the acid neutralizing capacity of a lake is above 25 micro-equivalents per liter (μeq/L) then a 10 percent change in acid neutralizing capacity is considered significant (USDA 2000, Fox et al. 1989). For lakes with lower acid neutralizing capacity a change of 1 μeq/L is considered significant.

Results showed that potential impacts were below the established thresholds for all lakes except Upper Frozen Lake in the Bridger Wilderness Area for all alternatives considered. For this lake, whose acid neutralizing capacity is less than 25 μeq/L, each alternative led to an increase of more than 1 μeq/L. For other lakes only Florence Lake in the Cloud Peak Wilderness Area showed a potential impact that was above the 10 percent change. Under Alternative B, C, and E, a cumulative increase of 10.4% was indicated.

Coal Review

As noted above, the Coal Review documented the air quality impacts of operations for coal development in the same region along with technical analyses of water and socioeconomic studies for potential coal development in the Montana and Wyoming Powder River Basin area. Figure 1-2 provides a depiction of the coal review study area and the associated receptor grids. Modeling results were presented for a base year (2002), using actual emissions and estimates of actual emissions and operations for that year. Modeling results were also presented for upper and lower reasonably foreseeable development scenarios, projected for 2010; and qualitative estimates of potential impacts were provided for 2015 based on expected development of specified source groupings. The analyses evaluated potential impacts both within the PRB itself and at selected sensitive areas surrounding the region. The analysis specifically looked at potential impacts of coal mines, power plants, coal-bed methane development, and other activities. Results were provided for both Montana and Wyoming source groups and receptors.

The study area covers the CBNG development region in Montana. The technical air quality analysis effort focused on coal development, with additional assessment of CBNG development in Wyoming.

For the base year, results were provided as maximum potential impacts for receptor groups, including the near-field grid receptors, separately in Montana and Wyoming, and at the sensitive Class I and Class II receptor groups. This analysis provided the basis for making estimates of changes in future impacts. The analysis also provided potential impacts of acid deposition and visibility in the sensitive receptor areas, as well as assessment of changes in acid neutralizing capacity at identified sensitive lakes.

In general, the air quality in the region is very good, as demonstrated by measured levels of NO_2, SO_2, and PM_{10} with the exception of PM_{10} concentrations near coal mine operations. Both the monitored data and the modeled results for the base year study showed that there was a concern about ambient concentrations of PM_{10}, particularly for the 24-hour standard in the near-field receptor grid at receptors near coal mine operations in both Wyoming and Montana. This result was consistent with the modeled concentrations, which showed potential exceedances of the 24-hour PM_{10} standard for the base year. The Class I area potential impacts were evaluated to compare potential impacts to PSD increments as a threshold of concern and do not represent a regulatory PSD Increment Consumption Analysis.

At the Wyoming near-field receptors, the maximum potential impacts were associated with coal-related operations in Wyoming. Potential impacts of NO_2 and SO_2 were well below the ambient air quality standards for all receptors. For PM_{10} the analysis predicted potential impacts above the 24-hour PM_{10} National and Wyoming Ambient Air Quality Standard of 150 $\mu g/m^3$ at a few receptors near the mining operations. The base year maximum annual potential impacts were predicted to be below the annual PM_{10} standard of 50 $\mu g/m^3$. The maximum potential impacts were restricted to a few receptors near the mining operations, however.

Similar to the near-field in Wyoming, the projected potential impacts on NO_2 and SO_2 levels in Montana were well below the applicable state and federal standards. The predicted impacts on 24-hour PM_{10} levels were above the standard of 150 $\mu g/m^3$ at a few points near mining operations. The annual PM_{10} impact was predicted to be below the annual standards.

Of all the Class I areas that were analyzed, the maximum potential impacts were predicted to occur at the Northern Cheyenne Indian Reservation in Montana. The bulk of the potential impacts for all three criteria pollutants at Class I areas were caused by coal-related sources in Montana, and the bulk of the SO_2 impacts occurred from power plant emissions. All potential impacts were predicted to be below the ambient standards at all receptors for the base year. Of all the Class I areas that were analyzed, the maximum potential impacts were predicted to occur at the Northern Cheyenne Indian Reservation in Montana. Potential impacts at other Class I areas were also tabulated, but showed still lower impacts. At the nearest areas (Washakie Wilderness Area and Wind Cave National Park) impacts were generally a few percent of the ambient standards.

Among the sensitive Class II areas, the maximum potential impacts occurred at the Crow Indian Reservation in Montana. Potential impacts of NO_2 and SO_2 at sensitive Class II areas were again well below the ambient standards, but PM_{10} impacts were 20 percent of the 24-hour ambient standard and 6 percent of the annual PM_{10} standard. Among the sensitive Class II areas, the maximum potential impacts occurred at the Crow Indian Reservation in Montana.

Visibility potential impacts were analyzed for the indicated Class I and Class II areas. Using the CALPUFF modeling system, potential impacts were analyzed using the Method 6 approach, which uses monthly relative humidity values for each of the receptor groups. Potential impacts were assessed using the highest 24-hour calculated extinction within each receptor group, and were calculated as a percent change in extinction from a background value. The study tabulated the reduced visibility at the maximum impact receptor in each of the Class I and Class II groups. Results were presented as the number of days of annual visibility reduction of 5 percent and 10 percent of the background value. Maximum potential impacts were observed at Class I areas adjacent to the source area (the Northern Cheyenne Indian Reservation) and to the east of the PRB, specifically the Badlands National Park and the Wind Cave National Park. These receptor groups had maximum modeled impacts above 10 percent degradation for 200 days or more per year.

Acid deposition potential impacts were analyzed for nitrogen and sulfur compounds for all the indicated Class I areas. For all areas, the combined deposition rates did not exceed the established thresholds of 3 kilograms per hectare per year (kg/ha-yr) for nitrogen compounds and 5 kg/ha-yr for sulfur compounds. The maximum deposition rates were observed at the Wind Cave National Park but all potential impacts were less than 10 percent of the established thresholds.

Eight separate lakes were identified as sensitive to acid deposition impacts, and were analyzed in accord with the screening methodology as provided by the US Forest Service. Data for lake acid neutralizing capacity were taken from the FS web site, which provides data for the 10 percent ANC values for the individual lakes. The threshold for significance was established at a change of 10 percent reduction for lakes with an acid neutralizing capacity of 25 micro-equivalents per liter (µeq/L) or more and a change of 1 µeq/L for lakes with less than 25 µeq/L acid neutralizing capacity. For the base year, all potential impacts were below the established thresholds, but were close to the established thresholds for Upper Frozen Lake in the Bridger Wilderness Area and at Florence Lake in the Cloud Peak Wilderness Area.

The Task 3A report for the Coal Review provided a modeling assessment of projected coal-related growth for 2010. Both a projected lower development scenario and an upper development scenario were analyzed. For coal-related sources, the overall projected growth in operations (and emissions) for the lower development scenario was about 13 percent in both Wyoming and Montana. For the upper development scenario, the projected growth from the base year was about 32 percent in Wyoming and 41 percent in Montana. The analyses included the foreseeable growth in power plant emissions, as a result of foreseeable additions to power generation. The Roundup Power Plant was not included directly in this analysis (although a separate evaluation of this individual source was conducted with the same modeling effort).

In comparison to the base year results discussed above, the following conclusions were made: For the near-field receptor grids, air quality modeling results showed that the predicted development continued to exacerbate the predicted air quality impacts for 24-hour PM_{10} and that the impacts on annual PM_{10} levels in Wyoming only would exceed the PM_{10} standard of 50 $\mu g/m^3$ at a few receptor points under the 2010 upper development scenario. Potential impacts of other pollutants increased with increased development, but the modeled impacts remained well below the ambient air quality standards.

The major potential impacts on Class I areas continued to occur at the Northern Cheyenne Indian Reservation. Predicted impacts were well below the ambient standards, but were above the PSD increments. At other Class I areas, only the 24-hour PM_{10} impacts were modeled to be above the PSD increments for the base year and for the 2010 upper and lower development scenarios.

At the modeled Class II receptor areas, the maximum potential impacts occurred at the Crow Indian Reservation. Predicted 24-hour PM_{10} impacts were above the PSD Class II increments (30.5 to 36.7 $\mu g/m^3$ versus a standard of 30 $\mu g/m^3$). Impacts at other Class II areas were below the established Class II increments.

At the identified Class I areas, the analysis identified the modeled increase in the number of days where potential impacts exceeded a 10 percent reduction in visibility. The major potential impacts occurred at Class I areas to the east of the PRB area, including, for the 2010 upper development scenario, an increase of 26 days per year at Badlands National Park, 22 days per year at Theodore Roosevelt National Park, and 15 days per year at Wind Cave National Park.

For sensitive lake impacts, modeled results showed changes in acid neutralizing capacity above 10 percent at Florence Lake for each of the 2010 scenarios, and an increase of more than 1 µeq/L at Upper Frozen Lake. These findings are consistent with the Oil and Gas EIS and with the base year Coal Review analysis. In general impacts at other lakes are well below the thresholds for significant impact.

Objective of This Study

The main objective of this study is to identify the changes in air quality impact resulting from the projected alternatives of development. Potential impacts are assessed at “near-field receptor grids” in both Wyoming and Montana and at the individual sensitive receptor areas as well. The impacts were evaluated for the same receptor set that was used in the Coal Review, using the same dispersion model and the receptor data. The near-field potential impacts refer to receptors in the Powder River Basin, near the projected development. Generally those receptors are within 50km of the development area.

The assessment included evaluation of potential impacts at all receptor groups on ambient air levels of nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter with aerodynamic diameter of 10 microns or less (PM_{10}), and selected hazardous air pollutants (HAPs). The HAPs were evaluated at the near-field receptors in Montana and Wyoming, but not at the sensitive receptor areas. At the sensitive receptor areas, potential impacts on visibility and acid deposition were also evaluated. The study evaluates the changes in potential impacts for each of these fields for the expected levels of development. The study includes evaluation of potential impacts at identified sensitive lakes in the region.

The study included development of emission rates and emission factors, or increases in emissions, for each of the source groups. Emission rates for CBNG development and conventional oil and gas development were based on data developed for the 2003 final EIS (Argonne 2002). Information from state agencies was utilized for development of the baseline year emissions from non-project sources.

Key Issues

Similar to the Coal Review, the key issues include the following:

- Characterizing emissions and controls. The emission source groups that were developed for the Coal Review form the basis for developing emission rates for this study, based on the changes in expected production for those source groups.
- Using representative meteorological data. Modeling was conducted using three years of gridded meteorological data, using the CALPUFF modeling system. The potential impacts of base year operations were modeled with all three years, and the year with the maximum impact was chosen for further modeling addressing the alternate development scenarios.
- Assessing nearby impacts. The evaluation of potential impacts in the PRB, using a “near-field receptor grid” is similar to the Coal Review Task 1A study. The study does not address the type of impact analyses that would be provided for obtaining an air permit for a specific facility. The focus is to provide a general depiction of overall potential impacts in the region.
- Assessing potential impacts on Class I and sensitive Class II areas. Class I sensitive areas require enhanced protection, based on federal law. The study evaluates potential impacts on ambient air quality standards, acid deposition, visibility, and identified sensitive lakes. The PSD increment consuming sources are not identified or modeled separately in this study. Therefore while the results are compared to the Class I and Class II PSD increments, no formal PSD evaluation is made.

Figure 1-1

Montana Statewide Oil and Gas EIS Study Receptor Grids and Modeling Domain

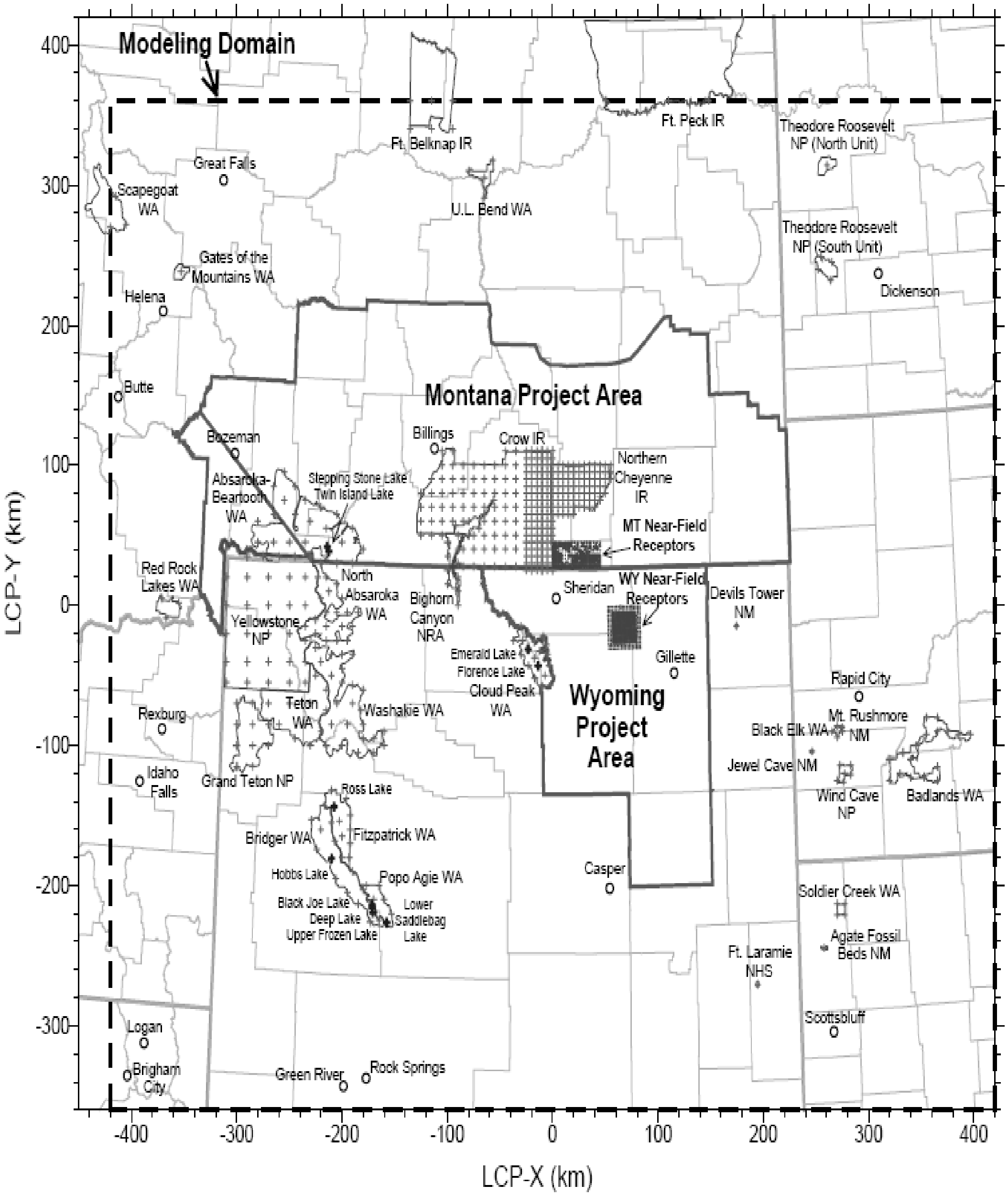
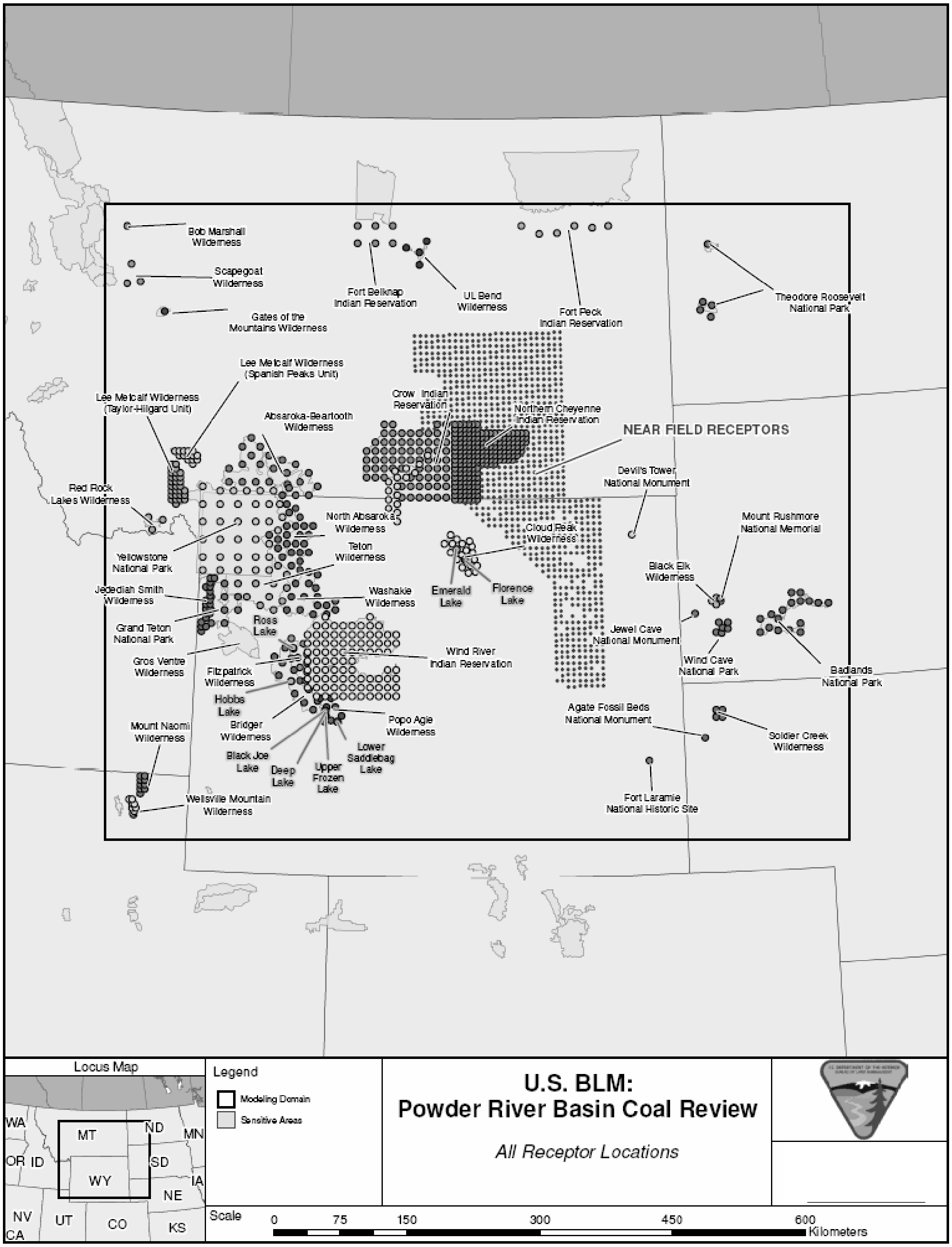


Figure 1-2

Coal Review Receptor Grids and Modeling Domain



2.0 TECHNICAL APPROACH

Overview of Assessment Approach

The objective of the study is to evaluate potential impacts over a wide range of receptors centered over the PRB study area. The evaluation covers receptors within the PRB in both Montana and Wyoming, and it includes individual sensitive receptor groups in the region surrounding the PRB study area. Key aspects of the assessment include the selection of air emissions within the study area, the selection of a modeling system to conduct that evaluation, the selection of a receptor set (within the model system) to be used for evaluating those potential impacts, and the selection of criteria for evaluation of those potential impacts.

This study addressed the impact of changes in emissions from a base year for three separate development scenarios. The assessment evaluated changes in air quality levels for NO_2, SO_2, PM_{10} and $PM_{2.5}$ at the identified receptors. The potential impacts from the development scenarios were assessed at all receptor groups. The study analyzed the potential impacts from identified separate source groups, which allowed a characterization of potential impacts from the individual groups.

This section provides a detailed review of the modeling system, the emissions characterization, the receptor grids that were used, and the assessment criteria that were used for evaluation of potential impacts.

Air Quality Modeling

To conduct a formal modeling of those potential impacts, the USEPA guideline model CALPUFF (Scire, et al. 2000) was used to estimate potential impacts in both the PRB receptors and the sensitive surrounding areas. The CALPUFF modeling system was recommended for a refined modeling analysis of the region in order to assess potential impacts over near-field and distant receptor areas. The CALPUFF modeling system has three main components:

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

The CALPUFF modeling system is designed to treat the time-varying point and area source emissions, model domains at distances from tens of meters to hundreds of kilometers from the sources; predict averaging times from 1 hour to 1 year; predict impacts for inert pollutants that are not chemically changed in the atmosphere; predict potential impacts of pollutants that may be subject to removal and chemical conversion mechanisms; and be applied to rough terrain situations. Given these strengths and the objectives of the study, the CALPUFF model is aptly suited to carrying out the required atmospheric dispersion modeling.

The CALPUFF modeling domain for the PRB Coal Study was established to be identical to that used in the PRB Oil and Gas Final EIS (BLM 2003) and the base year study that is part of the overall coal review (ENSR 2005a,b). A depiction of the CALPUFF modeling domain, along with the depiction of the study area and sensitive receptors, is provided in Figure 1-2.

The CALMET input files were developed from the regional MM5 data base for 2001, 2002, and 2003. All three years were used to develop the potential impacts for the base year (2004 emissions). The study first analyzed the potential impacts for all three years for the base year, focusing on potential impacts in the near-field. A comparison of the potential impacts from those three years concluded that the year 2002 would provide the highest potential impacts in the near-field. For each of the development scenarios, the potential impacts were then analyzed using only 2002 meteorological data.

Receptor Grids and Analyses

Receptor grids were established for both near-field and far-field areas (sensitive Class I and Class II areas of concern). These included the near-field receptors in both states, which cover the study area in each state. The receptor grids are the same as those in the Coal Review, as shown in Figure 1-2. The near-field grid receptors cover grid points within the boundaries of the PRB development area. Near-field receptors were arranged to obtain the maximum estimated concentrations that result from development within the PRB.

The purpose of establishing the near-field receptors is to characterize the overall air quality conditions in the PRB as a result of this development, but not to focus on potential impacts from any one individual source. This approach does NOT address the modeling that would be needed for assessing potential impacts at any facility fence lines, which is generally required for obtaining an air permit from a regulatory agency. Consequently, all near-field receptors that were located within 1 km of a modeled source were removed from the near-field grid. Overall the near-field receptor grid points were spaced at 1-km intervals over the study area. The elevation of each receptor was obtained from the USGS Digital Elevation Model data for the 1:250,000 quads with 90-meter horizontal resolution.

Receptors spaced at 1-km intervals were located along boundaries of Class I and Class II areas and receptors spaced at 2-km intervals were located within each of the following Class I and specified Class II sensitive areas of concern within the modeling domain:

- Badlands National Park
- Wind Cave National Park
- Bridger Wilderness Area
- Fitzpatrick Wilderness Area
- Washakie Wilderness Area
- North Absaroka Wilderness Area
- Northern Cheyenne Indian Reservation (Class 1, Northern Cheyenne Tribal Council)
- Devils Tower National Monument
- Mount Rushmore National Memorial
- Jewel Cave National Monument
- Agate Fossil Beds National Monument
- Fort Laramie National Historic Site
- Black Elk Wilderness Area
- Soldier Creek Wilderness Area
- Cloud Peak Wilderness Area
- Yellowstone National Park
- Grand Teton National Park
- Teton Wilderness Area
- Absaroka Beartooth Wilderness Area
- Bighorn Canyon National Recreation Area
- Popo Agie Wilderness Area
- Crow Indian Reservation (Class II, Crow Tribal Council)
- Theodore Roosevelt National Park

The following areas are near the edge of the modeling domain. Modeled impacts at receptors within these areas near the edge of the modeling domain might be associated with model inaccuracies and uncertainties due to edge effects of the modeling. Therefore, estimates of potential impacts to these areas near the edge of the modeling domain were made by placing representative receptors no nearer than 25 km from the edge of the modeling domain:

- Bob Marshall Wilderness Area
- Gates of the Mountains Wilderness Area
- Lee Metcalf Wilderness Area, Spanish Peaks Unit
- Lee Metcalf Wilderness Area, Taylor Hillgard Unit
- Red Rock Lakes Wilderness Area
- Jedediah Smith Wilderness Area
- Mount Naomi Wilderness Area
- Wellsville Mountain Wilderness Area
- U.L. Bend Wilderness Area
- Fort Peck Indian Reservation (Class I, Fort Peck Tribal Council)
- Scapegoat Wilderness Area
- Fort Belknap Indian Reservation.

These locations as well as other sensitive receptors, such as lakes are indicated in Figure 1-2. The receptors were spaced with sufficient density to assure that the maximum potential air quality impacts are evaluated. All sensitive receptors were identified and reviewed in the modeling protocol by the stakeholder group, prior to initiating the modeling.

Emissions Input Data

Source characterization and emissions data are key inputs to conducting a successful modeling analysis. The bulk of the emissions data were provided by the regulatory agencies (Wyoming Department of Environmental Quality, or WDEQ, and the Montana Department of Environmental Quality, or MDEQ). Emissions data for major sources in nearby states, which are also within the model grid, were obtained from the individual state regulatory agencies (Idaho, Utah, Nebraska, South Dakota, and North Dakota).

Emissions Source Groups

Similar to the Coal Review, the emission sources for the study were separated into various emission source groups, which were analyzed separately. The emission source groups that were analyzed focused on certain air pollutant emissions including SO_2, NOx, and PM_{10}. The emission source groups that were analyzed also focused on certain hazardous air pollutant (HAP) emissions including benzene, n-hexane, toluene, ethyl-benzene, xylene and formaldehyde. The study also included a group of major sources that were identified by the Environmental Defense Fund (and others) in response to the analyses in the Montana Statewide EIS. The following emission source groups were analyzed as part of this study:

- All sources combined;
- CBNG sources;
  - CBNG production, separately for each state
  - CBNG operation, separately for each state;
- Conventional oil and gas sources;
- Coal-related sources (from both states, including power plants and conversion facilities) ;
- Coal mines (in both states) ;
- Montana sources (all sources located in Montana not otherwise identified);
- Wyoming sources (all sources located in Wyoming not otherwise identified);
- Non-coal sources (roads, railroads, urban areas, miscellaneous sources, all sources in ID, UT, NE, SD, ND) ;
- Environmental Defense Fund (EDF) identified sources; and
- Power plants (includes coal- and gas-fired power plants in Wyoming and Montana).

Base Year Selection

At the start of the project the year 2004 was selected as a base year for determining current emissions and potential impacts. The 2004 data were readily available, and the year coincided with the emissions inventory being collected by the Western Regional Air Partnership (WRAP). Emission rates for 2004 were calculated in different manners for each emission source group. Emission rates for the projected development scenarios were estimated for the year with the expected maximum emissions from the development scenarios. For this effort, the 20^{th} year of projected development was used, as discussed below. The methodology used to calculate emission rates for each emission source group is as follows.

Alternative Development Year

The purpose of this effort is to characterize maximum emissions from selected alternate development scenarios over an extended period in the future, and to evaluate the comparative potential impacts from the emissions associated with each alternate development scenario when considering approval of any of those alternatives. This study will use projected emissions for each scenario as input into the dispersion model. The alternative development year (ADY) that was used for evaluation of alternatives was selected based on the total maximum emissions from the Montana CBM construction and operation combined for each of the alternatives over a 20 year span.

Data shown in Table 2-1 provide the total emissions from well construction and operations, and total emissions from the combined sources for each alternative. The table shows the maximum potential impacts are likely to occur in year 20 or 21 of this analysis (2026 or 2027) for all alternatives. Construction emissions peak in Year 4, but operational emissions are much larger and therefore dominate the emission pattern. Details of the total emissions are provided in the Air Quality Modeling Technical Support Document (ALL 2006). Based on the emissions data presented in Table 2-1, Year 20 was selected as the ADY for which potential impacts are modeled in this report. For the base year (2004) and the ADY (Year 20), a set of emission factors and emission rates for each of the identified source groups was developed, as described below.

Emissions by Source Group

This section summarizes the calculation of emissions for each source group identified above. Both the base year and ADY are included in this discussion.

Coal Bed Natural Gas Sources

As shown in Table 2-1, the coal bed natural gas (CBNG) production sources form the basis for conducting the evaluation. For this study, projected CBNG development was provided for the Montana area study by watershed area. Each of the watersheds was identified and a level of CBNG development was assigned to each watershed, including both well development/construction and well operation in year 20. Emissions from the well development and operation were calculated based on the number of

wells in each category, using emission factors that were developed for Table 2-1.
A total of 15 separate watersheds are included in this analysis, for each of the three alternative development scenarios that are under consideration. Table 2-2 lists each alternative, along with projected development and associated emission rates for each watershed. The total wells and emissions are also provided for each alternative.

Among the alternatives, there are different development rates in several of the watersheds. In the Rosebud watershed, the maximum operation wells occur in Alternative E, with less in Alternatives F and H respectively. The Lower Yellowstone Sunday and Upper Yellowstone Lake B combined had greater development in Alternative E than in any of the other alternatives.

Overall Alternative E had greater development in terms of operational wells, but the least in terms of wells under construction. In general the development from Alternative E through Alternative H showed an increase in the number of wells under construction. Other relevant development data is presented in Tables 2-1 and 2-2.

To conduct the modeling, the emissions from each watershed were assigned to 5 separate point sources within each watershed, using representative stack parameters for oil and gas development.

Table 2-1
Total Annual Emissions for Alternatives Under Consideration

Year	Alternative E			Alternative F			Alternative H		
	Sum Total Emissions Oper (Tons)	Sum Total Emissions Const (Tons)	Sum Total Emissions All (Tons)	Sum Total Emissions Oper (Tons)	Sum Total Emissions Const (Tons)	Sum Total Emissions All (Tons)	Sum Total Emissions Oper (Tons)	Sum Total Emissions Const (Tons)	Sum Total Emissions All (Tons)
1	536	1917	2454	357	1277	1634	357	1276	1633
2	1717	2303	4021	1250	1915	3166	1250	1914	3164
3	3543	4220	7762	2419	2261	4679	2419	2263	4681
4	6009	4596	10605	3740	2461	6201	3744	2473	6217
5	8476	4220	12696	5080	2260	7340	5069	2263	7332
6	10516	3070	13586	6255	1914	8169	6261	1999	8260
7	12126	2684	14810	7333	1916	9249	7356	1914	9271
8	13413	1917	15331	8412	1914	10326	8428	1914	10342
9	14486	1918	16404	9490	1914	11404	9499	1914	11413
10	15452	1532	16984	10568	1914	12482	10570	1914	12485
11	16202	1151	17353	11644	1915	13559	11642	1914	13556
12	16846	1151	17998	12713	1905	14618	12713	1914	14627
13	17490	1150	18641	13731	1734	15465	13784	1914	15699
14	18134	1150	19285	14702	1735	16437	14856	1914	16770
15	18778	1151	19929	15673	1735	17407	15927	1914	17842
16	19368	959	20327	16573	1482	18055	16998	1914	18913
17	19905	957	20862	17401	1479	18880	18040	1809	19850
18	20441	960	21400	18200	1377	19578	19018	1683	20701
19	20924	766	21690	18906	1143	20049	19930	1578	21508
20	21457	571	22028	19487	935	20422	20754	1367	22122
21	0	0	0	19691	1070	20761	21071	575	21646
22	0	0	0	19032	1043	20075	0	0	0
23	0	0	0	17198	1049	18247	0	0	0

Coal Production Related Sources

For coal production related sources, which included mines, mine roads, railroads, and coal conversion sources, the base year data (2004) was used to establish the baseline emissions. Coal production estimates were obtained from analyses of the Coal Review, and those estimates were used to change total coal-related mining sources Total coal development was based on the Coal Review. Emissions for the ADY were based on coal development projections and applied to both Montana and Wyoming.

Figure 2-1 provides a graphical representation of the expected changes in coal production over the next two decades. The Coal Review provided an updated coal production scenario for 2004 and 2020. The coal average values of the coal production increase from 380 million tons/year in 2004 to 580 million tons/year in 2020. This ratio (1.53) was applied to coal development in Wyoming and Montana from the base year to the ADY.

Conventional Oil & Gas Sources

For conventional oil and gas sources, the baseline year data (2004) was used to establish the baseline emissions. The number of operating wells and the number of conventional oil and gas production levels for the base year and for the ADY were obtained from available data (MBOGC 2006). Emissions estimates include both operating wells and well construction as indicated in the Table 2-3. The emission factors shown in Table 2-3 were developed from a combination of data sources, and the factors represent the emissions in ton/year that would be emitted by either well construction or well operation. For the ADY, the total number of wells, including operation and construction are also indicated. The table shows the dramatic increase in the number of operating wells, but a slight reduction in the number of wells being constructed. Overall, emissions of NO_X from this source group would decline about 109 ton/year from the base year to the ADY. Emissions of PM_{10} would increase slightly and emissions of SO_2 would decrease slightly from the base year.

To conduct the modeling effort, the locations of the emissions sources were assigned to five separate point sources within each of the indicated counties. No specific site location data were available, and therefore this approach represented a suitable approximation for the modeling effort.

Power Plant Sources

For coal-fired power plants, the projected ADY emission rates for power plants that were not operational in 2004 but are expected to be operational in the ADY were derived from the actual power plant permit applications or the power plant permits from the specified facility. This should allow for a conservative estimate since the permitted emission rates will be the allowable emission rates, and actual emission rates from these new power plants could be less than the allowable emissions but cannot be higher. Where stack parameters were available, those data were used for input into the modeling. Emissions of NO_x, SO_2, and PM_{10} from the power plant permits were determined from expected levels of best available control technology (BACT) that would be applied to those sources. If a coal-fired plant permit application or permit was not obtainable, emissions from a coal-fired plant of the equivalent size was used to estimate emissions. The coal-fired power plants for which emissions were estimated for the ADY include the following:

- WYGEN2
- Two Elk Unit 1
- Basin Electric / Gillette
- Hardin Generating Station
- Roundup Power Plant
- Great Falls Power Plant

These coal-fired power plants are included as individual sources, in addition to the existing coal-fired facilities which were also analyzed. For existing coal-fired power plant sources that were operational in 2004, to account for a possible increase in capacity between the baseline year to ADY, a scaling factor was used to increase the capacity of these sources from 88% capacity factor in 2004 to a 90% capacity factor in the ADY.

Table 2-2
Summary of Total Emissions by Watershed
Year 20 of Development

Alternative E

Watersheds	Operational Wells	Construction Wells	NOx Emissions (Tons)	PM10 Emissions (Tons)	SO2 Emissions (Tons)	VOC Emissions (Tons)
Upper Tongue	5024	0	1930	424	37	2141
Lower Tongue	4503	0	1730	380	33	1919
Middle Powder	2741	0	1053	231	20	1168
Little Powder	261	0	100	22	2	111
Rosebud	4698	0	1805	396	35	2003
Mizpah	163	0	63	14	1	70
Clarks Fork Yellowstone	587	0	226	50	4	250
Lower Yellowstone Sunday	2219	0	852	187	16	946
Upper Yellowstone Lake B	1045	93	490	121	14	453
Little Bighorn	881	100	433	110	13	384
Lower Bighorn	1043	121	516	131	15	455
Middle Musselshell	131	9	59	14	2	57
Upper Yellowstone Pompeys	262	35	133	34	4	114
Stillwater	131	23	72	19	2	57
Upper Musselshell	98	13	50	13	2	43
TOTAL	23787	394	9511	2145	201	10170

Alternative F

Watersheds	Operational Wells	Construction Wells	NOx Emissions (Tons)	PM10 Emissions (Tons)	SO2 Emissions (Tons)	VOC Emissions (Tons)
Upper Tongue	5024	0	1930	424	37	2141
Lower Tongue	4440	139	1838	424	42	1904
Middle Powder	2638	122	1129	266	27	1134
Little Powder	261	0	100	22	2	111
Rosebud	4515	198	1923	451	46	1941
Mizpah	164	0	63	14	1	70
Clarks Fork Yellowstone	653	0	251	55	5	278
Lower Yellowstone Sunday	1565	49	648	149	15	671
Upper Yellowstone Lake B	687	57	318	78	9	298
Little Bighorn	582	20	242	56	6	250
Lower Bighorn	663	35	288	68	7	286
Middle Musselshell	89	3	37	9	1	38
Upper Yellowstone Pompeys	173	12	77	19	2	75
Stillwater	85	6	38	9	1	37
Upper Musselshell	63	4	28	7	1	27
TOTAL	21602	645	8911	2050	201	9260

Table 2-2 (Continued)

Alternative H						
Watersheds	**Operational Wells**	**Construction Wells**	**NOx Emissions (Tons)**	**PM10 Emissions (Tons)**	**SO2 Emissions (Tons)**	**VOC Emissions (Tons)**
Upper Tongue	5024	0	1930	424	37	2142
Lower Tongue	4502	0	1730	380	33	1919
Middle Powder	2741	0	1053	231	20	1168
Little Powder	261	0	100	22	2	111
Rosebud	4263	322	1944	474	52	1843
Mizpah	164	0	63	14	1	70
Clarks Fork Yellowstone	587	0	226	50	4	250
Lower Yellowstone Sunday	2219	0	852	187	16	946
Upper Yellowstone Lake B	841	303	611	179	26	383
Little Bighorn	882	0	339	74	7	376
Lower Bighorn	1044	0	401	88	8	445
Middle Musselshell	86	100	128	43	7	45
Upper Yellowstone Pompeys	163	218	270	91	15	87
Stillwater	131	0	50	11	1	56
Upper Musselshell	99	0	38	8	1	42
TOTAL	23007	943	9734	2275	231	9882

Figure 2-1
Projected Coal Development for PRB Wyoming

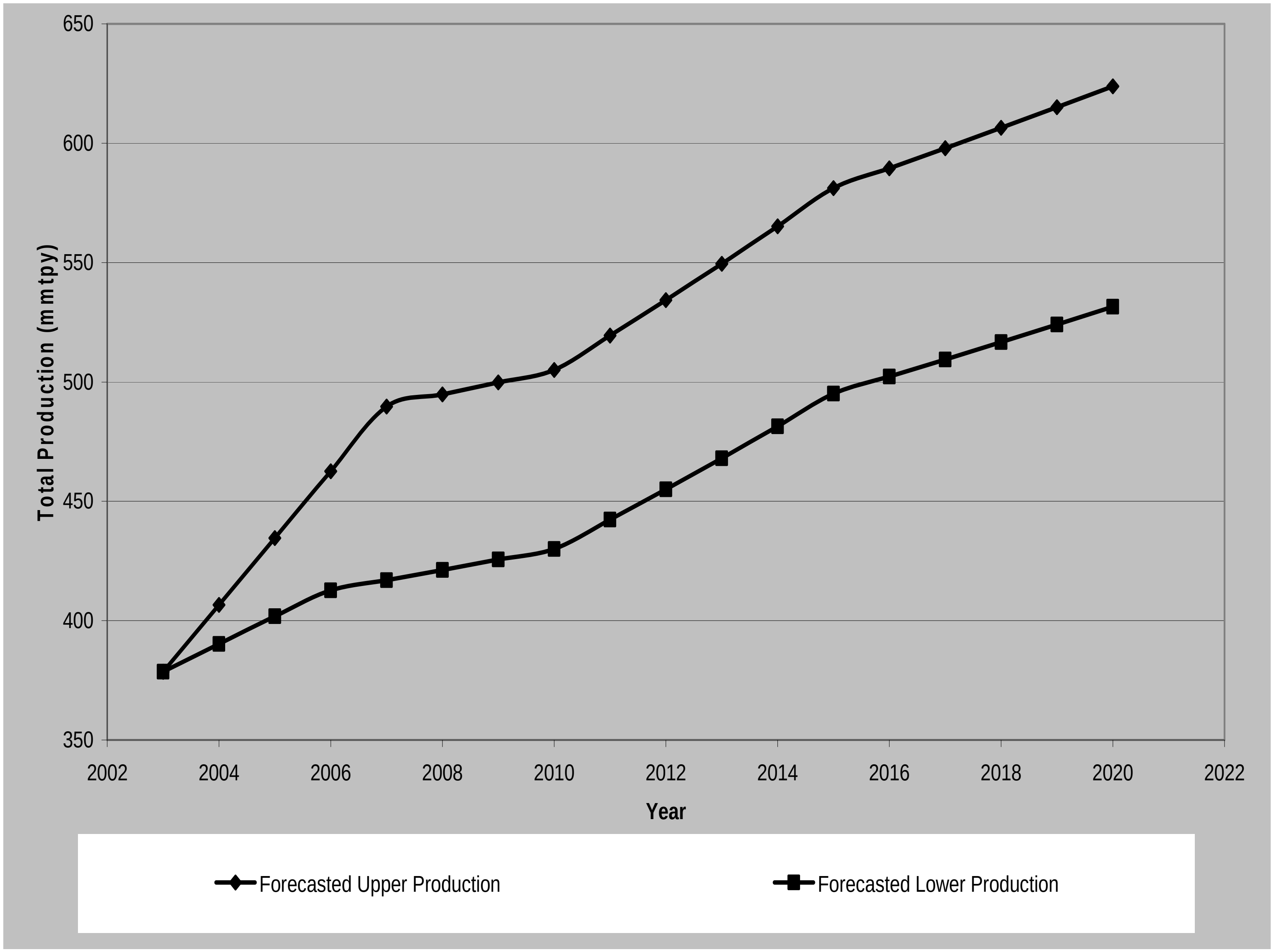


Table 2-3
Base Year 2004 and Alternative Production Year (Year 20) Emissions
Montana Conventional Oil and Gas Operation and Construction

Base Year	County	Wells Oper	Wells Const	NOx Emissions Oper (Tons)	NOx Emissions Const (Tons)	PM10 Emissions Oper (Tons)	PM10 Emissions Const (Tons)	SO2 Emissions Oper (Tons)	SO2 Emissions Const (Tons)
2004	Big Horn	46	2	1.22	18.99	0.99	1.67	0.09	2.34
2004	Carbon	99	7	2.62	66.47	2.14	5.85	0.19	8.20
2004	Custer	4	0	0.11	0.00	0.09	0.00	0.01	0.00
2004	Golden Valley	2	0	0.05	0.00	0.04	0.00	0.00	0.00
2004	Musselshell	74	20	1.96	189.90	1.60	16.70	0.14	23.42
2004	Powder River	57	5	1.51	47.48	1.23	4.18	0.11	5.86
2004	Rosebud	96	10	2.54	94.95	2.07	8.35	0.19	11.71
2004	Stillwater	16	9	0.42	85.46	0.35	7.52	0.03	10.54
2004	Sweetgrass	5	3	0.13	28.49	0.11	2.51	0.01	3.51
2004	Yellowstone	28	5	0.74	47.48	0.60	4.18	0.05	5.86
2004	Carter	0	12	0.00	113.94	0.00	10.02	0.00	14.05
2004	Wheatland	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2004	Treasure	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	427	73	11.30	693.15	9.21	60.96	0.82	85.49
	Emission Factors			0.0264573	9.4951754	0.0215694	0.8350877	0.0019282	1.1710526
ADY[1]									
20	Big Horn	230	6	6.08	60.64	4.96	5.33	0.44	7.48
20	Carbon	230	6	6.08	60.64	4.96	5.33	0.44	7.48
20	Carter	115	3	3.04	30.32	2.48	2.67	0.22	3.74
20	Custer	69	2	1.82	18.19	1.49	1.60	0.13	2.24
20	Golden Valley	34	1	0.91	9.10	0.74	0.80	0.07	1.12
20	Musselshell	402	11	10.65	106.12	8.68	9.33	0.78	13.09
20	Powder River	345	10	9.12	90.96	7.44	8.00	0.67	11.22
20	Rosebud	345	10	9.12	90.96	7.44	8.00	0.67	11.22
20	Stillwater	115	3	3.04	30.32	2.48	2.67	0.22	3.74
20	Sweetgrass	23	1	0.61	6.06	0.50	0.53	0.04	0.75
20	Treasure	11	0	0.30	3.03	0.25	0.27	0.02	0.37
20	Wheatland	17	0	0.46	4.55	0.37	0.40	0.03	0.56
20	Yellowstone	115	3	3.04	30.32	2.48	2.67	0.22	3.74
	TOTAL	2052	57	54.29	541.23	44.26	47.60	3.96	66.75
	NET CHANGE	1625	-16	42.99	-151.92	35.05	-13.36	3.13	-18.74

1 – ADY – Alternative Development Year

Other Major Sources

This analysis included emissions from other major sources in both Montana and Wyoming as wells as nearby states, which are located within the modeling domain as presented above. Each regulatory agency in Idaho, Utah, Nebraska, South Dakota, and North Dakota were contacted to obtain emissions data for sources with major operating permits (as required under Title V of the Clean Air Act Amendments of 1990). Locations and stack parameters were taken from available source data. Emissions data for 2004 were used for most cases, but for some instances, the potential emissions were used. In addition for some sources with multiple emission sources, the total source emissions were characterized as a single point for the whole facility. These sources were all over 400 km from the near-field grids in Montana and Wyoming, and such characterizations would not affect the potential impacts at these distant receptors.

The other sources included all the sources in the domain that were identified by the Environmental Defense Fund in its comments on the Montana Statewide Oil and Gas EIS.

As a convenience in interpreting the modeling, source potential impacts were grouped in several components, including all Montana sources, all Wyoming sources, railroad data, etc. In addition the Tongue River Railroad projected emissions were included. Emissions were developed for points along the segments of the railroad, with emission rates per mile developed from the Tongue River Railroad EIS.

For these other sources there was no adjustment to the emission rates from the baseline year to the alternative development year (ADY). The modeled location for the projections did not change from the baseline modeling for any sources except for the CBM development, conventional oil and gas development and new power plants.

Ambient Air Quality During the Base Year

Ambient air quality conditions in Montana for 2004 were generally very good. Reported data as provided on the USEPA AIRS data base (www.epa.gov/air/data/reports.html) for 2004 were downloaded and are summarized for each pollutant below.

PM_{10}

A total of 40 separate PM_{10} monitors were installed and operated in Montana in 2004. The applicable standards are 150 µg/m^3 for the second-highest 24-hour level and 50 µg/m^3 for the annual average.

In Big Horn County 8 separate monitors operated, with the highest second-highest 24-hour PM_{10} level of 82 µg/m^3 at Decker Coal #1 and the highest annual level of 25 µg/m^3 at Decker Coal #7. For background concentrations, the 4th highest 24-hour level was 28 µg/m^3 at Decker Coal #5 and the lowest annual average was 14 µg/m^3 at two sites.

In Rosebud County, one station operated at Lame Deer (intersection of Highways 212 and 39). The second highest 24-hour PM_{10} level was 48 µg/m^3, with an annual average of 22 µg/m^3.

In Yellowstone County (Billings) there were two operating PM_{10} monitoring sites. At these two sites, second highest 24-hour monitored level was 38 µg/m^3 and the annual averages were 16 and 21 µg/m^3 respectively.

$PM_{2.5}$

A total of 21 separate $PM_{2.5}$ monitoring sites were installed and operating in 2004, with two at Lame Deer and one in Billings (in the study area). The 24-hour standard is met by evaluating the 98th percentile of the highest concentrations for all the collected 24-hour samples. At Lame Deer Site 1, there were 114 observations and the 98th percentile value would be the 111th (fourth highest) reading. The fourth-highest 24-hour $PM_{2.5}$ level at that site was 16 µg/m^3 compared to a standard of 65 µg/m^3 (proposed to be 35 µg/m^3). At the second Lame Deer Site, there were 25 readings taken, and the second highest reading (98th percentile) was 11 µg/m^3. In Billings there were 116 observations, and the fourth-highest 24-hour reading was 19 µg/m^3. The annual average $PM_{2.5}$ levels were 5.8 and 5.9 µg/m^3 at the two Lame Deer sites, and 8.2 µg/m^3 in Billings, versus an annual arithmetic average standard of 15 µg/m^3.

NO_2

NO_2 was measured at three sites in Montana in 2004, with all three sites in Rosebud County. The Montana 1-hour standards (not to be exceeded more than once per year) is 0.5 ppm, and the actual readings were 0.027, 0.027, and 0.029 ppm at the three sites. The Montana and federal ambient standard is 0.053 ppm and the measurements for annual average at all three

Rosebud County sites was 0.003 ppm. Ambient levels are well below the applicable standards. The annual average reading is about 6 percent of the annual standard.

SO_2

A total of 13 SO_2 monitoring stations operated in Montana in 2004. Three were in Rosebud County and nine were in Yellowstone County. The Yellowstone observations are not discussed here, because they reflect impacts of nearby major SO_2 sources (although all readings are below applicable ambient standards). In Rosebud County, the highest second-highest 1-hour SO_2 readings are 0.007, 0.013, and 0.016 ppm respectively, against a Montana-only 1-hour standard of 0.5 ppm. The highest second-highest 3-hour values are 0.003, 0.006 and 0.007 ppm respectively compared to a standard of 0.5 ppm. The highest second-highest 24-hour averages are 0.002, 0.003, and 0.004 ppm respectively, compared to an ambient standard of 0.14 ppm. For the annual average, all Rosebud measurements are 0.001 ppm, compared to an annual average standard of 0.03 ppm. Results show that for the Rosebud County area, the actual levels are about 3 percent of the standards or less. Current SO_2 conditions in the study area are very clean.

3.0 MODELED RESULTS FOR BASE YEAR AND ALTERNATIVE DEVELOPMENT SCENARIOS

Using the model and source groups discussed in Chapter 2, the modeling effort evaluated the three meteorological years (2001, 2002, and 2003) by modeling potential impacts of each of the source groups for the base year (2004). Potential impacts from the base year study showed that maximum potential impacts occurred with the 2002 meteorological data. Further analyses for the three development alternatives then used the 2002 meteorological data only for assessing potential impacts.

A summary of the key findings for each of the air quality components is provided in Table 3-1. The detailed analysis for each of the components is provided in this Chapter. In general the results of this modeling study are consistent with the findings of the Coal Review and the Oil and Gas EIS.

Impacts on Ambient Air Quality

Using the receptor grids identified in Chapter 2 along with the source groupings, the model was used to predict the potential impacts at each receptor point in the receptor grid. For this analysis, the results are provided for the maximum receptor in each group, which may not be the same receptor in each of the modeling scenarios. Potential impacts may occur at different receptors for each of the modeling scenarios, but those changes in maximum receptor are not identified in these results.

The analysis does not separate the sources into PSD increment-consuming and non PSD increment consuming sources. Therefore the results cannot be used to develop a pattern of increment consumption for a particular site. The PSD comparisons are for disclosure of potential impacts and identification of potential areas of concern only and do not constitute a regulatory PSD increment consumption analysis, which may be required for specific projects by air permitting authorities.

The model results are also limited by certain assumptions regarding sources and receptors. The source characterizations are based on available data, and do not represent specific stacks or sources of fugitive emissions. The modeling sources are generally provided by area or volume, to represent multiple sources within each specified unit. The specific fence lines or exclusion areas around a modeled source are also not specifically identified in this study. The results cannot, therefore, be interpreted as evaluating maximum potential impacts that might occur at the boundary or fence line of a specific source. The receptors in the near-field grid in both states were removed from modeling if their location was within 1 km of any source.

Table 3-1
Summary of Modeled Air Quality Impacts

Air Quality Component		**Alternate Development Year Impacts (includes modeled base year emissions)**
Concentrations	Criteria	Below NAAQS and state AAQS, except near-field PM10
	HAPs	Less than RELs and RfCs, except for benzene
Visibility	Far-field	Class I areas have greater than 200 days with greater than 1 dv, maximum impacts not affected by scenarios E, F and H.
Atmospheric Deposition Sulfur	LOC	Below 5 kg/hectare-year
Atmospheric Deposition Nitrogen	LOC	Below 3 kg/hectare-year
Atmospheric Deposition Lake Chemistry	ANC	Development raises impacts above LAC for two lakes.

Impacts at Near-field Receptors in Montana

Results are provided for the near-field receptor grid for Montana in Figure 3-1. The figure shows the potential impacts at the maximum receptor for each modeling scenario: the base year, and the maximum potential impact for each of the alternative scenarios. The potential impacts on that receptor group are depicted for all sources and the potential impacts that result from the individual source groups are identified in Figure 3-1. Data are provided for each ambient standard and PSD increment for NOx, SO_2 and PM_{10}. Specific data are provided in The Air Quality Model Technical Support Document (ALL 2006), for air quality impacts at all receptor groups. In this presentation, the impact from one source group would not likely be at the same receptor as that of the other source group; therefore the results for each group are not arithmetically additive to obtain an overall impact.

The results show a predicted impact from the Tongue River Railroad emissions for the 1-hour Montana NO_2 standard, about 50 percent of that standard. This result may be due partially to the relationship between the source characterization and the receptor grid. The Tongue River Railroad is presumed to operate in the ADY.

The potential impacts from all sources on the near-field receptor grid do increase over the base year, but overall the NOx emissions from the alternatives show a higher impact for Alternative E than for the other alternatives for the one-hour standard. When evaluating the potential impacts of the alternatives alone, the emissions do not lead to substantial differences among them for the annual or 1-hour NO_2 potential impacts. This discrepancy can be explained by the areal distribution of potential impacts, which for Alternative E would include areas already impacted by existing sources.

For the annual NO_2 potential impacts in Montana the Tongue River Railroad and the CBNG operation play the major role, but are clearly well below the NAAQS and even the comparative PSD annual NO_2 increment. These data are provided for comparison only and do not represent a regulatory PSD Increment Consumption Analysis.

Figure 3-1 also provides results for PM_{10}, $PM_{2.5}$ and SO_2. The results show a relatively high impact from the Tongue River Railroad and from MT CBM operations but all potential impacts are well below any standards. The NO_2 potential impacts would be the major concern regarding the development of the alternatives, on the Montana near-field grid.

Impacts at Near-field Receptors in Wyoming

Results for the Wyoming near-field receptors are provided in Figure 3-2. In Wyoming the coal operations led to modeled impacts on PM_{10} levels that are above the NAAQS for the 24-hour period (150 $\mu g/m^3$), for the base year as well as for ADY. The modeled impacts are nearly double the standard for the base year scenario. The remaining data show that potential impacts are well below the ambient air quality standards. The Wyoming coal operations are largely responsible for the predicted impacts for all scenarios, although non-coal sources do contribute a notable portion of the impact.

The potential impacts of NO_2 are generally about 40 percent of the annual standard, with no real difference for the alternatives analyzed in the ADY. The coal sources are the largest contributor to the maximum NO_2 potential impacts, however, CBNG and non-coal sources also have contributions. Potential impacts of NO_2 are above the Class II PSD increment at the maximum receptors in Wyoming.

The potential impacts of SO_2 emissions are well below the ambient standards and PSD increments for all scenarios. The potential impacts from power plants do, however, show substantial increases in impacts at the maximum power plant receptor. Those potential impacts are, however, still well below the ambient standards and PSD increments. These data are provided for comparison only and do not represent a regulatory PSD Increment Consumption Analysis.

Air Quality Impacts at Class I Area Receptors

As discussed in Chapter 2, the potential impacts at Class I areas were also modeled, with separate assessments for each Class I receptor group. The Class I area with the highest potential impacts was the Northern Cheyenne Indian Reservation in Montana. Those results are provided in Figure 3-3. The potential impacts are all well below the ambient standards, and also are less than the respective PSD increments.

Data for two other Class I areas are also presented (the Theodore Roosevelt National Park in Figure 3-4 and the Wind Cave National Park in Figure 3-5) as these two Class I areas represent the closest Class I areas east of the development area, and should provide a representative depiction of potential impacts at the Class I areas in western North Dakota and western South Dakota. For all areas, all potential impacts are well below the ambient standards, and are also well below the PSD increments for all pollutants modeled. It is also important to note that the comparative impacts for the ADY show little differentiation in potential impacts among the alternatives. The base year 24-hour PM_{10} impact at Theodore Roosevelt was 5.2 $\mu g/m^3$, and the impact at Wind Cave was 6.4 $\mu g/m^3$, against a Class I PSD increment of 8 $\mu g/m^3$. These data are provided for comparison only and do not represent a regulatory PSD Increment Consumption Analysis.

Air Quality Impacts at Sensitive Class II Area Receptors

Potential impacts at the Crow Indian Reservation are higher than potential impacts at the other identified Class II area receptor groups for all scenarios. Figure 3-6 provides a depiction of results similar to those provided above. For this receptor group, modeled impacts are all well below the ambient standards and they are below the established Class II PSD increments, except for potential impacts on the 24-hour PM_{10} levels. Again, there is little difference in impact among the proposed alternative development scenarios.

The other nearby Class II receptor group is the Cloud Peak Wilderness Area in north Central Wyoming, just west of the PRB. Results for this receptor group are shown in Figure 3-7. All potential impacts are well below applicable standards for all scenarios, and potential impacts are less than the Class II PSD increments for all scenarios. The 24-hour PM_{10} potential impacts reach 5 $\mu g/m^3$ for the base year, but this is less than the comparable PSD increment of 30 $\mu g/m^3$. The greatest percentage increases arise from coal and power plant operations, but these increases still do not exceed ambient standards or PSD increments. Data is also presented for the Bighorn Canyon National Recreation Area (Figure 3-8) and the Wind River Indian Reservation (Figure (3-9). For both of these Class II areas, potential impacts are well below applicable standards for all scenarios, and potential impacts are less than the Class II PSD increments for all scenarios. These data are provided for comparison only and do not represent a regulatory PSD Increment Consumption Analysis.

Impacts on Visibility

Under the Clean Air Act, visibility has been established as a critical resource for identified Class I areas. The study provides an analysis of potential impacts at the Class I areas and at sensitive Class II areas in the region. Under the guidance of the Federal Land Managers Air Quality Workgroup (FLAG), the potential impacts were provided using the CALPUFF modeling system and the Method 6 approach, which uses monthly relative humidity values for representative receptor groups.

Visibility potential impacts are based on the highest 24-hour calculated extinction at the indicated source receptors. Potential impacts are based on a presumed pristine background and calculated as a percent increase in extinction (reduced visibility) from that background value. The study tabulated the reduced visibility at the maximum impact receptor in each of the Class I and Class II groups in terms of the maximum reduction on any one 24-hour period, the number of days annually that showed visibility reductions of 5 percent and 10 percent. These reductions are indicated as reductions in deciviews (0.5 and 1 deciview respectively). A significance threshold of 10 percent has been used in this analysis to evaluate the impact from the source groups.

Table 3-2 provides a listing of potential visibility impacts for the base year for each of the analyzed areas with source contributions provided for all sources combined, all Montana sources, the listed CBM operation and construction potential impacts, and potential impacts from Montana oil and gas operations. More detailed data for contributions from other source groups are provided in Attachment A. For the Class I areas, the maximum potential impacts were determined at the North Cheyenne Indian Reservation, the Wind Cave National Park, and the Badlands National Park in South Dakota. Both of the South Dakota areas are downwind (prevailing wind direction from the west) from the PRB and the sources analyzed in this study. In the base year, model results showed more than 200 days of potential impacts with a change of 10 percent or more in extinction at each of these locations. All Class I areas showed some impact with no fewer than 21 days of impact greater than 1 deciview.

For the Class II areas, the maximum potential impacts were at the Crow Indian Reservation in Montana. Nine other Class II areas showed potential impacts of 1 deciview or more for 200 days or more per year, and these areas also were east (downwind in the prevailing wind direction) of the PRB. The results showed that there was at least some impact on each of the receptor groups from each of the source groups. Coal operations dominated the potential impacts at the Class II areas, and the potential impacts on the Class I areas were noted for all the source groups.

The results also show that the Montana Oil and Gas operations and construction do not play a significant role in potential visibility impacts at either Class I or sensitive Class II areas. For the base year there are only a few days with visibility potential impacts above 5 deciviews at the Crow Indian Reservation and at the Northern Cheyenne Indian Reservation.

Table 3-3 provides a depiction of the potential impacts of all sources for each of the proposed alternatives. Data are provided for all receptor areas for all sources for each of the alternatives. For most areas, there is no change in impact among the alternatives. For example, at the areas with high potential impacts (Badlands and Theodore Roosevelt National Parks) there is no overall difference among the alternatives. At the Northern Cheyenne Indian Reservation, there is a change of 3 and 8 days respectively (for all sources combined) when comparing the potential impacts of Alternative E to Alternatives F and Alternative H respectively. At the Crow Indian Reservation, a maximum of 365 days per year are impacted for all scenarios. When examining the visibility potential impacts of all Montana sources for each alternative, there is only a change of one or two days of impact above 1.0 deciviews when comparing the potential impacts of these alternatives. The Northern Cheyenne Indian Reservation would see a slight increase in the number of days with potential impacts above 1.0 deciviews (from Alternative E through Alternative H), and the Crow Indian Reservation would continue to see 365 days/year impacted by a 1.0 deciview level. Other visibility impact data are provided in detail in Appendix A.

Impacts on Acid Deposition

Emissions of NO_X and SO_2 can lead to increasing potential impacts of acidic deposition in the region. This analysis evaluates the potential increase in acid deposition as a result of the increased production activity noted above. The base year analysis showed that potential impacts for all listed Class I and Class II areas were below the established thresholds for sulfur and nitrogen deposition, which are 5 kilograms per hectare per year (kg/ha-yr) for sulfur compounds and 3 kg/ha-yr for nitrogen compounds. Table 3-3 provides a summary of base year deposition levels at the sensitive receptor areas. The highest modeled impacts are at the Northern Cheyenne Indian Reservation with nitrogen deposition reaching 0.292 kg/ha-yr, or about 10 percent of the threshold. Maximum sulfur deposition is approximately 0.39 kg/ha-yr at the Northern Cheyenne Indian Reservation, or about 8 percent of the threshold. The table also shows that the contributions from base year CBM and Montana oil and gas operations and construction are minimal at any of the receptor areas.

Additional data are provided for other source groups in Appendix A. Relatively higher deposition rates were noted to the east of the PRB, as a result of the prevailing wind direction in the region. For all receptors and for both sulfur and nitrogen compounds, the combined deposition rates do not exceed the thresholds given in these tables.

For the ADY, potential impacts on acid deposition were calculated for each alternative. Table 3-4 provides a summary listing of potential impacts for each alternative, for all source groups combined. The results show that potential impacts are slightly higher than in the base year, but all potential impacts remain well below the deposition threshold. Potential impacts continue to be highest at the Northern Cheyenne Indian Reservation, with little difference among the alternatives. Total nitrogen potential impacts approach 2 kg/hectare-year, or about two-thirds of the threshold value. Sulfur deposition potential impacts also show little difference among the scenarios, and they approach approximately 10 percent of the threshold value.

Impacts on Sensitive Lake Acid Neutralizing Capacity

The analysis of potential impacts of deposition of acidic substances was carried out in accordance with the screening methodology as provided by the US Forest Service (USFS 2000). Data for lake neutralizing capacity were obtained from the USFS web site, which provides data for the 10 percent ANC values for the individual lakes that were evaluated. The threshold is intended to account for sensitive conditions that may occur with an episodic or seasonal basis. Input data to the analysis include the deposition rates that were modeled for the base year, and the development scenarios analyzed herein.

The input data are provided in Table 3-5 for the analyzed lakes. Results are provided for the base year analysis as well as the predicted development scenarios. The threshold for significance is based on a 10 percent change in ANC for lakes with an ANC of 25 micro equivalents per liter (ueq/L) and a 1 ueq/L threshold change for lakes with an ANC value of less than 25 ueq/L.

Data on the modeled potential impacts for the lakes analyzed is provided in Table 3-6. All lakes except the Upper Frozen Lake in the Bridger WA have 10 percent ANC values of 25 ueq/L or more, and therefore Upper Frozen Lake is discussed separately below. For the other lakes the modeled percent ANC change is 10 percent or less at all lakes except Florence Lake. For that lake, the analyzed base year impact is 11.7 percent and the predicted impact for the ADY is 12.9 percent for all alternative development scenarios. There is no difference among the scenarios for potential impacts on these pristine lakes.

At Upper Frozen Lake, the base year impact was 2.4 ueq/L, which is more than the threshold value of 1 ueq/L threshold that is established for such lakes. The modeled results for each of the development scenarios show an impact of 2.6 ueq/L for Upper Frozen Lake, a change of only 0.2 ueq/L for that lake. The results show a minimal impact, and no difference in impact, among the alternatives considered for this evaluation.

Analysis of Hazardous Air Pollutant Impacts

The modeling study also addressed HAP potential impacts from sources in the study area. Since the potential impacts were greatest in the near-field receptor grids of both states, only those areas were analyzed for HAP potential impacts. The model was used to develop both 1-hour and annual potential impacts for these emissions. Results of the 1-hour modeled impacts for these modeling efforts were compared to the RELs (USEPA 2005). Table 3-6 provides an analysis of the short term potential impacts for the six analyzed compounds (benzene, ethyl benzene, formaldehyde, n-hexane, toluene, and xylene) compared to the RELs. Results show that all potential impacts are below the RELs except for formaldehyde in the Wyoming near-field receptor grid. Potential impacts are about 70 percent greater than the established REL for formaldehyde.

The potential impacts for chronic and carcinogenic risks are provided in Table 3-7 for the Montana and Wyoming near-field receptor grids. All potential impacts are well below the non-carcinogenic RfCs, with the maximum comparative impact for formaldehyde at the Wyoming near-field receptors, where those potential impacts are about 66 percent of the established RfC. The potential impacts for carcinogenic risk are also provided in Table 3-8. All potential impacts are well below the 1 in 1 million risk, except for benzene potential impacts in Wyoming, where the potential impacts are about 1.0 to 1.3 X 10^{-5} for the various scenarios. This impact is evident in the base year as well as each of the development scenarios.

Table 3-2
Visibility - Method 6 and Monthly f(RH) values - Base Year

Receptor Set	ALL SOURCES				ALL MT				MT CBM Construction				MT CBM Operation				MT OIL & GAS			
	Number of Days > N% Change in B_{ext}		Maximum % Change in B_{ext}	8th Highest % Change in B_{ext}	Number of Days > N% Change in B_{ext}		Maximum % Change in B_{ext}	8th Highest % Change in B_{ext}	Number of Days > N% Change in B_{ext}		Maximum % Change in B_{ext}	8th Highest % Change in B_{ext}	Number of Days > N% Change in B_{ext}		Maximum % Change in B_{ext}	8th Highest % Change in B_{ext}	Number of Days > N% Change in B_{ext}		Maximum % Change in B_{ext}	8th Highest % Change in B_{ext}
	5%	10%			5%	10%			5%	10%			5%	10%			5%	10%		
CLASS I AREAS																				
Badlands NP Class I	272	206	219	118	53	20	25	14	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.7	0.5
Bob Marshall W Class I	28	21	48	30	20	10	34	17	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.2	0.1
Bridger W Class I	230	152	437	156	38	19	40	18	0	0	0.2	0.0	0	0	0.2	0.1	0	0	0.9	0.2
Fitzpatrick W Class I	157	105	291	129	35	17	58	23	0	0	0.1	0.0	0	0	0.2	0.1	0	0	0.8	0.2
Fort Peck IR Class I	120	79	168	77	55	25	26	17	0	0	0.1	0.0	0	0	0.2	0.1	0	0	2.9	1.0
Gates of the Mountain W Class I	85	52	113	52	66	39	60	34	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.4	0.2
Grand Teton NP Class I	163	90	180	71	45	19	31	13	0	0	0.1	0.0	0	0	0.1	0.0	0	0	0.5	0.1
North Absaorka W Class I	149	85	229	110	90	41	66	37	0	0	0.2	0.0	0	0	0.3	0.1	0	0	1.1	0.5
North Cheyenne IR Class I	299	234	313	122	192	97	79	33	1	0	6.8	2.2	2	0	9.5	3.1	0	0	2.5	1.3
Red Rock Lakes Class I	96	48	87	49	49	20	41	16	0	0	0.0	0.0	0	0	0.1	0.0	0	0	0.4	0.1
Scapegoat W Class I	47	29	78	48	36	20	52	37	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.3	0.1
Teton W Class I	149	87	247	108	53	21	64	23	0	0	0.1	0.0	0	0	0.2	0.0	0	0	0.7	0.2
Theodore Roosevelt NP Class I	213	153	356	131	74	33	57	26	0	0	0.2	0.1	0	0	0.3	0.1	0	0	4.6	1.3
UL Bend W Class I	125	62	140	48	79	27	43	21	0	0	0.1	0.0	0	0	0.1	0.0	0	0	0.5	0.4
Washakie W Class I	169	110	335	144	75	38	85	43	0	0	0.2	0.0	0	0	0.3	0.1	0	0	1.1	0.4
Wind Cave NP Class I	320	247	265	147	69	22	24	16	0	0	0.2	0.1	0	0	0.2	0.1	0	0	2.0	0.8
Yellowstone NP Class I	188	102	207	91	102	45	64	30	0	0	0.2	0.0	0	0	0.2	0.0	0	0	1.1	0.2
SENSITIVE CLASS II AREAS																				
Absaorka Beartooth W Class II	201	131	266	109	170	100	135	45	0	0	0.4	0.1	0	0	0.6	0.1	0	0	2.1	0.5
Agate Fossil Beds NM Class II	295	225	401	130	54	14	21	14	0	0	0.1	0.1	0	0	0.2	0.1	0	0	1.0	0.3
Big Horn Canyon NRA Class II	356	295	376	154	200	122	143	63	0	0	1.2	0.6	0	0	1.9	0.9	10	2	24.6	5.8
Black Elk W Class II	306	214	252	144	67	23	22	15	0	0	0.1	0.1	0	0	0.2	0.1	0	0	2.3	0.6
Cloud Peak Class II	201	136	232	162	92	44	34	24	0	0	3.1	0.3	0	0	4.5	0.4	0	0	1.8	0.7
Crow IR Class II	365	360	428	266	365	350	401	165	1	0	5.2	2.6	5	0	7.2	3.4	14	2	18.1	6.7
Devils Tower NM Class II	324	260	268	130	82	29	29	17	0	0	0.2	0.1	0	0	0.3	0.2	0	0	2.2	0.9
Fort Belknap IR Class II	100	52	131	45	56	21	44	26	0	0	0.1	0.0	0	0	0.1	0.0	0	0	0.5	0.3
Fort Laramie NHS Class II	288	244	514	145	48	10	21	13	0	0	0.1	0.0	0	0	0.1	0.1	0	0	1.0	0.4
Jedediah Smith W Class II	167	94	172	59	45	22	31	14	0	0	0.0	0.0	0	0	0.1	0.0	0	0	0	0
Jewel Cave NM Class II	309	238	271	140	65	24	22	14	0	0	0.2	0.1	0	0	0.4	0.1	0	0	2	1
Lee Metcalf W Class II	165	107	138	55	140	87	89	40	0	0	0.1	0.0	0	0	0.1	0.0	0	0	1	0
Mt Naomi W Class II	78	51	195	70	4	1	12	3	0	0	0.0	0.0	0	0	0.1	0.0	0	0	0	0
Mt Rushmore Class II	297	202	248	140	61	23	22	15	0	0	0.1	0.1	0	0	0.2	0.1	0	0	2	1
Popo Agie W Class II	207	136	485	166	37	17	38	17	0	0	0.2	0.1	0	0	0.2	0.1	0	0	1	0
Soldier Creek WA Class II	297	240	396	119	59	18	20	15	0	0	0.1	0.1	0	0	0.2	0.1	0	0	1	0
Wellsville Mountain W Class II	62	36	157	54	1	0	8	2	0	0	0.0	0.0	0	0	0.1	0.0	0	0	0	0
Wind River IR Class II	305	235	546	224	97	44	88	39	0	0	3	2	1	0	5	1	0	0	1	0

Table 3-3
Visibility - Method 6 and Monthly f(RH) values - Future Alternatives

Receptor Set	ALL SOURCES - ALT E				ALL SOURCES - ALT F				ALL SOURCES - ALT H			
	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext
	5%	10%			5%	10%			5%	10%		
CLASS I AREAS												
Badlands NP Class I	283	219	230	125	283	219	230	125	283	219	230	125
Bob Marshall W Class I	46	28	60	42	46	28	60	42	46	28	60	42
Bridger W Class I	225	146	456	152	225	146	456	152	225	147	456	152
Fitzpatrick W Class I	157	109	318	128	157	109	318	128	157	109	318	128
Fort Peck IR Class I	154	92	169	82	154	91	169	82	154	92	169	82
Gates of the Mountain W Class I	103	69	118	92	103	69	118	91	103	69	118	92
Grand Teton NP Class I	165	92	182	77	165	92	182	76	165	93	182	77
North Absaorka W Class I	161	90	256	129	161	90	255	129	161	90	256	129
North Cheyenne IR Class I	361	325	338	175	362	328	338	178	362	333	339	180
Red Rock Lakes Class I	99	50	94	53	99	50	94	53	99	50	94	53
Scapegoat W Class I	68	48	113	68	68	48	113	68	68	48	113	68
Teton W Class I	154	92	268	120	154	92	267	119	154	92	268	120
Theodore Roosevelt NP Class I	232	172	356	136	232	172	356	136	232	172	356	136
UL Bend W Class I	176	99	154	60	176	97	153	60	176	99	154	60
Washakie W Class I	178	115	368	152	177	115	368	152	178	115	369	152
Wind Cave NP Class I	325	262	275	147	325	262	275	147	325	262	276	147
Yellowstone NP Class I	193	105	226	97	193	105	225	97	193	105	226	97
SENSITIVE CLASS II AREAS												
Absaorka Beartooth W Class II	213	137	303	127	213	137	302	126	213	137	303	128
Agate Fossil Beds NM Class II	297	237	399	133	297	237	399	133	297	237	399	134
Big Horn Canyon NRA Class II	356	298	411	185	356	298	409	185	356	298	410	185
Black Elk W Class II	318	233	270	150	318	233	270	150	318	233	270	150
Cloud Peak Class II	216	147	239	177	216	146	239	176	216	147	239	177
Crow IR Class II	365	365	578	259	365	365	577	253	365	365	578	257
Devils Tower NM Class II	328	279	278	135	328	279	278	134	328	279	278	135
Fort Belknap IR Class II	173	92	143	54	172	92	143	54	173	92	143	54
Fort Laramie NHS Class II	296	249	537	151	296	249	537	150	296	249	537	151
Jedediah Smith W Class II	169	96	174	66	169	95	174	66	169	96	174	66
Jewel Cave NM Class II	320	252	293	142	320	252	293	142	320	252	293	142
Lee Metcalf W Class II	175	114	153	62	175	114	152	62	175	114	153	62
Mt Naomi W Class II	80	52	198	70	80	52	198	70	80	52	198	70
Mt Rushmore Class II	312	221	262	147	311	221	262	147	312	221	262	147
Popo Agie W Class II	211	137	502	164	211	137	502	164	211	138	502	165
Soldier Creek WA Class II	299	245	396	126	299	245	396	126	299	245	396	126
Wellsville Mountain W Class II	64	40	161	57	64	40	161	57	64	40	161	57
Wind River IR Class II	310	243	566	214	310	243	565	214	311	243	566	214

Table 3-3 (continued)
Visibility - Method 6 and Monthly f(RH) values - Future Alternatives

Receptor Set	MT CBM Construction - ALT E				MT CBM Construction - ALT F				MT CBM Construction - ALT H			
	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext
	5%	10%			5%	10%			5%	10%		
CLASS I AREAS												
Badlands NP Class I	0	0	0.2	0.1	0	0	0.4	0.3	0	0	0.5	0.3
Bob Marshall W Class I	0	0	0.1	0.0	0	0	0.1	0.0	0	0	0.3	0.1
Bridger W Class I	0	0	0.3	0.1	0	0	0.5	0.2	0	0	0.6	0.3
Fitzpatrick W Class I	0	0	0.3	0.1	0	0	0.5	0.2	0	0	0.9	0.4
Fort Peck IR Class I	0	0	0.7	0.2	0	0	0.7	0.3	0	0	2.6	0.6
Gates of the Mountain W Class I	0	0	0.4	0.1	0	0	0.3	0.1	0	0	1.4	0.4
Grand Teton NP Class I	0	0	0.2	0.1	0	0	0.3	0.1	0	0	0.4	0.2
North Absaorka W Class I	0	0	0.5	0.3	0	0	1.1	0.4	0	0	1.3	0.8
North Cheyenne IR Class I	0	0	2.4	0.9	50	8	19.1	10.0	122	26	30.8	16.1
Red Rock Lakes Class I	0	0	0.3	0.1	0	0	0.3	0.1	0	0	1.1	0.2
Scapegoat W Class I	0	0	0.2	0.1	0	0	0.2	0.1	0	0	0.7	0.2
Teton W Class I	0	0	0.3	0.1	0	0	0.5	0.1	0	0	0.9	0.3
Theodore Roosevelt NP Class I	0	0	0.8	0.3	0	0	1.1	0.5	0	0	2.1	0.8
UL Bend W Class I	0	0	0.3	0.2	0	0	0.7	0.2	0	0	0.9	0.7
Washakie W Class I	0	0	0.7	0.3	0	0	0.7	0.4	0	0	1.5	0.7
Wind Cave NP Class I	0	0	0.3	0.1	0	0	0.6	0.3	0	0	0.6	0.3
Yellowstone NP Class I	0	0	0.4	0.2	0	0	0.9	0.2	0	0	1.6	0.6
SENSITIVE CLASS II AREAS												
Absaorka Beartooth W Class II	0	0	3.6	1.2	0	0	2.0	0.6	0	0	2.5	1.4
Agate Fossil Beds NM Class II	0	0	0.2	0.1	0	0	0.4	0.2	0	0	0.4	0.2
Big Horn Canyon NRA Class II	1	0	8.4	3.4	0	0	3.1	1.4	0	0	2.0	1.0
Black Elk W Class II	0	0	0.3	0.1	0	0	0.3	0.1	0	0	0.3	0.1
Cloud Peak Class II	0	0	1.3	0.4	0	0	2.5	0.6	0	0	2.2	0.5
Crow IR Class II	166	117	110.0	60.7	106	34	31.5	17.4	64	21	29.4	19.5
Devils Tower NM Class II	0	0	0.6	0.2	0	0	0.9	0.5	0	0	0.8	0.4
Fort Belknap IR Class II	0	0	0.3	0.1	0	0	0.6	0.2	0	0	1.0	0.5
Fort Laramie NHS Class II	0	0	0.2	0.1	0	0	0.4	0.2	0	0	0.4	0.2
Jedediah Smith W Class II	0	0	0.1	0.1	0	0	0.3	0.1	0	0	0.3	0.1
Jewel Cave NM Class II	0	0	0.3	0.1	0	0	0.6	0.3	0	0	0.5	0.3
Lee Metcalf W Class II	0	0	0.5	0.2	0	0	0.6	0.2	0	0	1.9	0.6
Mt Naomi W Class II	0	0	0.1	0.0	0	0	0.1	0.0	0	0	0.2	0.0
Mt Rushmore Class II	0	0	0.3	0.1	0	0	0.6	0.3	0	0	0.6	0.3
Popo Agie W Class II	0	0	0.3	0.2	0	0	0.5	0.2	0	0	0.6	0.3
Soldier Creek WA Class II	0	0	0.2	0.1	0	0	0.5	0.2	0	0	0.4	0.3
Wellsville Mountain W Class II	0	0	0.1	0.0	0	0	0.1	0.0	0	0	0.2	0.0
Wind River IR Class II	0	0	0.5	0.3	0	0	0.8	0.4	0	0	1.5	0.7

Table 3-3 (continued)
Visibility - Method 6 and Monthly f(RH) values - Future Alternatives

Receptor Set	MT CBM Operation - ALT E				MT CBM Operation - ALT F				MT CBM Operation - ALT H			
	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext	Number of Days > N% Change in Bext		Maximum % Change in Bext	8th Highest % Change in Bext
	5%	10%			5%	10%			5%	10%		
CLASS I AREAS	**CLASS I AREAS**											
Badlands NP Class I	2	0	6.7	3.9	1	0	6.4	3.7	2	0	6.5	3.7
Bob Marshall W Class I	0	0	1.5	0.5	0	0	1.4	0.4	0	0	1.5	0.5
Bridger W Class I	2	0	8.3	2.7	2	0	7.8	2.4	2	0	8.2	2.6
Fitzpatrick W Class I	2	0	8.9	2.4	2	0	8.2	2.2	2	0	8.7	2.3
Fort Peck IR Class I	7	1	10.2	5.0	6	0	9.4	4.1	6	0	9.9	4.9
Gates of the Mountain W Class I	0	0	4.1	1.1	0	0	3.5	0.9	0	0	3.9	1.0
Grand Teton NP Class I	0	0	4.9	1.2	0	0	4.5	1.1	0	0	4.8	1.2
North Absaorka W Class I	8	3	14.9	5.7	8	3	14.1	5.1	8	3	14.5	5.5
North Cheyenne IR Class I	296	215	130.4	61.8	294	206	125.3	59.0	328	240	118.7	63.5
Red Rock Lakes Class I	0	0	4.1	0.9	0	0	3.9	0.8	0	0	4.1	0.8
Scapegoat W Class I	0	0	2.5	0.8	0	0	2.2	0.7	0	0	2.4	0.8
Teton W Class I	3	0	7.8	2.2	3	0	7.2	2.0	3	0	7.6	2.1
Theodore Roosevelt NP Class I	11	2	15.0	6.8	11	2	13.6	6.2	11	2	14.4	6.6
UL Bend W Class I	6	1	10.2	3.5	6	0	9.6	3.2	6	0	9.9	3.4
Washakie W Class I	10	3	12.0	5.8	8	3	11.1	5.4	9	3	11.7	5.5
Wind Cave NP Class I	8	0	8.4	5.0	6	0	7.8	4.5	7	0	8.3	4.8
Yellowstone NP Class I	5	1	13.2	2.5	3	1	12.3	2.2	4	1	12.9	2.3
SENSITIVE CLASS II AREAS												
Absaorka Beartooth W Class II	12	4	33.1	6.5	10	3	31.3	6.0	12	4	32.1	6.2
Agate Fossil Beds NM Class II	1	0	5.3	2.5	0	0	4.9	2.3	1	0	5.2	2.4
Big Horn Canyon NRA Class II	45	24	34.8	17.7	37	18	30.5	14.2	52	27	33.9	18.2
Black Elk W Class II	6	0	8.8	4.7	4	0	8.2	4.4	6	0	8.7	4.5
Cloud Peak Class II	22	9	71.1	10.9	21	8	68.4	10.2	21	9	70.2	10.6
Crow IR Class II	228	131	133.6	54.1	205	115	129.2	46.0	331	257	240.5	128.8
Devils Tower NM Class II	11	2	10.9	6.7	11	1	10.2	6.3	11	1	10.6	6.6
Fort Belknap IR Class II	3	0	8.5	2.9	3	0	7.9	2.5	3	0	8.2	2.9
Fort Laramie NHS Class II	3	0	5.8	2.7	1	0	5.5	2.4	2	0	5.7	2.6
Jedediah Smith W Class II	0	0	3.9	1.3	0	0	3.7	1.2	0	0	3.9	1.3
Jewel Cave NM Class II	6	0	9.4	4.0	6	0	8.7	3.6	6	0	9.2	3.9
Lee Metcalf W Class II	1	0	8.2	1.9	1	0	7.6	1.5	1	0	8.0	1.8
Mt Naomi W Class II	0	0	2.3	0.4	0	0	2.1	0.4	0	0	2.2	0.4
Mt Rushmore Class II	6	0	8.5	4.5	4	0	7.9	4.3	6	0	8.3	4.4
Popo Agie W Class II	4	0	9.1	3.3	3	0	8.5	3.0	4	0	9.0	3.2
Soldier Creek WA Class II	1	0	6.2	3.1	1	0	5.8	2.9	1	0	6.1	3.0
Wellsville Mountain W Class II	0	0	2.1	0.3	0	0	2.0	0.3	0	0	2.1	0.3
Wind River IR Class II	9	4	13.2	6.0	9	3	12.2	5.6	9	4	12.9	5.8

Table 3-4
Modeled Deposition for Nitrogen and Sulfur - Base Year

Note: Bold type indicate a modeled impact that is above the Comparative Deposition Value

Receptor Set	POLLUTANT	Maximum Deposition (kg/ha - yr)				
		ALL SOURCES	MT CBM Construction	MT CBM Operation	MT Oil & Gas	Threshold
CLASS I AREAS						
Badlands NP Class I Area	Nitrogen	1.13E-01	2.75E-05	4.49E-05	5.05E-04	3
	Sulfur	1.63E-01	5.03E-06	2.37E-06	1.30E-05	5
Bridger W Class I Area	Nitrogen	1.18E-02	1.57E-06	2.54E-06	4.20E-05	3
	Sulfur	1.96E-02	3.22E-07	1.53E-07	1.03E-06	5
Bob Marshall W Class I Area	Nitrogen	1.17E-01	7.53E-06	1.26E-05	4.67E-05	3
	Sulfur	2.09E-01	1.84E-06	8.70E-07	1.10E-06	5
Fitzpatrick W Class I Area	Nitrogen	1.29E-01	7.41E-06	1.23E-05	6.05E-05	3
	Sulfur	1.72E-01	1.58E-06	7.51E-07	1.37E-06	5
Fort Peck IR Class I Area	Nitrogen	7.10E-02	1.52E-05	2.49E-05	6.00E-03	3
	Sulfur	1.33E-01	2.36E-06	1.12E-06	2.31E-05	5
Gates of the Mountain W Class I Area	Nitrogen	6.70E-02	4.46E-06	7.22E-06	1.48E-04	3
	Sulfur	8.11E-02	7.96E-07	3.79E-07	2.69E-06	5
Grand Teton NP Class I Area	Nitrogen	6.36E-02	5.46E-06	8.94E-06	4.47E-05	3
	Sulfur	1.69E-01	8.99E-07	4.27E-07	9.17E-07	5
North Absaorka W Class I Are	Nitrogen	1.21E-01	1.51E-05	2.50E-05	3.31E-04	3
	Sulfur	1.97E-01	2.73E-06	1.28E-06	2.97E-06	5
North Cheyenne IR Class I Area	Nitrogen	2.92E-01	4.29E-03	7.15E-03	5.48E-03	3
	Sulfur	3.91E-01	3.76E-04	1.78E-04	2.92E-05	5
Red Rock Lakes Class I Area	Nitrogen	4.36E-02	2.76E-06	4.52E-06	3.59E-05	3
	Sulfur	6.13E-02	4.27E-07	2.03E-07	6.39E-07	5
Scapegoat W Class I Area	Nitrogen	2.76E-02	3.08E-06	4.95E-06	2.62E-04	3
	Sulfur	4.44E-02	5.69E-07	2.70E-07	2.23E-06	5
Teton W Class I Area	Nitrogen	7.98E-02	7.92E-06	1.31E-05	9.97E-05	3
	Sulfur	1.51E-01	1.51E-06	7.13E-07	1.51E-06	5
Theodore Roosevelt NP Class I Area	Nitrogen	2.50E-01	2.79E-05	4.60E-05	2.89E-03	3
	Sulfur	3.39E-01	4.42E-06	2.10E-06	5.01E-05	5
UL Bend W Class I Area	Nitrogen	6.46E-02	1.19E-05	1.92E-05	3.86E-04	3
	Sulfur	9.09E-02	2.10E-06	9.98E-07	6.00E-06	5
Washakie W Class I Area	Nitrogen	1.17E-01	1.12E-05	1.86E-05	2.19E-04	3
	Sulfur	2.18E-01	2.15E-06	1.01E-06	2.44E-06	5
Wind Cave NP Class I Area	Nitrogen	1.96E-01	3.71E-05	6.40E-05	5.21E-04	3
	Sulfur	3.21E-01	7.02E-06	3.33E-06	1.37E-05	5
Yellowstone NP Class I Area	Nitrogen	8.02E-02	1.39E-05	2.30E-05	1.26E-04	3
	Sulfur	1.28E-01	2.16E-06	1.01E-06	1.85E-06	5
CLASS I / CLASS II SENSITIVE LAKES						
Black Joe Lake, Bridger WA	Nitrogen	9.64E-02	7.41E-06	1.24E-05	4.44E-05	3
	Sulfur	1.90E-01	1.81E-06	8.59E-07	1.08E-06	5
Deep Lake, Bridger WA	Nitrogen	9.87E-02	7.25E-06	1.21E-05	4.32E-05	3
	Sulfur	1.91E-01	1.78E-06	8.42E-07	1.06E-06	5
Emerald Lake, Cloud Peak WA	Nitrogen	1.52E-01	1.45E-04	2.60E-04	4.33E-04	3
	Sulfur	2.08E-01	2.07E-05	9.82E-06	6.16E-06	5
Florence, Cloud Peak WA,	Nitrogen	1.58E-01	1.37E-04	2.52E-04	4.27E-04	3
	Sulfur	2.16E-01	2.10E-05	9.95E-06	6.39E-06	5
Hobbs Lake, Bridger WA	Nitrogen	8.95E-02	5.54E-06	9.13E-06	3.68E-05	3
	Sulfur	1.69E-01	1.23E-06	5.83E-07	9.59E-07	5
Lower Saddlebag, Popo Agie WA	Nitrogen	1.16E-01	8.05E-06	1.36E-05	4.48E-05	3
	Sulfur	2.21E-01	1.96E-06	9.27E-07	1.07E-06	5
Ross Lake, Cloud Peak WA	Nitrogen	8.88E-02	6.93E-06	1.14E-05	5.09E-05	3
	Sulfur	1.64E-01	1.40E-06	6.63E-07	1.19E-06	5
Upper Frozen Lake, Bridger WA	Nitrogen	1.04E-01	7.18E-06	1.20E-05	4.20E-05	3
	Sulfur	1.97E-01	1.76E-06	8.34E-07	1.03E-06	5

Table 3-5
Maximum Deposition for Alternate Development Scenarios

Receptor Set	POLLUTANT	Maximum Deposition (kg/ha - yr)			
		ALL SOURCES - Alternative E	ALL SOURCES - Alternative F	ALL SOURCES - Alternative H	Threshold
CLASS I AREAS					
Badlands NP Class I Area	Nitrogen	1.20E-01	1.20E-01	1.20E-01	3
	Sulfur	1.83E-01	1.83E-01	1.83E-01	5
Bridger W Class I Area	Nitrogen	1.79E-02	1.78E-02	1.79E-02	3
	Sulfur	2.70E-02	2.70E-02	2.70E-02	5
Bob Marshall W Class I Area	Nitrogen	1.14E-01	1.14E-01	1.14E-01	3
	Sulfur	2.38E-01	2.38E-01	2.38E-01	5
Fitzpatrick W Class I Area	Nitrogen	1.30E-01	1.30E-01	1.30E-01	3
	Sulfur	1.87E-01	1.87E-01	1.88E-01	5
Fort Peck IR Class I Area	Nitrogen	7.93E-02	7.90E-02	7.95E-02	3
	Sulfur	1.46E-01	1.46E-01	1.46E-01	5
Gates of the Mountain W Class I Area	Nitrogen	9.39E-02	9.37E-02	9.39E-02	3
	Sulfur	1.11E-01	1.11E-01	1.11E-01	5
Grand Teton NP Class I Area	Nitrogen	6.53E-02	6.53E-02	6.53E-02	3
	Sulfur	1.78E-01	1.78E-01	1.78E-01	5
North Absaorka W Class I Are	Nitrogen	1.30E-01	1.30E-01	1.30E-01	3
	Sulfur	2.13E-01	2.13E-01	2.13E-01	5
North Cheyenne IR Class I Area	Nitrogen	1.87E+00	1.97E+00	1.99E+00	3
	Sulfur	4.88E-01	4.89E-01	4.92E-01	5
Red Rock Lakes Class I Area	Nitrogen	4.55E-02	4.55E-02	4.56E-02	3
	Sulfur	6.52E-02	6.52E-02	6.52E-02	5
Scapegoat W Class I Area	Nitrogen	4.13E-02	4.12E-02	4.14E-02	3
	Sulfur	6.12E-02	6.12E-02	6.12E-02	5
Teton W Class I Area	Nitrogen	8.36E-02	8.34E-02	8.36E-02	3
	Sulfur	1.61E-01	1.61E-01	1.61E-01	5
Theodore Roosevelt NP Class I Area	Nitrogen	2.58E-01	2.58E-01	2.58E-01	3
	Sulfur	3.53E-01	3.53E-01	3.53E-01	5
UL Bend W Class I Area	Nitrogen	9.11E-02	9.07E-02	9.15E-02	3
	Sulfur	1.23E-01	1.23E-01	1.23E-01	5
Washakie W Class I Area	Nitrogen	1.25E-01	1.24E-01	1.25E-01	3
	Sulfur	2.37E-01	2.37E-01	2.38E-01	5
Wind Cave NP Class I Area	Nitrogen	2.07E-01	2.07E-01	2.07E-01	3
	Sulfur	3.58E-01	3.58E-01	3.58E-01	5
Yellowstone NP Class I Area	Nitrogen	8.58E-02	8.56E-02	8.58E-02	3
	Sulfur	1.36E-01	1.36E-01	1.36E-01	5
CLASS I / CLASS II SENSITIVE LAKES					
Black Joe Lake, Bridger WA	Nitrogen	9.63E-02	9.62E-02	9.63E-02	3
	Sulfur	2.15E-01	2.15E-01	2.15E-01	5
Deep Lake, Bridger WA	Nitrogen	9.81E-02	9.81E-02	9.82E-02	3
	Sulfur	2.16E-01	2.16E-01	2.16E-01	5
Emerald Lake, Cloud Peak WA	Nitrogen	1.65E-01	1.64E-01	1.65E-01	3
	Sulfur	2.34E-01	2.34E-01	2.34E-01	5
Florence, Cloud Peak WA,	Nitrogen	1.70E-01	1.69E-01	1.70E-01	3
	Sulfur	2.43E-01	2.43E-01	2.43E-01	5
Hobbs Lake, Bridger WA	Nitrogen	8.83E-02	8.82E-02	8.83E-02	3
	Sulfur	1.82E-01	1.82E-01	1.82E-01	5
Lower Saddlebag, Popo Agie WA	Nitrogen	1.15E-01	1.15E-01	1.15E-01	3
	Sulfur	2.55E-01	2.55E-01	2.55E-01	5
Ross Lake, Cloud Peak WA	Nitrogen	8.94E-02	8.94E-02	8.95E-02	3
	Sulfur	1.76E-01	1.76E-01	1.76E-01	5
Upper Frozen Lake, Bridger WA	Nitrogen	1.03E-01	1.03E-01	1.03E-01	3
	Sulfur	2.22E-01	2.22E-01	2.22E-01	5

Table 3-6
Modeled Impacts on Acid Sensitive Lakes -Alternate Development Scenarios

Wilderness Area / Lake	Background ANC (ueq/l)	Number of Samples	Watershed Area (ha)	Annual Precipitation (meter)	Base Year ANC(o) (eq)	Base Year %ANC change	Base Year Hdep ueq/l	Alternative E %ANC change	Alternative E Hdep ueq/l	Alternative F %ANC change	Alternative F Hdep ueq/l	Alternative H %ANC change	Alternative H Hdep ueq/l
Bridger													
Black Joe	67	43	890	0.97	397109	4.2	2.9	4.6	3.1	4.6	3.1	4.6	3.1
Deep	60	61	205	0.97	80864	4.8	2.9	5.2	3.2	5.2	3.2	5.2	3.2
Hobbs	70	68	293	0.76	101715	4.9	3.3	5.1	3.5	5.1	3.5	5.1	3.5
Upper Frozen	5	(NA)	64.8	1.22	1033	123.9	2.4	133.1	2.6	133.1	2.6	133.1	2.6
Cloud Peak													
Emerald	55.3	9	293	0.97	104776	6.7	3.7	7.4	4.1	7.4	4.1	7.4	4.1
Florence	32.7	10	417	0.97	88177	11.7	3.8	12.9	4.2	12.9	4.2	12.9	4.2
Fitzpatrick													
Ross	53.5	35	4455	0.97	1768834	4.2	2.6	4.4	2.7	4.4	2.7	4.4	2.7
Popo Agie													
Lower Saddlebag	55.5	34	155	0.97	55628	6.2	3.4	6.7	3.7	6.7	3.7	6.7	3.7

Table 3-7
Modeled Acute Concentrations of Hazardous Air Pollutants (HAPs)
All Production Scenarios - All Sources

Receptor Set	*Pollutant*	*Averaging Period*	*RANK*	*Base Year*	*ALT E Total Impact*	*ALT F Total Impact*	*ALT H Total Impact*	*REL (µg/m3)*
Near Field Receptors All Data in µg/m^3								
Montana Near Field Receptors	Benzene	1-hour	1ST HIGH	0.29	0.36	0.31	0.30	1,300
	Ethyl Benzene	1-hour	1ST HIGH	0.01	0.01	0.01	0.01	35,000
	Formaldehyde	1-hour	1ST HIGH	13.3	16.6	14.2	13.8	94
	n-Hexane	1-hour	1ST HIGH	4.44	207.00	207.00	207.00	39,000
	Toluene	1-hour	1ST HIGH	0.2	0.3	0.3	0.3	37,000
	Xylene	1-hour	1ST HIGH	0.1	0.1	0.1	0.1	22,000
Wyoming Near Field Receptors	Benzene	1-hour	1ST HIGH	1.9	1.0	1.0	1.0	1,300
	Ethyl Benzene	1-hour	1ST HIGH	0.1	0.04	0.0	0.0	35,000
	Formaldehyde	1-hour	1ST HIGH	86.2	46.5	46.5	46.5	94
	n-Hexane	1-hour	1ST HIGH	3.1	12.8	12.8	12.8	39,000
	Toluene	1-hour	1ST HIGH	1.0	0.5	0.5	0.5	37,000
	Xylene	1-hour	1ST HIGH	0.4	0.2	0.2	0.2	22,000

Table 3-8
Modeled Annual Concentrations of Hazardous Air Pollutants (HAPs) - All Production Scenarios
All Sources

Receptor Set	Pollutant	Averaging Period*	RANK	Base Year	ALT E Total Impact	ALT F Total Impact	ALT H Total Impact	Non-Carcinogenic RfCs
Near Field Receptors - Non-Carcinogenic Impacts								**All Data in μg/m^3**
Montana Near Field Receptors	Benzene	Annual	1ST HIGH	0.0026	0.0031	0.0031	0.0032	30
	Ethyl Benzene	Annual	1ST HIGH	0.0001	0.0001	0.0001	0.0001	1,000
	Formaldehyde	Annual	1ST HIGH	0.1210	0.1400	0.1400	0.1400	9.8
	n-Hexane	Annual	1ST HIGH	0.1250	1.6000	1.6000	1.6000	200
	Toluene	Annual	1ST HIGH	0.0001	0.0034	0.0034	0.0034	400
	Xylene	Annual	1ST HIGH	0.0006	0.0006	0.0006	0.0006	100
Wyoming Near Field Receptors	Benzene	Annual	1ST HIGH	0.0093	0.0055	0.0055	0.0055	30
	Ethyl Benzene	Annual	1ST HIGH	0.0004	0.0003	0.0003	0.0003	1,000
	Formaldehyde	Annual	1ST HIGH	0.4270	0.2390	0.2390	0.2390	9.8
	n-Hexane	Annual	1ST HIGH	0.0562	0.0826	0.0826	0.0826	200
	Toluene	Annual	1ST HIGH	0.0049	0.0028	0.0028	0.0028	400
	Xylene	Annual	1ST HIGH	0.0020	0.0011	0.0011	0.0011	100
Near Field Receptors - Carcinogenic Risk Evaluation*				**Risk Evaluation X 10^{-6}**				
Montana	Benzene	Annual	1ST HIGH	0.015	0.017	0.017	0.017	
	Formaldehyde	Annual	1ST HIGH	0.000	0.001	0.001	0.001	
Wyoming	Benzene	Annual	1ST HIGH	0.052	0.030	0.030	0.030	
	Formaldehyde	Annual	1ST HIGH	0.002	0.001	0.001	0.001	

*Benzene Concentrations multiplied by risk factor: 7.8 X 10^{-6} X 0.71)
*Formaldehyde Concentrations multiplied by risk factor: 5.5 X 10^{-9} X 0.71)

Figure 3-1
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Montana Near-field Receptors

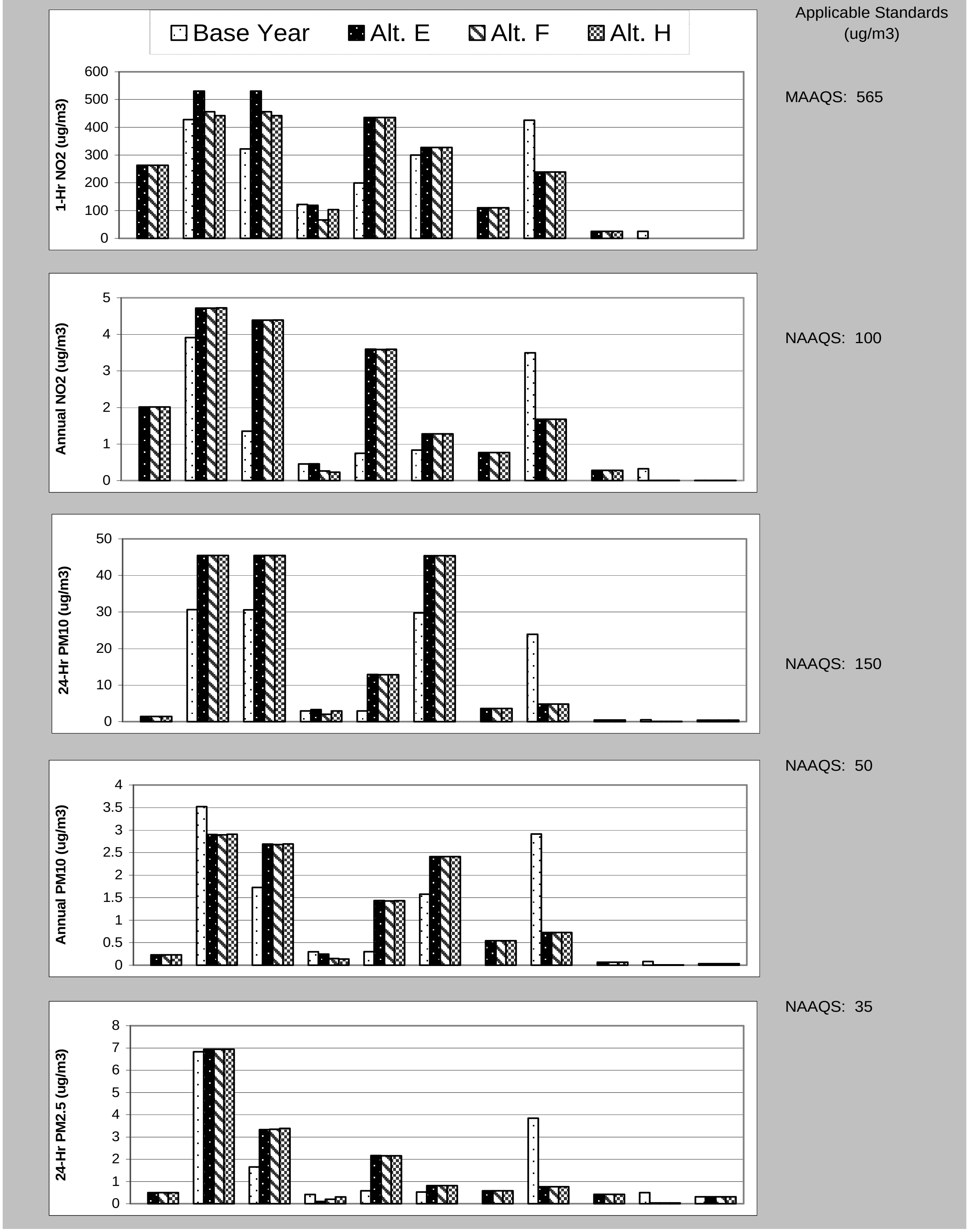


Figure 3-1 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Montana Near-field Receptors

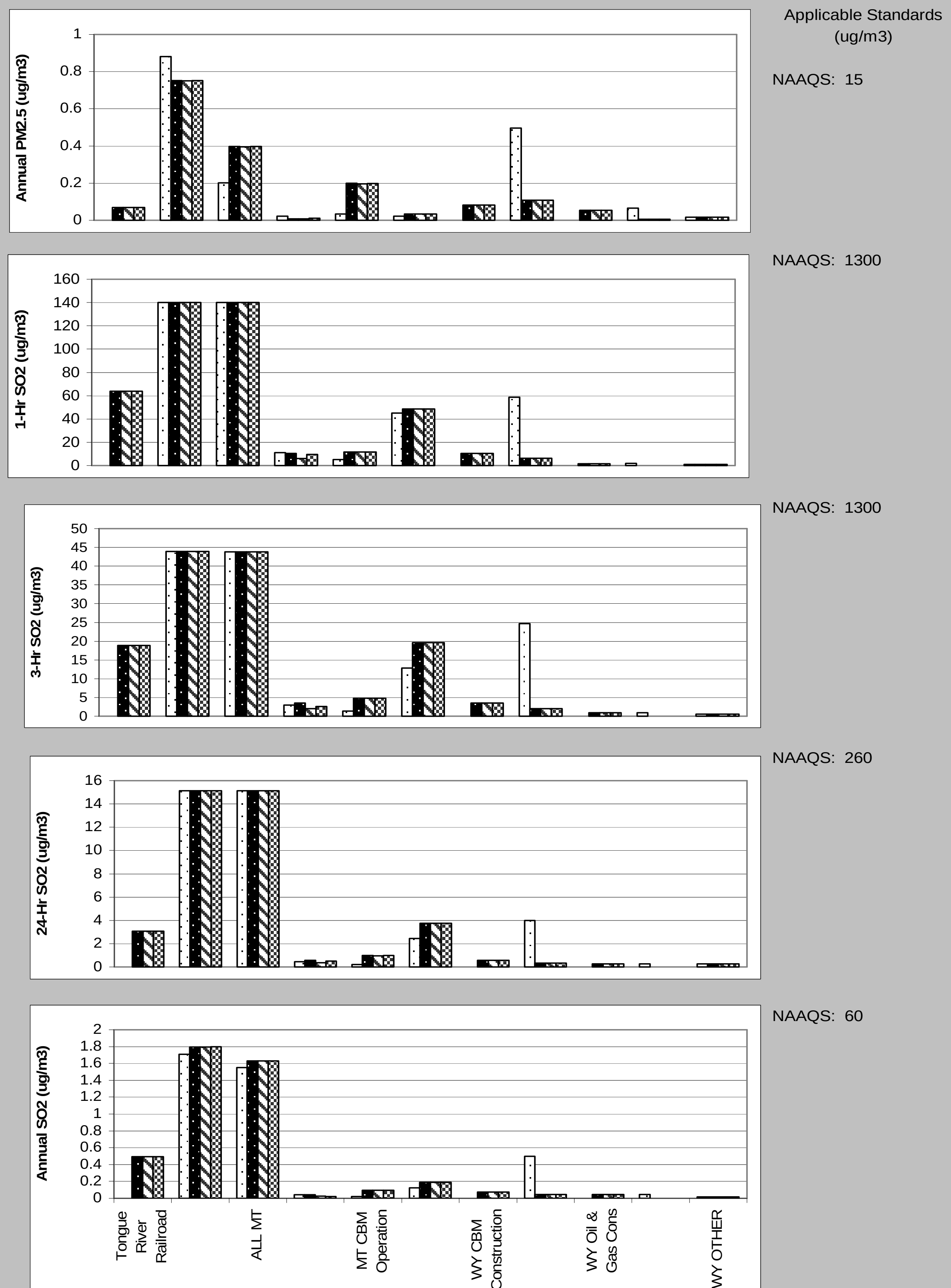
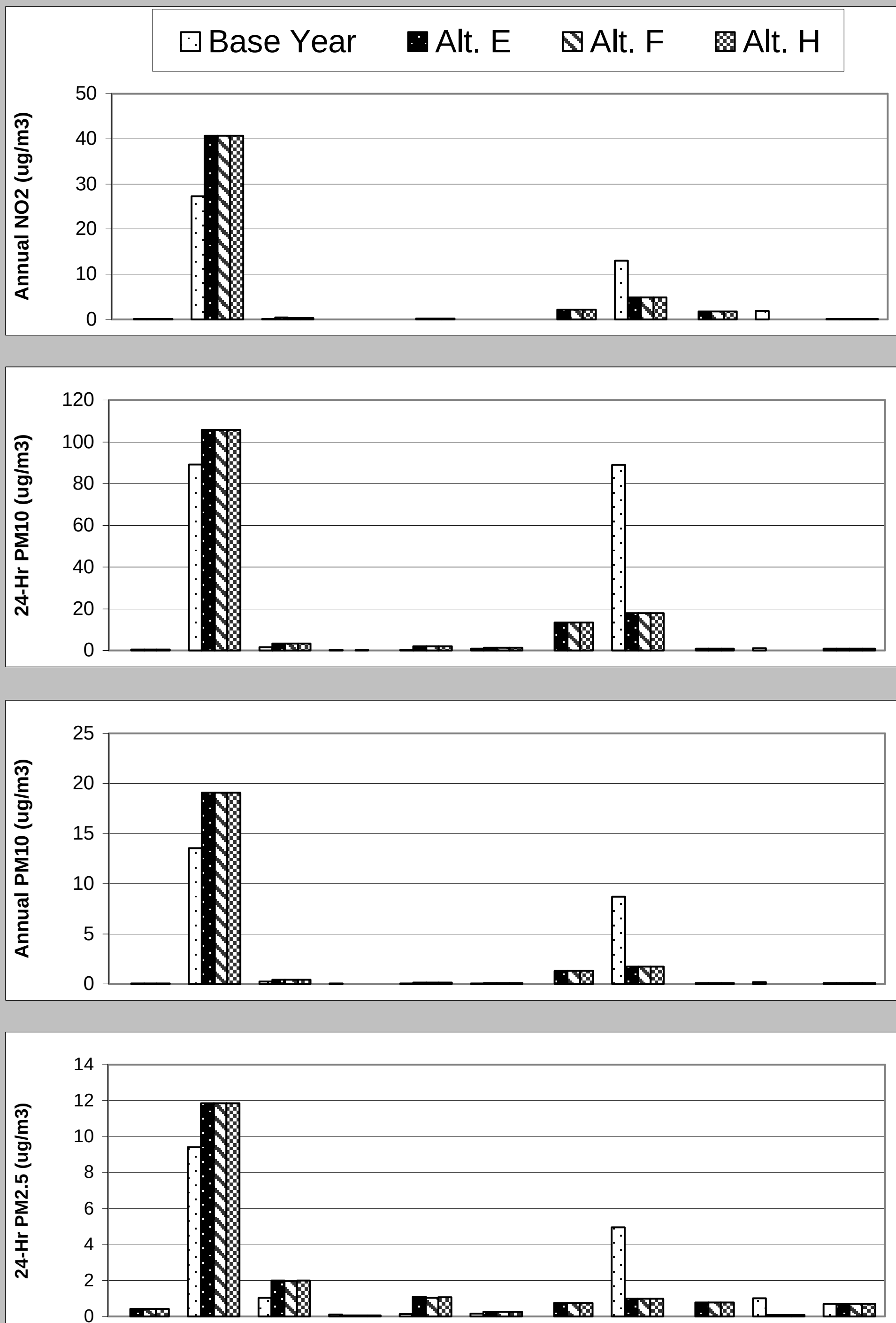


Figure 3-2
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Wyoming Near-field Receptors



Applicable Standards (ug/m3)

NAAQS: 100

NAAQS: 150

NAAQS: 50

NAAQS: 35

Figure 3-2 (continued)
Change in Modeled Concentrations of NO2, SO2, PM10, PM2.5
Wyoming Near-field Receptors

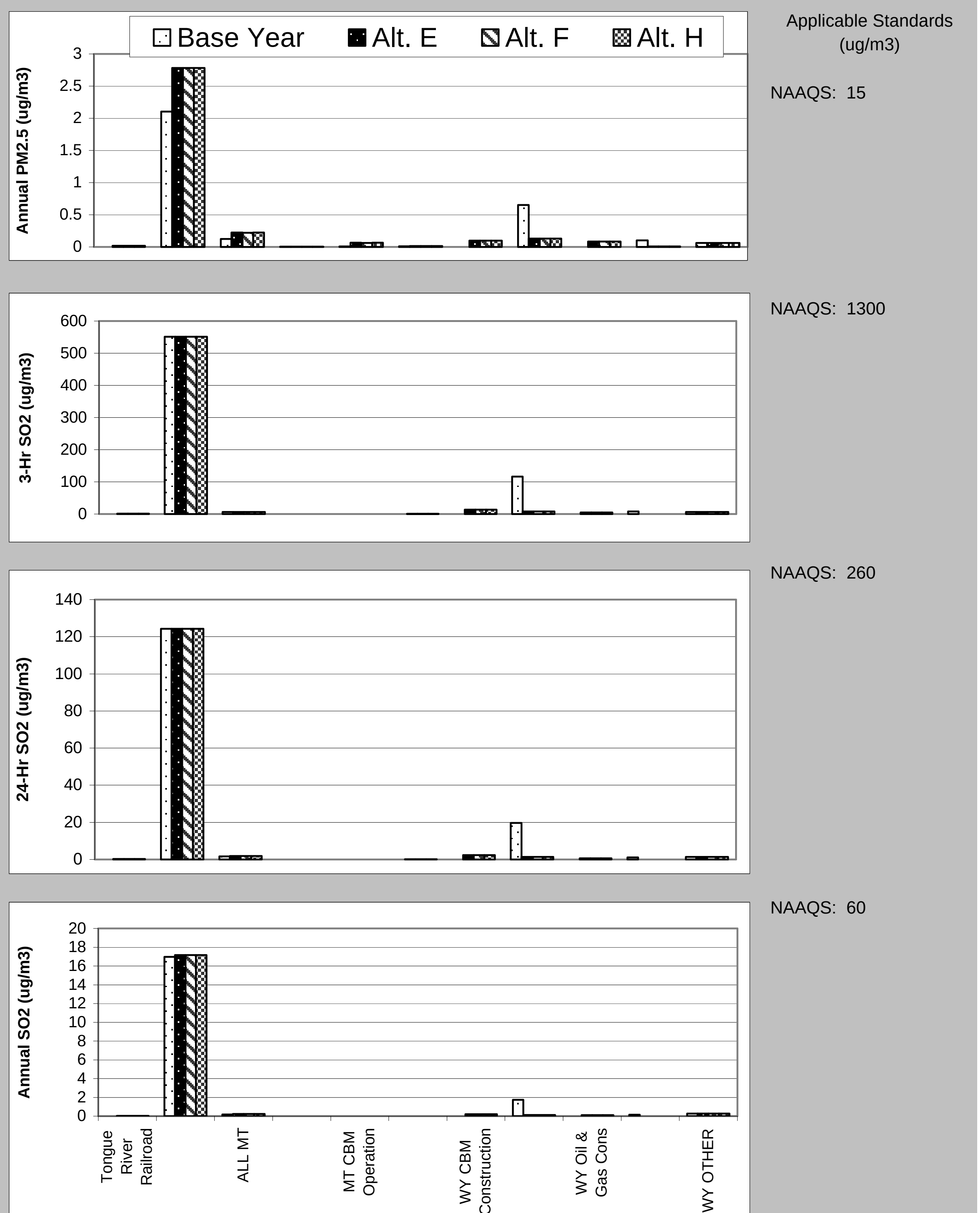


Figure 3-3
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Northern Cheyenne Indian Reservation

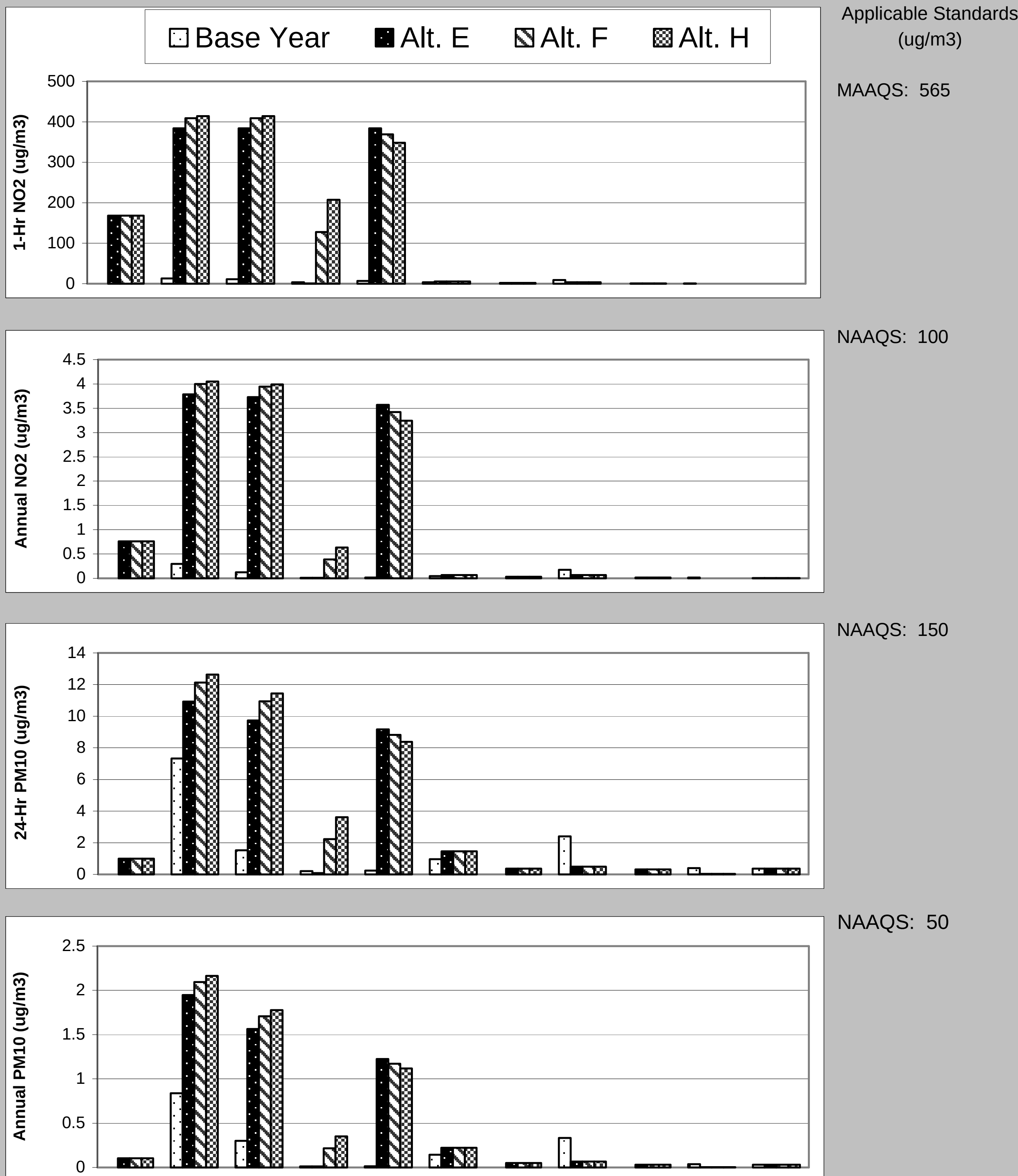


Figure 3-3 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Northern Cheyenne Indian Reservation

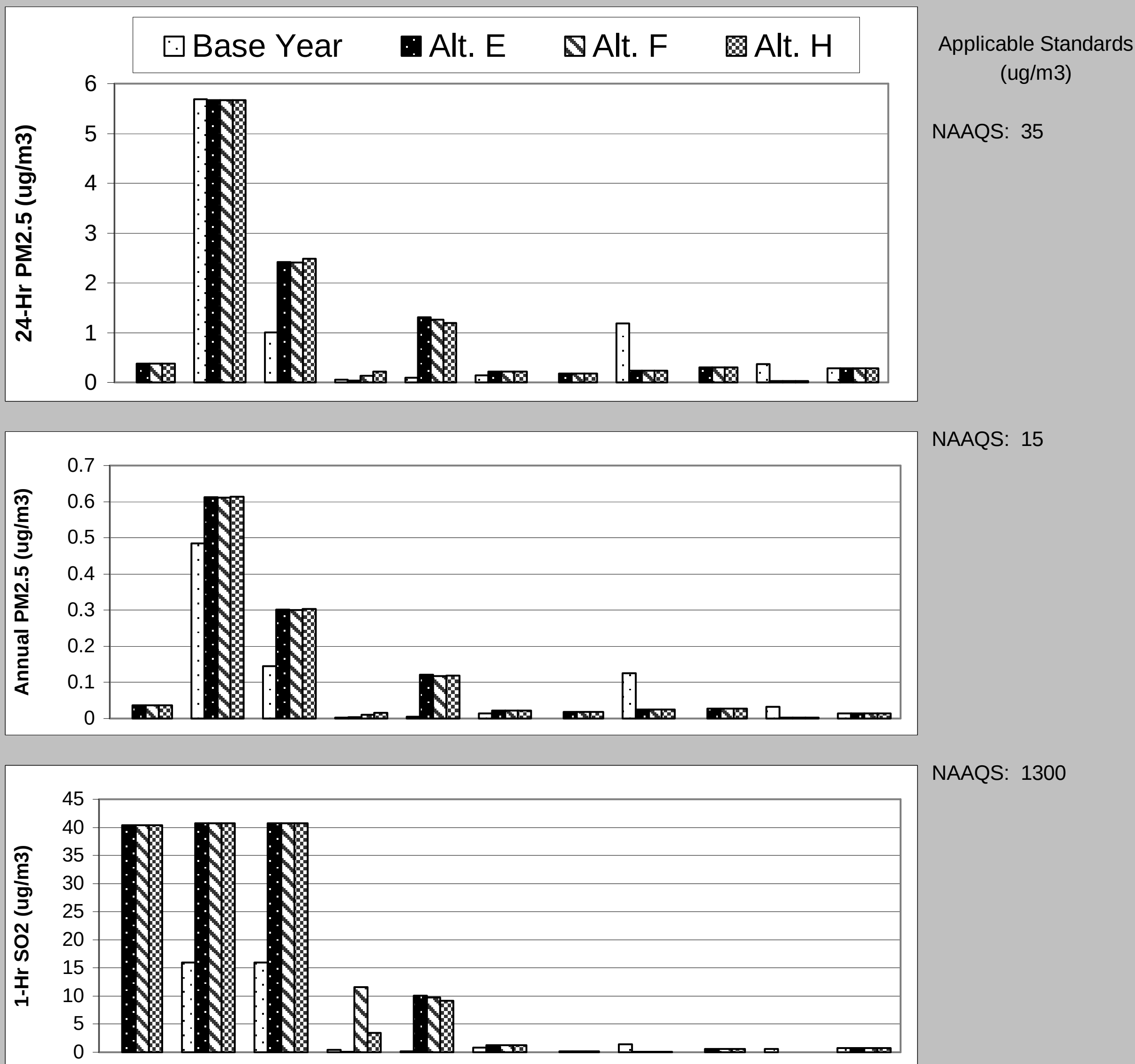


Figure 3-3 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Northern Cheyenne Indian Reservation

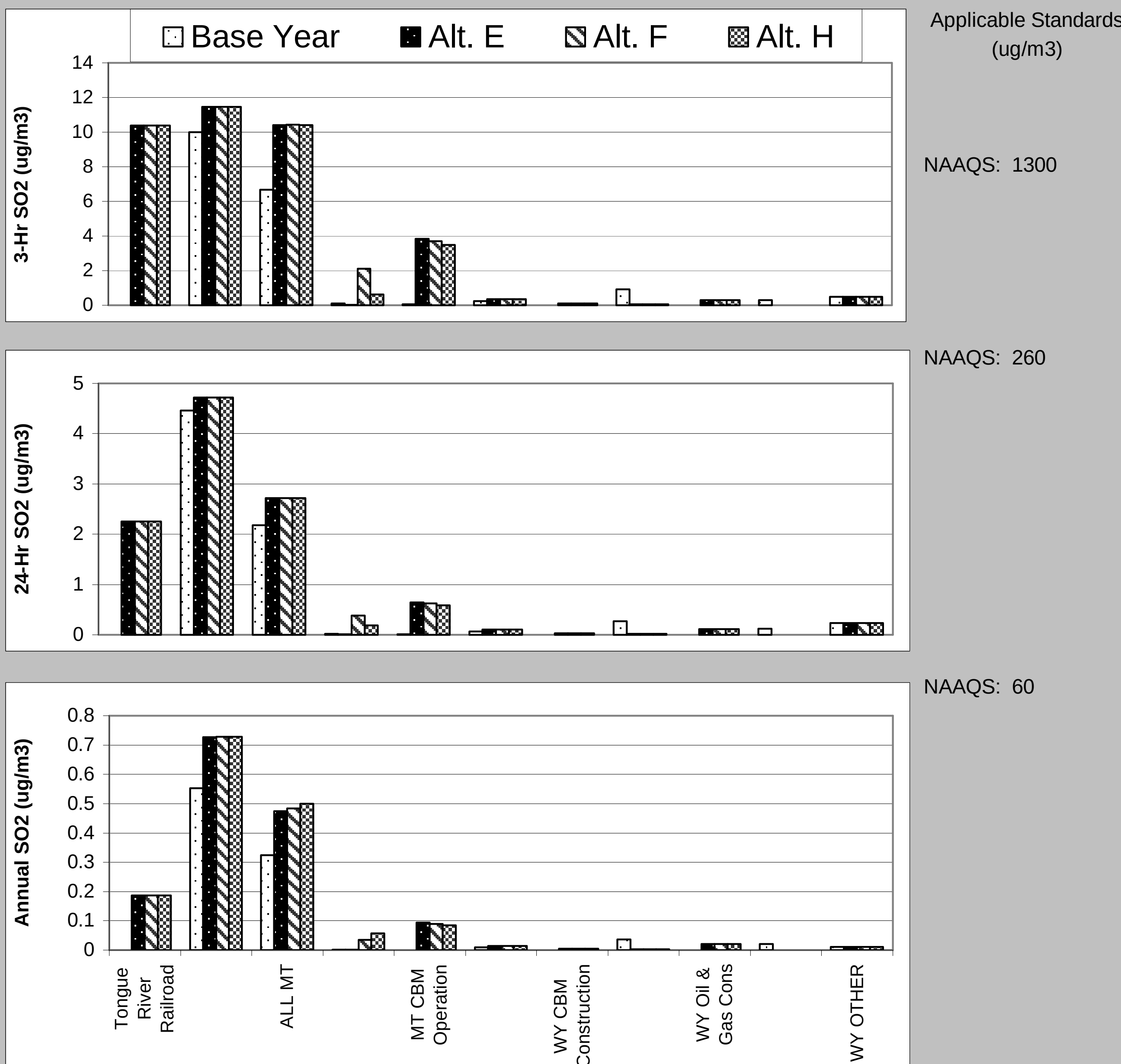


Figure 3-4
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Theodore Roosevelt National Park

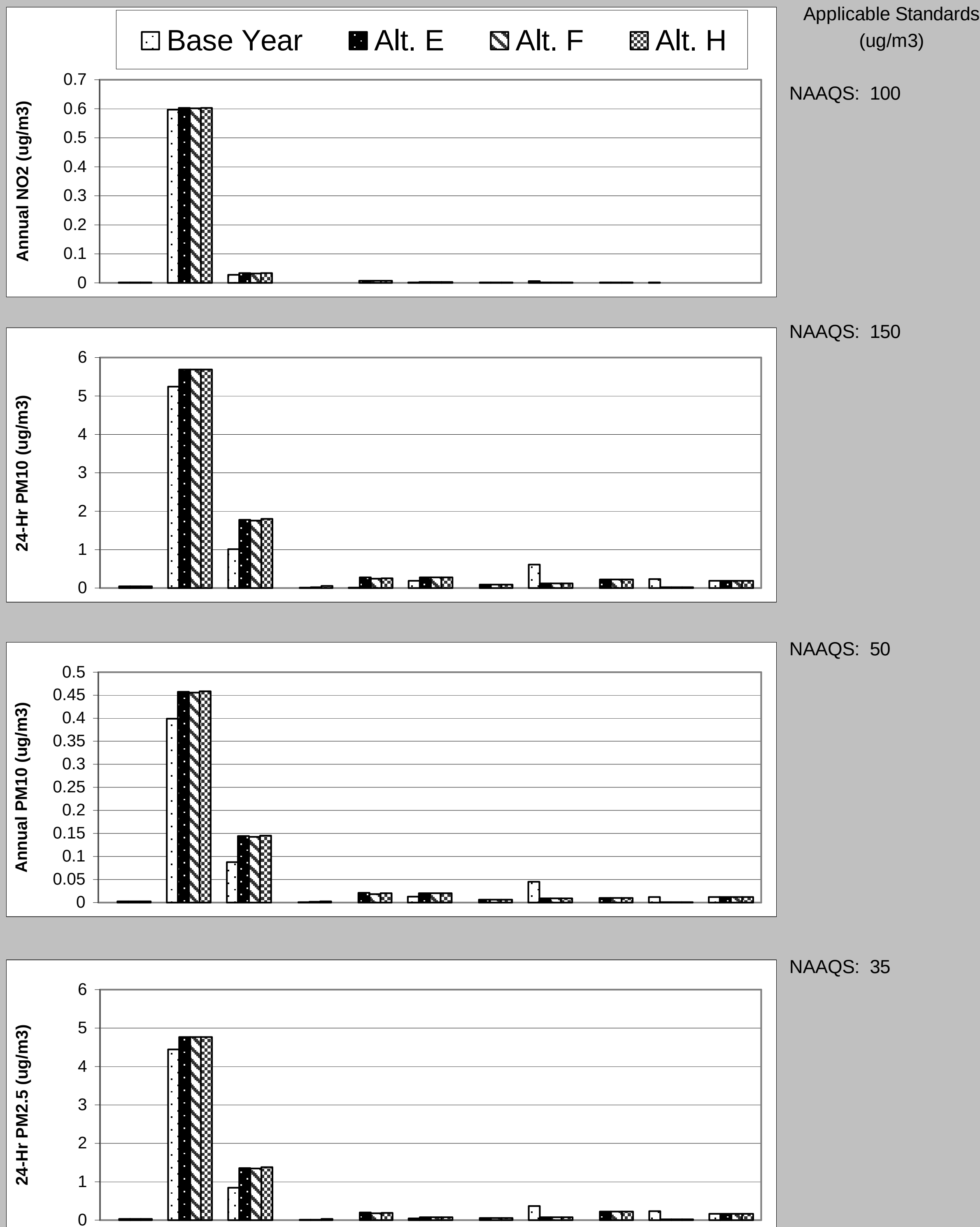


Figure 3-4 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Theodore Roosevelt National Park

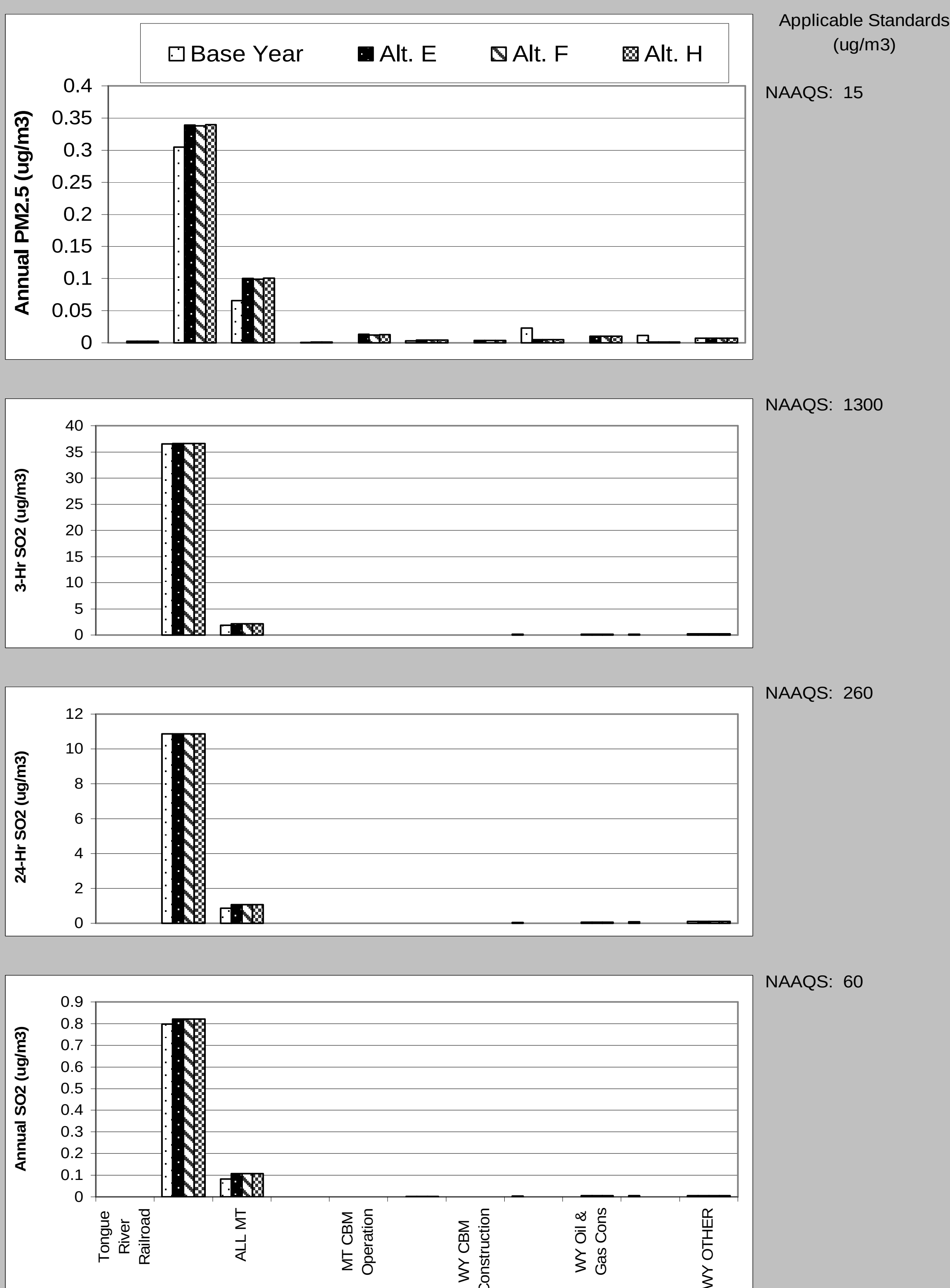


Figure 3-5
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Wind Cave National Park

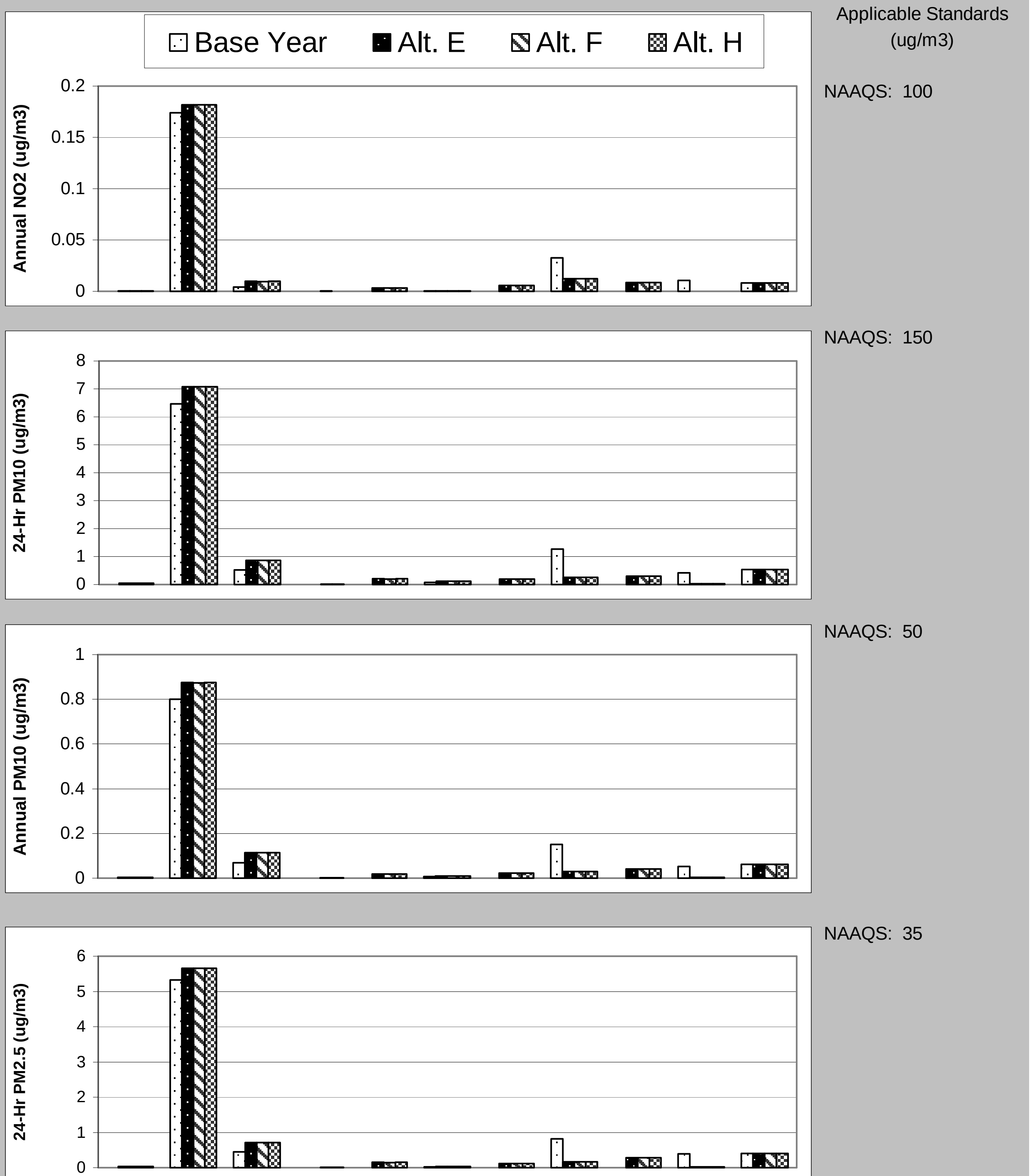


Figure 3-5 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Wind Cave National Park

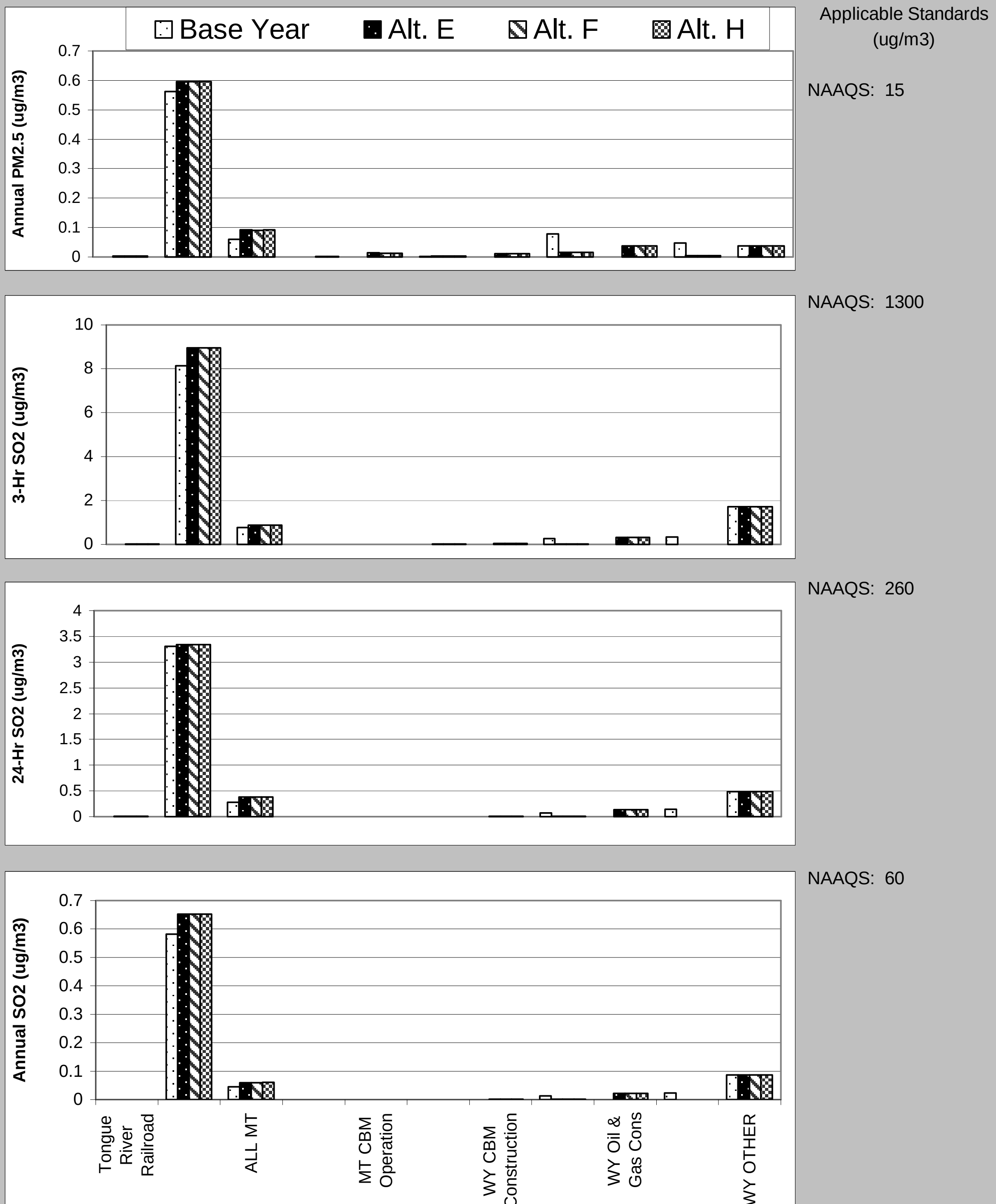


Figure 3-6
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Crow Indian Reservation

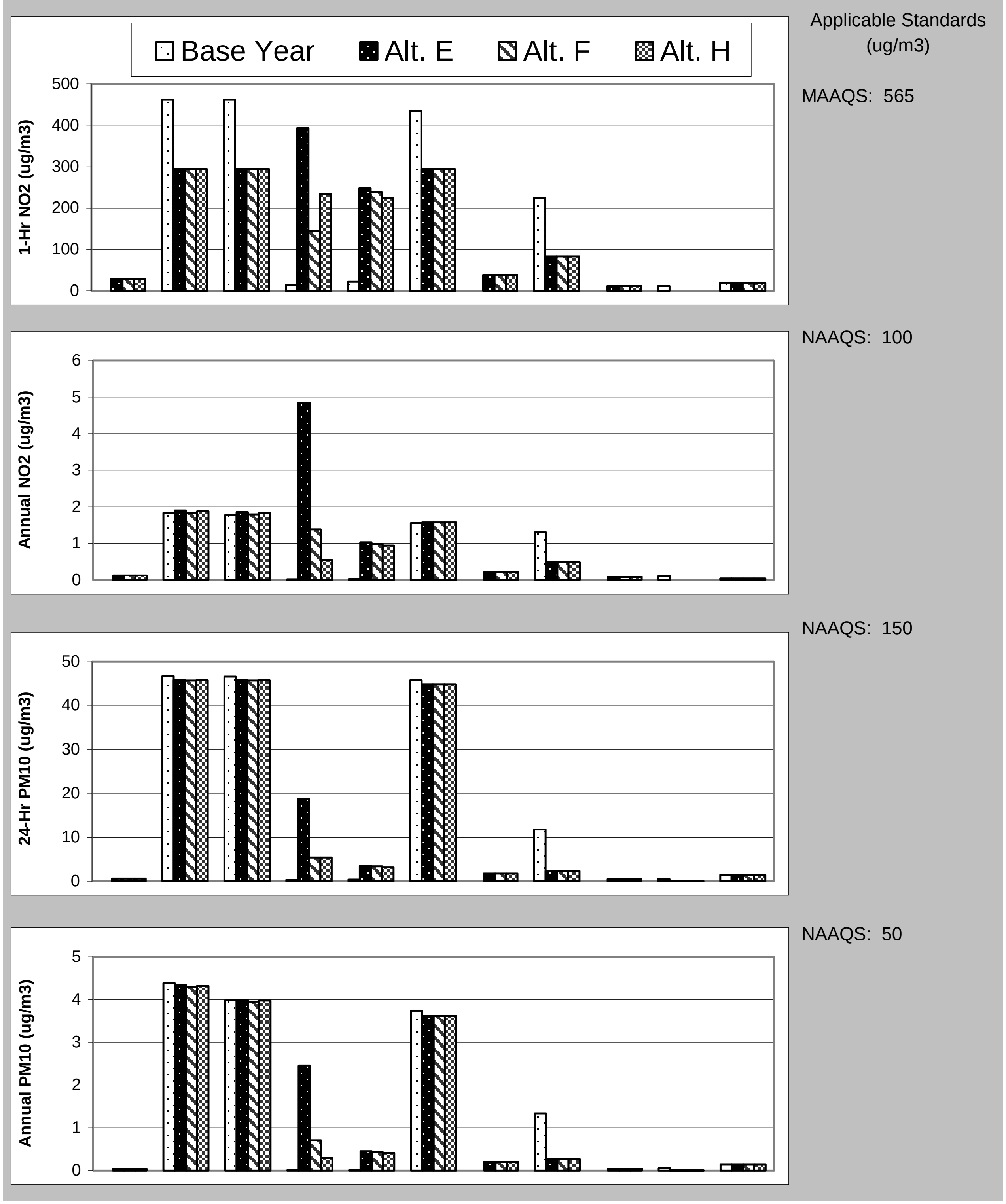


Figure 3-6 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Crow Indian Reservation

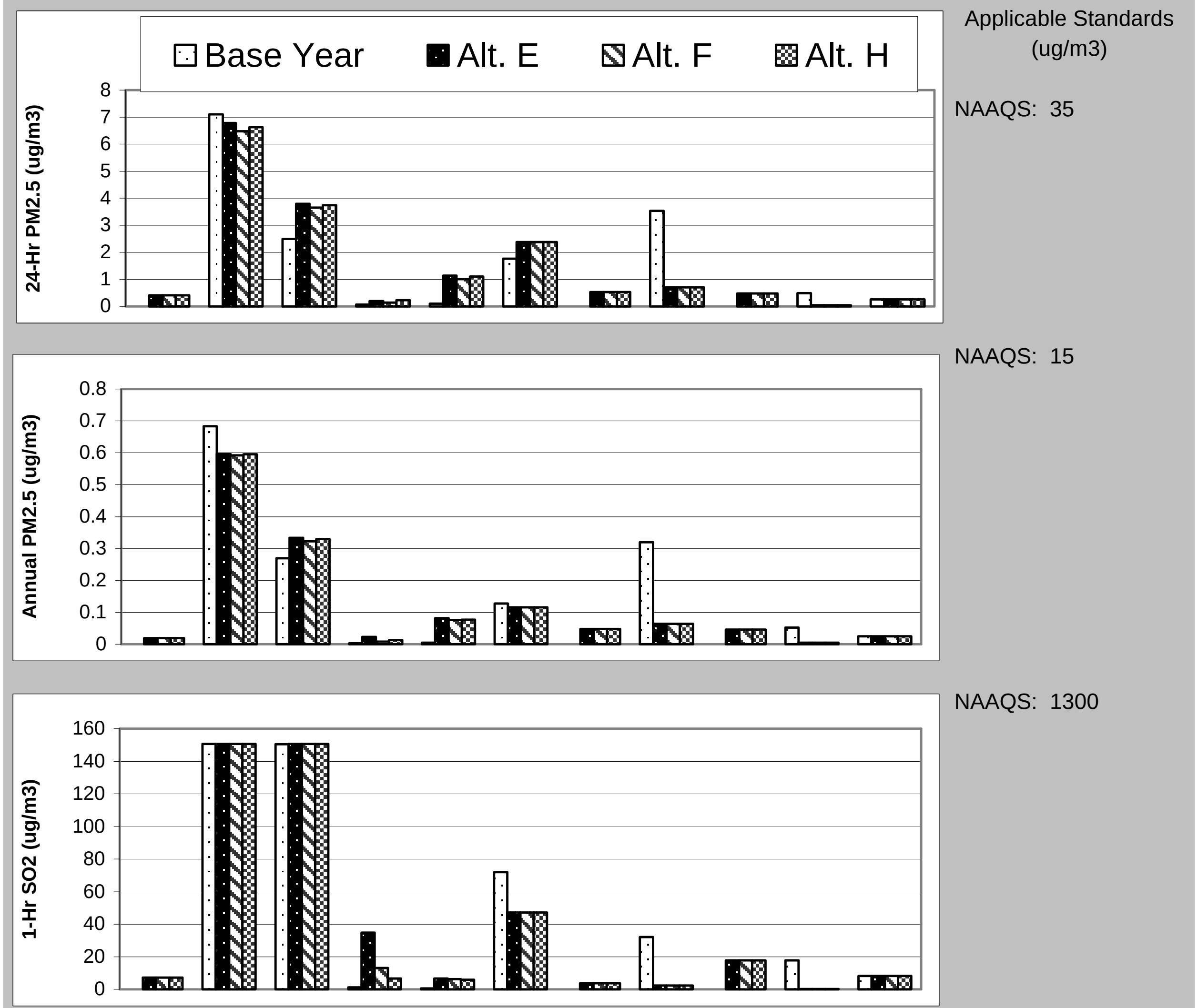
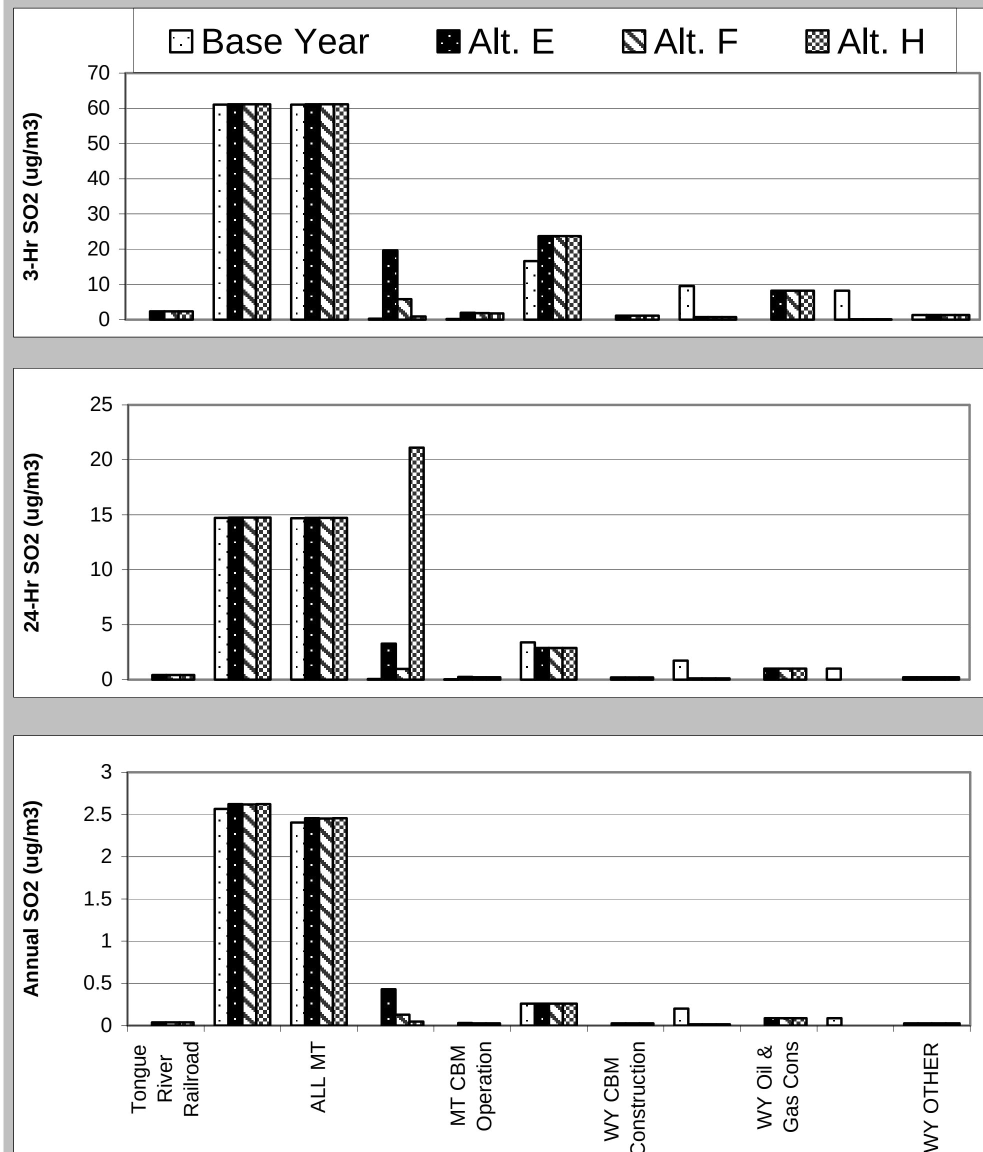


Figure 3-6 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Crow Indian Reservation



Applicable Standards (ug/m3)

NAAQS: 1300

NAAQS: 260

NAAQS: 60

Figure 3-7
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Cloud Peak Wilderness

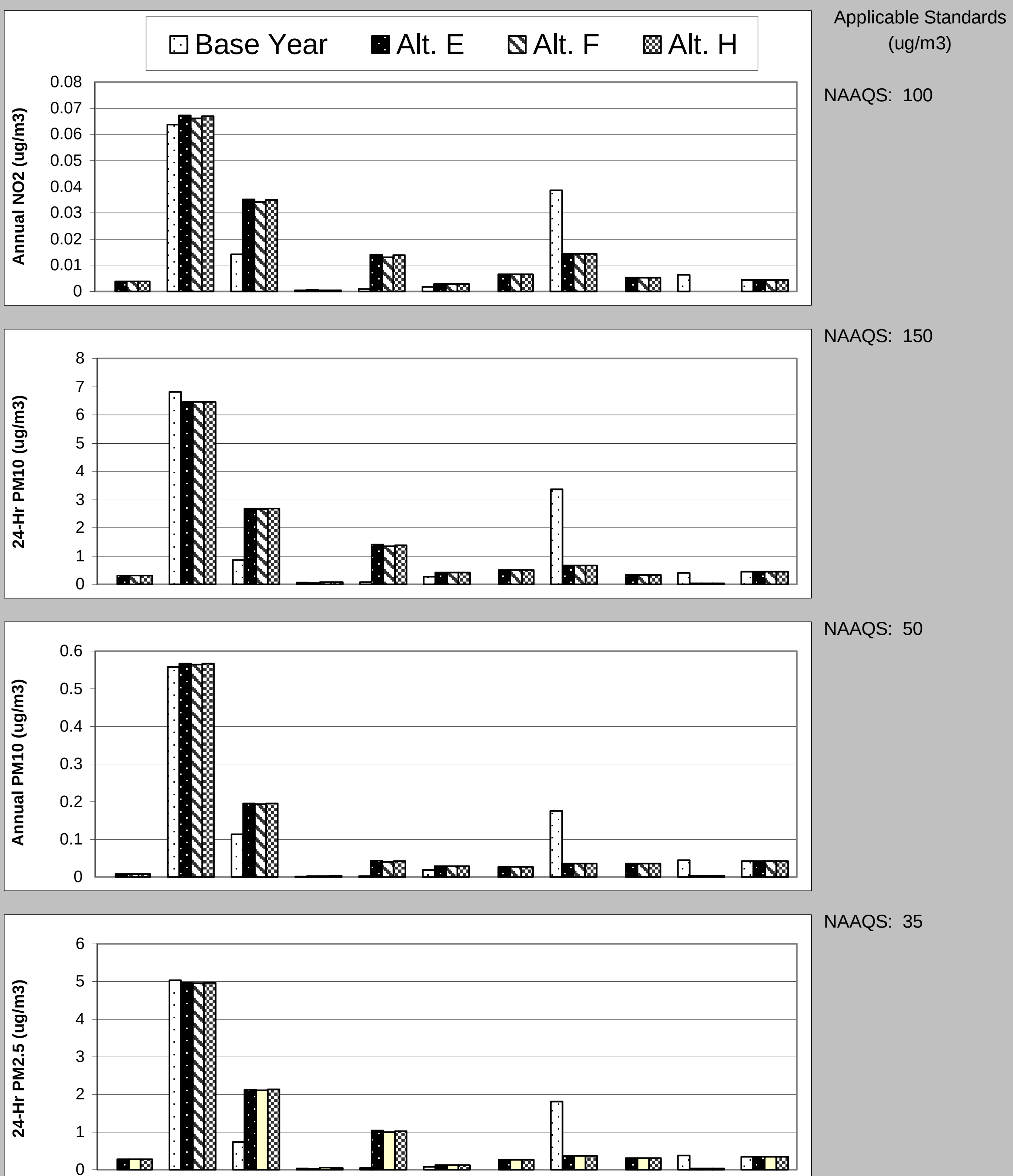


Figure 3-7 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Cloud Peak Wilderness

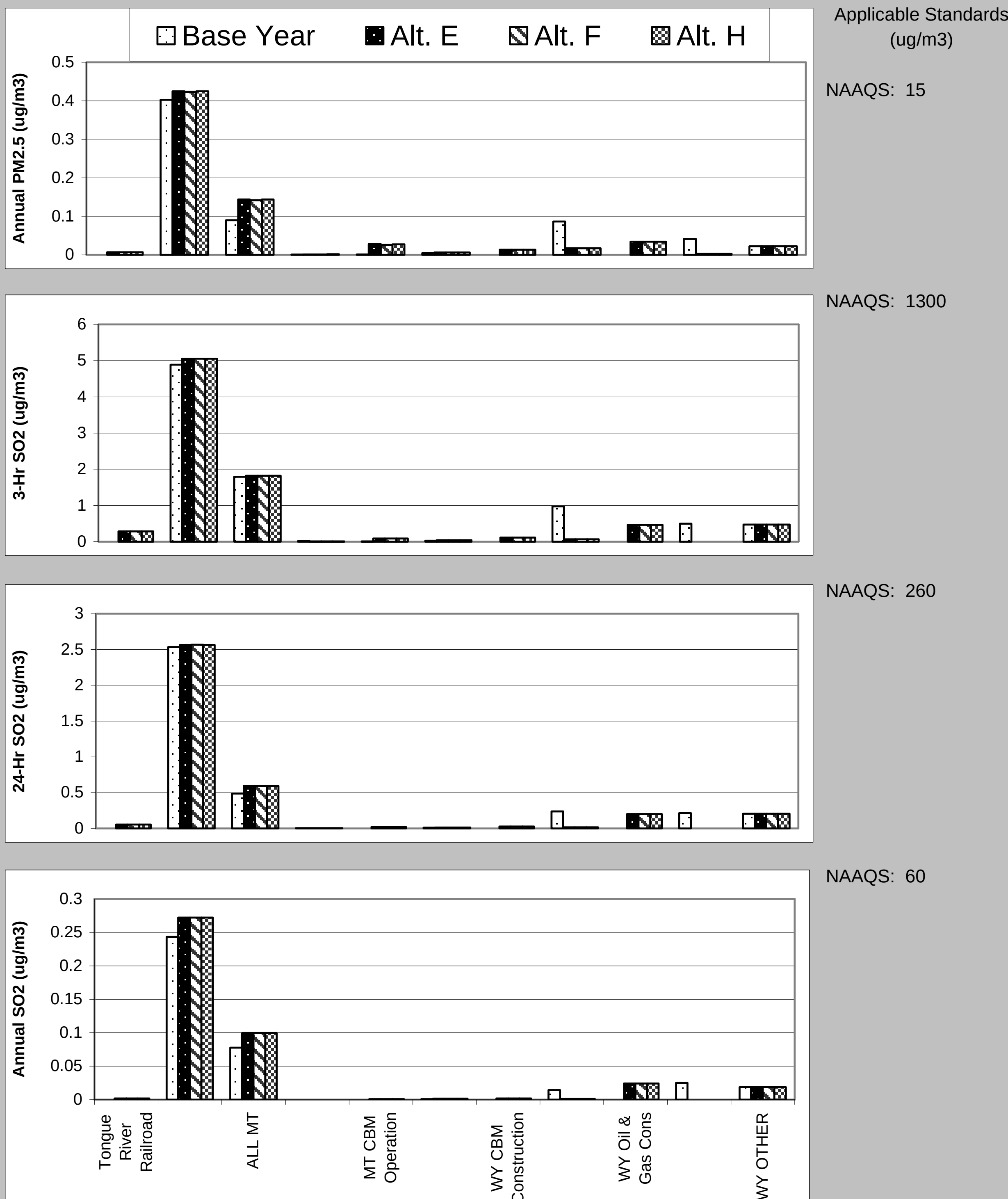


Figure 3-8
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Bighorn Canyon NRA

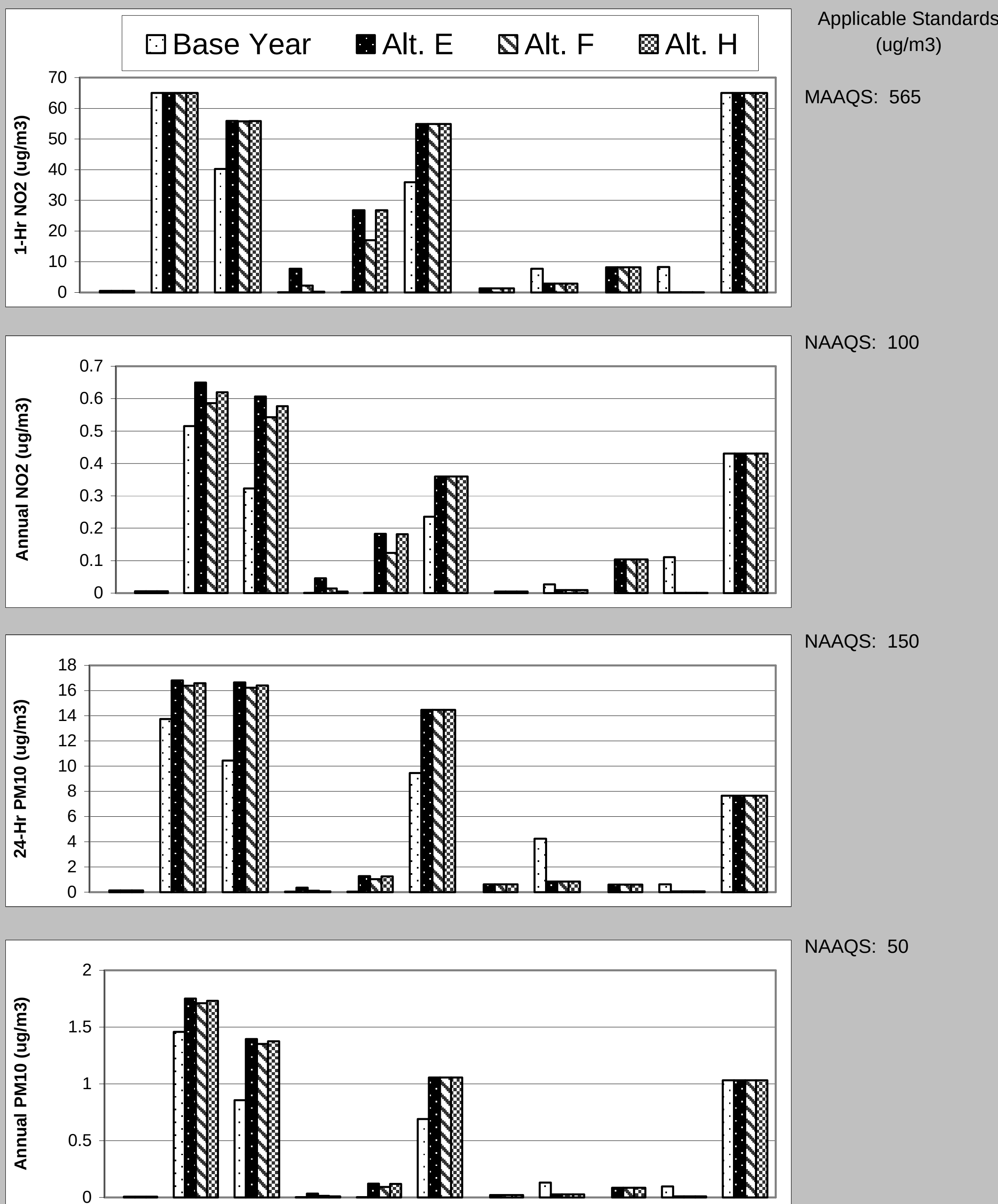


Figure 3-8 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Bighorn Canyon NRA

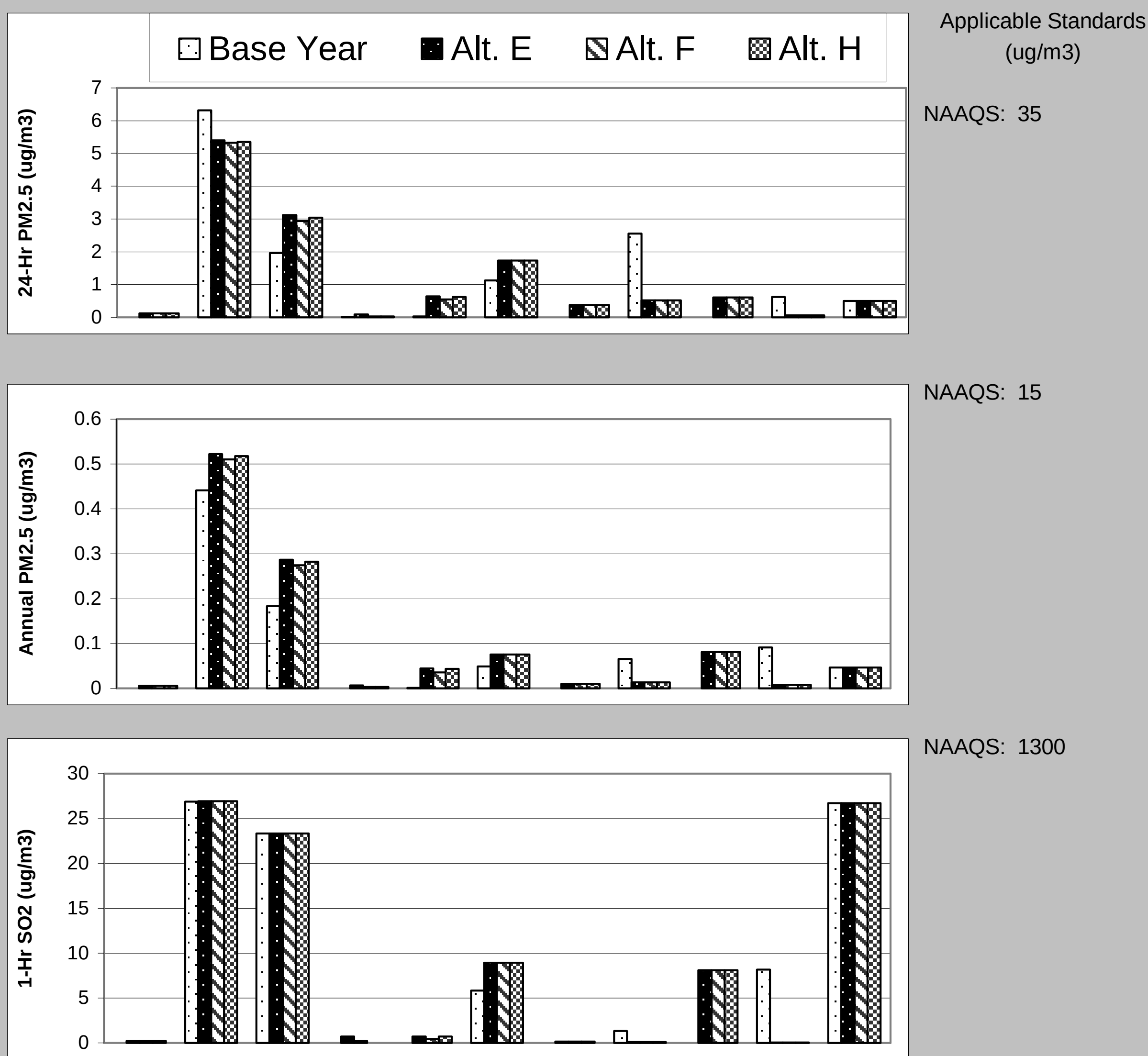


Figure 3-8 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Bighorn Canyon NRA

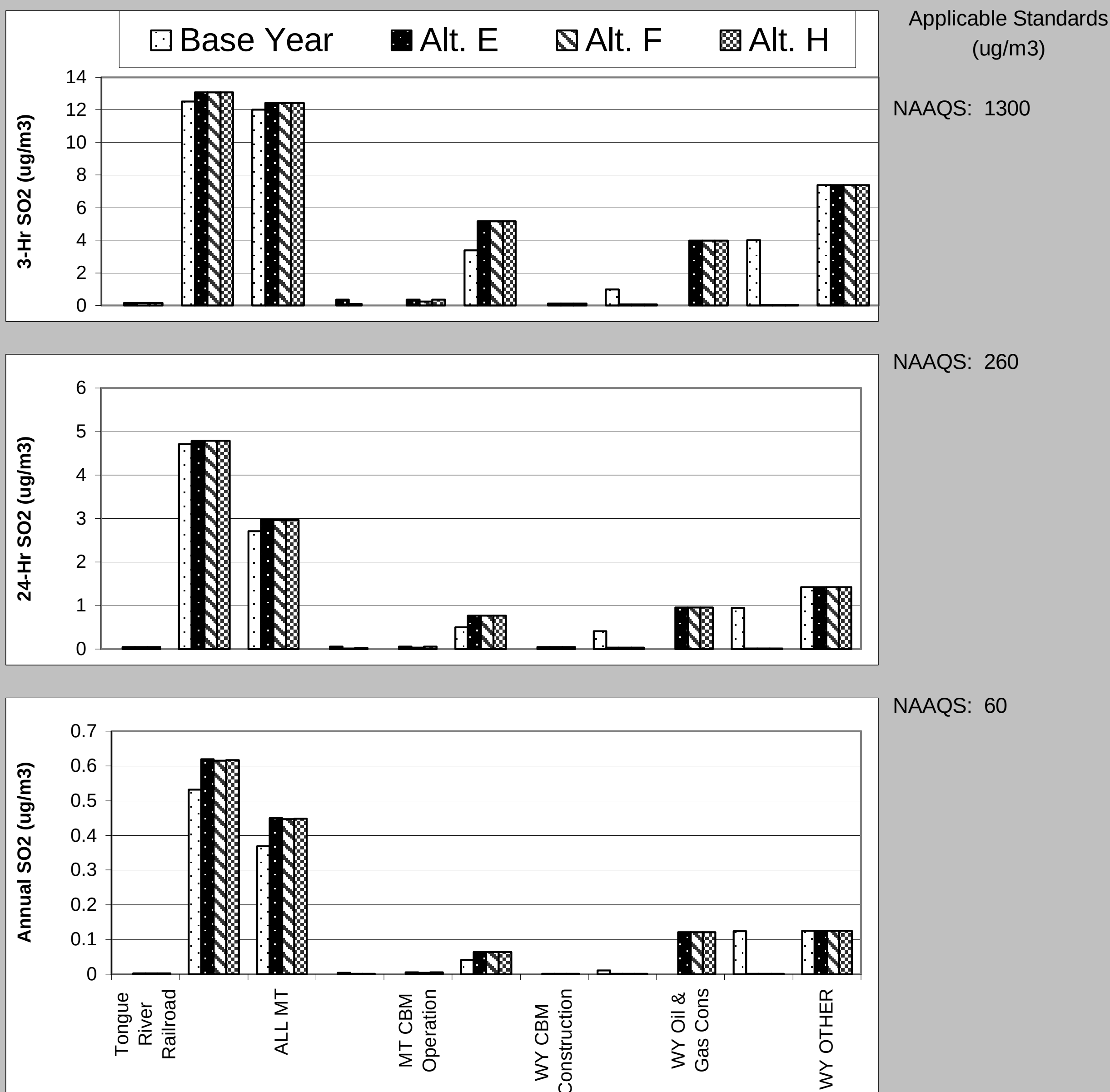


Figure 3-9
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Wind River Indian Reservation

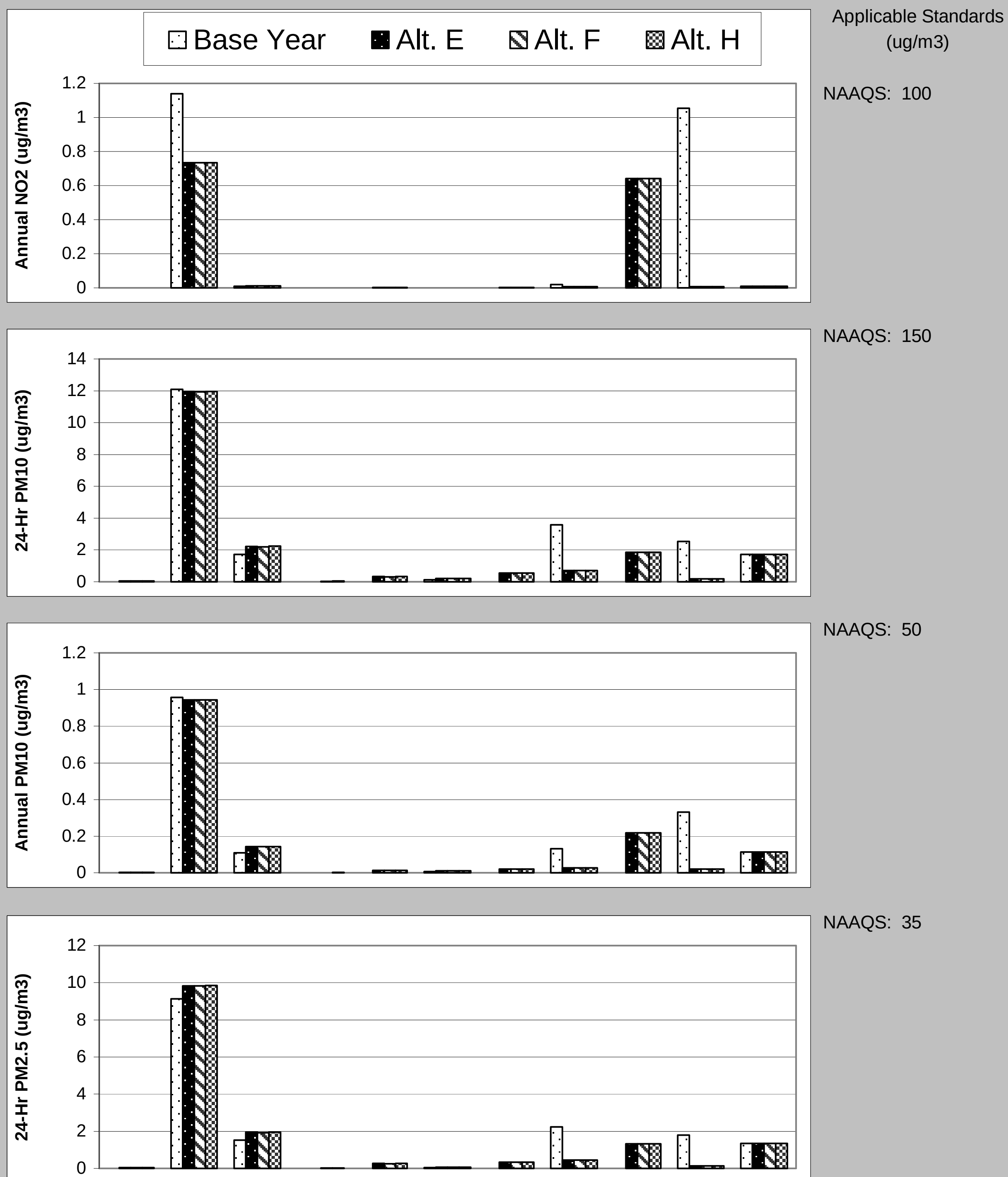
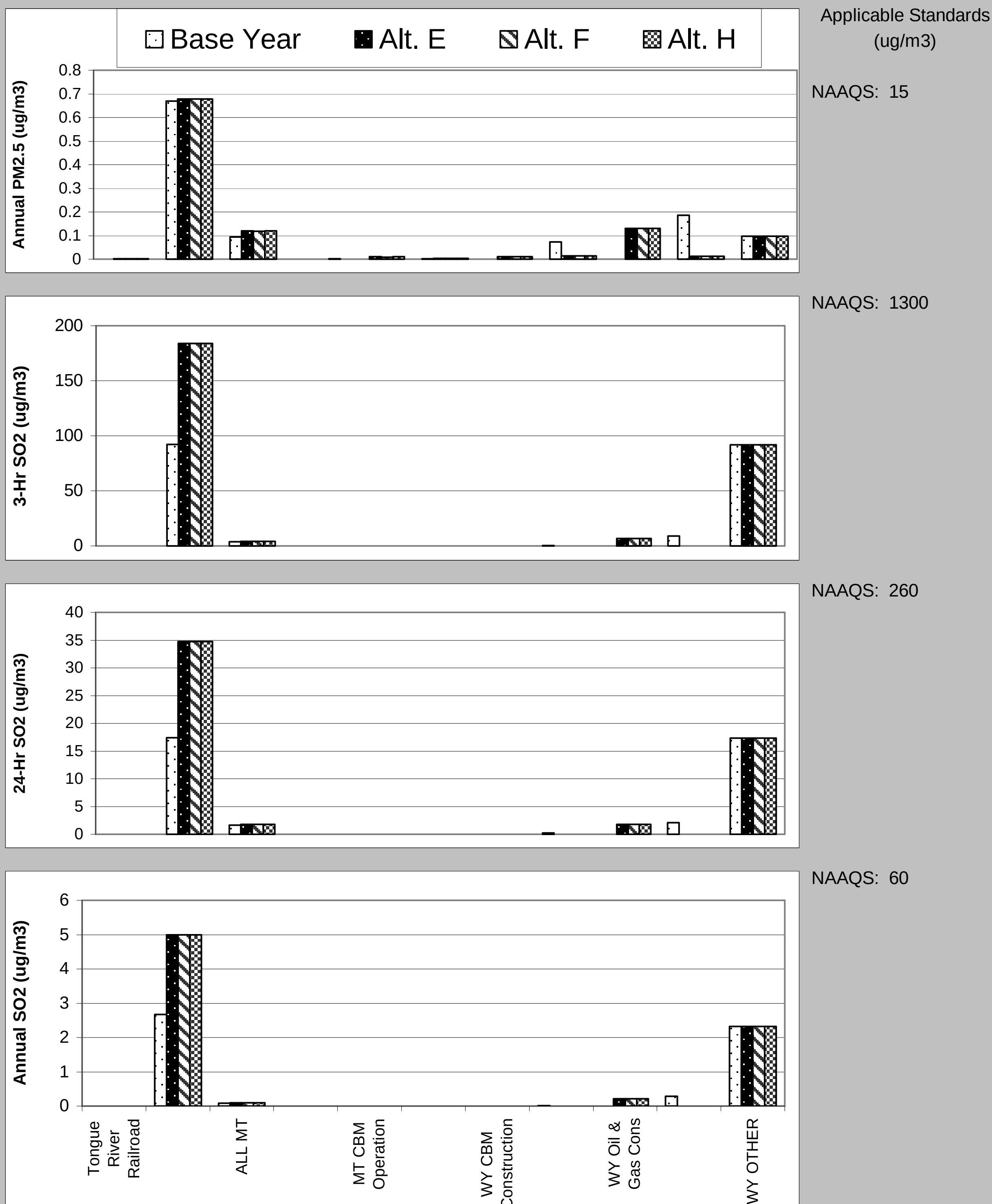


Figure 3-9 (continued)
Change in Modeled Concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$
Wind River Indian Reservation



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ATTACHMENT A

Review of Information on Health Effects

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Attachment A

REVIEW OF INFORMATION ON HEALTH EFFECTS

Introduction

In response to the findings of ambient air quality potential impacts in the Powder River Basin of Montana and Wyoming, resulting from current and projected development, this Attachment contains a summary of published information regarding potential health effects from Particulate Matter (PM). The modeled impacts showed the potential for PM_{10} concentrations to exceed the 24-hour ambient standards. The modeled exceedances were confined to a small number of receptors generally near major source development, such as coal fired power plants and coal mines.

Air monitoring station data collected for 2004 in Montana showed no exceedances of the 24-hour PM_{10} standard.

PM10 Health Effects: The health effects of short-term particulate concentrations on the public health have been reviewed in great detail, and were again reviewed as a part of the EPA-mandated evaluation of current ambient air quality standards. The most recent review (EPA 2004: *Air Quality Criteria for Particulate Matter*, EPA/600-P-99/002aF, October 2004) focuses on the establishment of the alternate $PM_{2.5}$ standards and discussed PM levels in general. The study summarizes both morbidity and mortality of potential impacts for both short term and long term exposures. The current standards for PM_{10} (150 $\mu g/m^3$ for 24 hours and 50 $\mu g/m^3$ for annual standards) are focused on protecting against morbidity and mortality effects. The study re-iterates a previous conclusion that "Efforts to quantify the number of deaths attributable to, and the years of life lost to, ambient PM exposures are currently subject to much uncertainty."

Recently a new PM standard ($PM_{2.5}$) has been promulgated, and state regulatory agencies are currently implementing programs to address those standards. $PM_{2.5}$ levels are being measured at Lame Deer in the study area, and results show that those levels are below the established ambient standards.

The potential impacts of PM concentrations are focused on sensitive populations, including those with existing cardiopulmonary disease. Nine percent of adults and eleven percent of children are diagnosed with asthma. There is some evidence that socioeconomic status also plays a role in predicting exposure and impact of PM levels of concern.

The study concludes that "Of concentration–response functions for PM-related effects, it can generally be said that the effect estimates are small in magnitude. In historical episodes with very high air pollution levels, risks on the order of a four-fold increase in mortality were estimated, but much smaller risk estimates have been reported from recent studies at current pollution levels."

"Relative risk estimates for total mortality from the prospective cohort studies fall in the range of 7 to 13 percent increase per 10 $\mu g/m^3$ increase in $PM_{2.5}$; there are no significant associations with long-term exposure to $PM_{10-2.5}$. Risk estimates from the short-term exposure studies are considerably smaller in magnitude, on the order of 2 to 6 percent increase in mortality per 25 $\mu g/m^3$ increase in $PM_{2.5}$ and $PM_{10-2.5}$."

"Effect estimates for morbidity responses to short-term changes in PM tend to be larger in magnitude that those for mortality; those for hospitalization generally range from 4-10 percent increases for cardiovascular diseases and 5-15 percent increases for respiratory diseases per 25 $\mu g/m^3$ increase in $PM_{2.5}$ and $PM_{10-2.5}$. From the more recent studies on visits to the emergency department or physicians' offices for respiratory conditions, effect estimate sizes have been somewhat larger, ranging up to about 35 percent per 25 $\mu g/m^3$ increase in $PM_{2.5}$."

As is indicated in the referenced EPA study, the predictive impact of these studies on individual small communities is subject to much uncertainty. However, given the fact that predicted impacts that exceed the 24-hour ambient air quality standard for PM_{10} are in remote, generally unpopulated areas, and that sensitive populations would generally not be confined to these areas, it is unlikely that the modeled impacts of PM_{10} levels would lead to any actual increase in morbidity or mortality of specific receptor populations.

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ATTACHMENT B

Review of Mitigation Measures

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Attachment B

REVIEW OF MITIGATION MEASURES

Model results have indicated the potential for PM_{10} to exceed the 24-hour regulatory standard. In addition, both PM_{10} and NO_x have the potential to impact visibility within PSD Class I and Class II areas. The following mitigation measures for PM and NO_x are those that are commonly employed to control air emissions. Other mitigation measures could be employed to achieve a desired control, including in tribal designated Class I areas, such as the Northern Cheyenne Indian Reservation. Additionally, through the air permitting process regulatory agencies may require specific controls based on the volume and type of emissions or the location of the emission source.

Mitigation of PM: Emissions of $PM_{2.5}$ and PM_{10} from industrial operations can be subjected to a wide range of mitigation activities or controls. Emissions of these pollutants from industrial sources, including stacks or vents, are often controlled satisfactorily by employing bag filters or electrostatic precipitators. Emissions of $PM_{2.5}$ and PM_{10} from these sources is generally subjected to review by air permitting agencies, because the nature of the source would trigger the need to obtain an air permit to construct such a facility. Any modifications to those facilities would also trigger the need to obtain such a permit. As a part of the review of those permits, agencies ensure that emissions are controlled and that impacts are with acceptable concentrations.

The $PM_{2.5}$ and PM_{10} emissions from fugitive sources, such as material stockpiles, construction operations, and material handling operations are also subject to potential mitigating controls. As impacts are identified, any impacts of concern can be addressed by imposing the related mitigation measures.

In general the mitigation measures that can be employed for materials handling, construction, hauling operations, and storage activities can be summarized as in the list of activities below.

(1) Surface exposure. When vegetation is removed from the right-of-ways for hauling or construction activities, applicants shall clear the smallest possible amount of cover to minimize the impact of wind erosion and fugitive dust.

(2) Revegetation. Where vegetation has been removed, and soils exposed, begin revegetation as soon as possible, and enhance revegetation with mulching or matting to stabilize the surface and promote plant growth.

(3) Construction or soil excavation. For exposed active construction surfaces and related stockpiles, include dust suppression activities such as surface watering or stabilization with chemical surfactants.

(4) Construction and handling during windy periods. Restrict construction or material handling operations during periods with high winds, such as a threshold of 30 miles per hour. Enhance surface water sprays as an option.

(5) Hauling operations. Maintain all haul roads that are continually active by surface watering, chemical stabilization, restricted vehicle speeds, and removal of all spillage onto the roadway surface. Cover and maintain the roadways with dust-inhibiting material to include gravel or small rocks.

(6) Construction equipment operations. Require the use of high quality (low sulfur) diesel fuel in all diesel-fired construction or operational engines. Maintain all engines in satisfactory operating conditions.

Mitigation of NO_x: NO_x, which includes nitrogen oxide (NO) and nitrogen dioxide (NO_2), is produced as a byproduct of combustion. Efforts aimed at controlling NO_x emissions and ambient air impacts can be focused on either decreasing the emissions or increasing the dispersion.

The EPA has researched mechanisms that govern the formation of NO_x during combustion as a basis for reducing NO_x emissions from combustion sources. EPA's early efforts focused on the prevention of NO_x through modification of the combustion process, since this approach held the promise of higher emissions reductions and greater economic efficiency than the use of flue gas treatment for NO_x control. There have been significant advances in combustion technology which can reduce the primary production of NO_2 at the combustion source. Control of NO_x is a complex process affected by the nitrogen content of the fuel, the amount and distribution of air in the combustion process, temperature, unit load, and burner design, among other factors. Therefore, NO_x emissions can vary significantly with changes in temperature and air/fuel mixing, and are controlled primarily by modifying the basic combustion process, with the result that combustion modification NO_x controls directly affect not only emissions, but often the efficiency and operability of the unit as well.

Flue gas control of NO_x consists of adding secondary control systems to the exhaust gas from a combustion process. Types of secondary control systems include selective catalytic systems, non-selective catalytic systems, chemical scrubbers, and wet scrubbers. In most cases, these types of control systems require periodic replacement, regeneration, or disposal of wastes resulting from their actions, which leads to increased costs for operation.

Another alternative for NO_x emissions control is to eliminate the combustion source and replace it with an electric process. Electric motors can be used to replace combustion driven engines.

Increased dispersion of NO_x emissions does not reduce emissions at the source, but acts to reduce near field impacts by spreading the emissions over a larger area. Enhanced dispersion can be achieved by increasing the buoyancy of the emissions or increasing the height of the emissions release in relation to the topographic surroundings. Buoyancy can be increased by increasing the temperature of the exhaust or by increasing the exhaust flow velocity. Release height is governed by good engineering practices, which limits the actual stack height allowed in relation to existing surrounding features, or a maximum allowable height, whichever is less.

Another mitigation alternative includes the regulatory permitting process, which would act to protect ambient air quality by preventing the issuance of permits in areas that would experience significant impacts from additional permitted sources.

The following mitigation measure are commonly employed to prevent potential impacts from NO_x which could lead to exceedances of federal or state ambient air quality standards:

(1) Implement Best Available Control Technology (BACT) for the emissions unit. For compressor engines, this can result in NO_x emission rate of 1 g/bhp-hr, which is lower than the 1.5 g/bhp-hr rate used in the modeling.

(2) Utilize electric powered compressor engines in place of fuel combustion sources. Using electric-powered compressor motors in place of the typical natural gas-fired compressor engines could eliminate primary NO_x emissions from compressor stations.

(3) Use alternative fuels, which have lower fuel nitrogen content. Natural gas-fired compressor engines typically have lower NO_x emissions than diesel-fired engines.

(4) Increase dispersion of NOx emissions to reduce near field impacts by spreading emissions over a larger area.

(5) Use of regulatory permitting to prevent new or additional sources into areas where their emissions would cause significant impacts to ambient air quality identified through the permitting process.