APPENDIX E
AIR QUALITY IMPACT TECHNICAL SUPPORT DOCUMENT

As discussed in chapter 4, an air quality impact assessment was conducted during preparation of the Wyoming Final EIS and Proposed Plan for the PRB Oil and Gas Project **(BLM 2003)** and the Montana Statewide Final Oil and Gas EIS and Proposed Amendment of the Powder River and Billings RMPs **(BLM 2003).** These documents will be referred to as the "Wyoming PRB Oil and Gas EIS" and the "Montana Statewide EIS" in the following discussion. The air quality impact analysis was prepared to evaluate the impacts of proposed oil and gas development in northeastern Wyoming and southeastern Montana on air quality in the region. This air quality impact assessment included projected coal mining operations in the Wyoming and Montana PRB, and the results are included in the cumulative impact section of this EIS and this appendix. 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. Environmental Assessment Division.

2002. Technical Support Document - *Air Quality Impact Assessment for the Montana Final Statewide Oil and Gas EIS and Proposed 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.* Argonne, Illinois.

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

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INTRODUCTION

Air pollution impacts are limited by local, state, tribal and federal air quality regulations, standards, and implementation plans established under the Clean Air Act (CAA) and administered by the WDEQ/AQD and the EPA. Although not applicable to the Alternatives analyzed in the Wyoming PRB Oil and Gas EIS or this EIS, the Montana Department of Environmental Quality, Air and Waste Management Bureau (MTDEQ-AWM) has similar jurisdiction over potential air pollutant emission sources in Montana, which can have a cumulative impact with WDEQ/AQD approved sources.

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (i.e., well operations, booster [field] and pipeline [sales] 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 Forest Service (FS), National Park Service (NPS), and the Fish and Wildlife Service (FWS) have also expressed concerns regarding potential atmospheric deposition (acid rain) and visibility impacts within distant downwind PSD (prevention of significant deterioration) Class I and PSD Class II sensitive areas under their administration, located throughout Wyoming, Montana, southwestern North Dakota, western South Dakota, and northwestern Nebraska.

EXISTING AIR QUALITY

The project area for the Wyoming PRB Oil and Gas EIS includes Campbell, Sheridan, Johnson, and northern Converse counties. The project area for the Montana Statewide EIS includes all of Carter, Powder River, Big Horn, Yellowstone, Carbon, Stillwater, Sweetgrass, Wheatland, Golden Valley, Musselshell, and Treasure counties, and portions of Rosebud and Custer counties. The analysis area for the West Hay Creek LBA tract is located in northern Campbell County, Wyoming, which lies in the eastern part of the project area for the Wyoming and PRB Oil and Gas EIS.

As described in chapter 3, specific air quality monitoring is not conducted throughout most of the project area for the Wyoming PRB Oil and Gas Project EIS and the Montana Statewide EIS. 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. As part of the air quality impact assessment prepared by Argonne National Laboratory (Argonne 2002), monitoring data measured throughout northeastern Wyoming and southeastern Montana 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 project area. Specific values presented in Table AQ-1 were used to define background conditions in the air quality impact analysis. The assumed background pollutant concentrations are below applicable ambient air quality standards for all pollutants and averaging times. These National and Wyoming

standards, and PSD increment values, are also presented in table AQ-1.

REGULATORY FRAMEWORK

The NAAQS and WAAQS 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 project area for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS is in attainment with all ambient air quality standards, as demonstrated by the relatively low concentration levels presented in table AQ-1. However, four areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Sheridan, Wyoming (PM_{10} - moderate); and Billings (CO), Lame Deer (PM_{10} - moderate) and Laurel (SO_2 - primary), Montana. EPA Region 8 staff are concerned that PM_{10} monitoring data collected near and south of Gillette, Wyoming, have also exceeded both the NAAQS and the available PSD Class II increment. Specific monitoring data are presented in tables AQ-2 and AQ-3.

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. In addition, 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 both FLPMA and the CAA, BLM can not authorize any activity which would not conform to all applicable local, state, tribal, and federal air quality laws, regulations, standards, and implementation plans.

Given the current attainment status for most of the Project Area for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS, 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 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.

TABLE AQ-1
ASSUMED BACKGROUND CONCENTRATIONS, APPLICABLE AMBIENT AIR QUALITY STANDARDS, AND PSD INCREMENT VALUES
(in $\mu g/m^3$)

Pollutant	Averaging Time [a]	Background Concentration	National Ambient Air Quality Standards	Wyoming Ambient Air Quality Standards	PSD Class I Increment	PSD Class II Increment
carbon monoxide	1-hour	3,500[b]	40,000	40,000	- - -	- - -
	8-hours	1,500[b]	10,000	10,000	- - -	- - -
Lead	Quarterly	n/a	1.5	1.5	- - -	- - -
Nitrogen dioxide	Annual	16.5[c]	100	100	2.5	25
Ozone	1-hour	82[d]	235	235	- - -	- - -
	8-hours	130[d]	157	157	- - -	- - -
$PM_{2.5}$	24-hours	19[f]	65	65	- - -	- - -
	Annual	7.6[f]	15	15	- - -	- - -
PM_{10}	24-hours	42[f]	150	150	8	30
	Annual	17[f]	50	50	4	17
sulfur dioxide	3-hours	8[e]	1,300	1,300	25	512
	24-hours	8[e]	365	260	5	91
	Annual	3[e]	80	60	2	20

Notes:

[a]Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.

[b]Amoco Ryckman Creek collected for an 8-month period during 1978-1979, summarized in the Riley Ridge EIS (BLM 1983).

[c]Data collected in Gillette, Wyoming (1996 – 1997).

[d]Data collected in Pinedale, Wyoming (1992 – 1994).

[e]Data collected at Devil's Tower (1983).

[f]Data collected in Gillette, Wyoming (1999).

Source: Argonne (2002)

n/a - data not available

TABLE AQ-2
ANNUAL AVERAGE PM_{10} MONITORING DATA COLLECTED NEAR AND SOUTH OF GILLETTE, WYOMING

(in $\mu g/m^3$)

Location	Station Number	1996	1997	1998	1999	2000	2001	2002 [a]
Rochelle R0-1	869	n/a	n/a	[15.3]	24.2	20.2	22.6	[25] [b]
North Rochelle E	874	n/a	n/a	n/a	[40] [b]	[51] [b]	[50] [b]	[35] [b]
Black Thunder BTM 26-2	877	21.0	17.7	23.2	33.4	30.9	25.6	[30] [b]
Antelope Site 4	881	n/a	14.5	13.4	16.2	16.7	19.8	[12] [b]
Triton Coal / Buckskin Mine	884	11.5	12.6	12.1	12.0	17.6*	18.3	[16] [b]
Cordero Hv-2	885	14.3	15.3	15.1	14.5	26.0*	24.3*	[30] [b]
Cordero Hv-3	889	11.9	10.9	10.4	9.7	17.1	19.8	[14] [b]
Coal Creek Ccm 26	890	9.0	7.9	8.6	8.5	8.3	[2.0]	n/a
Thunder Basin Coal / BTM	891	13.8	12.0	14.4	17 [b]	24.5	37 [b]	[57] [b]
Belle Ayr Ba-4, 5n, 5s	892	15.5	14.6	14.2	15.0	20.1	25 [b]	[20] [b]
Jacob Ranch Site 4	894	28.3	24.3*	25.1*	35.4*	35.9*	30.6*	n/a
Dry Fork Coal Co	896	13.8	13.0	10.5	9.3	10.8	13.2	[13] [b]
Triton Coal / Gillette	899	21.5	22.7	15.3	17.2	19.0*	21.0	[18] [b]
AMAX Eagle Butte Eb-5	900	12.5	10.6	11.6	11.7	15.0	15 [b]	[15] [b]
Jacob Ranch Site 5	905	15.0	14.6	15.1	20.5	21.3	31.7	n/a
North Rochelle 1	907	n/a	20.6	18.4	38.6	46.8	**50.8**	[52] [b]
Black Thunder BTM 36-1	915	n/a	n/a	n/a	n/a	[18] [b]	26 [b]	[16] [b]
Gillette, Wyoming	1002	16.1	16.7	17.6*	19.1*	20.7*	19.9*	[17] [b]

Notes:

[a] Incomplete data year; values reported through July 1, 2002.

[b] Supplemental data provided by (Payton 2002).

$\mu g/m^3$ - micrograms per cubic meter.

n/a - data not available.

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

data* - starred data are combined from two or more samplers operating at the same location during the same year.

Source: EPA (2002)

TABLE AQ-3
SECOND MAXIMUM 24-HOUR AVERAGE PM_{10} MONITORING DATA COLLECTED NEAR AND SOUTH OF GILLETTE, WYOMING

(in $\mu g/m^3$)

Location	Station Number	1996	1997	1998	1999	2000	2001	2002 [a]
Rochelle R0-1	869	n/a	n/a	[23]	62	46	63	[55] [b]
North Rochelle E	874	n/a	n/a		122	143	**156** [b]	[124] [b]
Black Thunder BTM 26-2	877	66	44	55	125	123	101	[62] [b]
Antelope Site 4	881	n/a	32	32	35	50	54	[25] [b]
Triton Coal / Buckskin Mine	884	31	34	36	36	53*	73 [b]	[43] [b]
Cordero Hv-2	885	32	36	42	36	73*	65*	[55] [b]
Cordero Hv-3	889	30	22	25	26	46	47	[40] [b]
Coal Creek Ccm 26	890	20	16	23	25	31	n/a	n/a
Thunder Basin Coal / BTM	891	34	26	39	43 [b]	80	97 [b]	[155] [b]
Belle Ayr Ba-4, 5n, 5s	892	39	34	53	56	48	70 [b]	[35] [b]
Jacob Ranch Site 4	894	101	62*	54*	103*	88*	119 [b]	n/a
Dry Fork Coal Co	896	34	39	35	22	32	42	[34] [b]
Triton Coal / Gillette	899	85	65	37	45	54*	80 [b]	[73] [b]
AMAX Eagle Butte Eb-5	900	30	37	37	51	48	61	[36] [b]
Jacob Ranch Site 5	905	44 [b]	39	43	47	50	97	n/a
North Rochelle 1	907	n/a	39	49	100	125	**268** [b]	[211] [b]
Black Thunder BTM 36-1	915	n/a	n/a	n/a	n/a	[24]	76 [b]	[31] [b]
Gillette, Wyoming	1002	46 [b]	29	36*	42*	60*	43 [b]	[35] [b]

Notes:

[a] Incomplete data year; values reported through July 1, 2002.

[b] Supplemental data provided by (Payton 2002).

$\mu g/m^3$ - micrograms per cubic meter.

n/a - data not available.

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

data* - starred data are combined from two or more samplers operating at the same location during the same year.

Source: EPA 2000

A regulatory PSD increment consumption analysis may be conducted as part of a new source review, or independently. The determination of PSD increment consumption is a legal responsibility of the applicable air quality regulatory agencies, with EPA oversight. In addition, an analysis of cumulative impacts due to all existing sources and the permit

applicant's sources is also required during new source review to demonstrate that applicable ambient air quality standards will be met during the operational lifetime of the permit applicant's operations.

Coal mining in the vicinity of the West Hay Creek LBA tract is not currently affected by the PSD regulations for two reasons: surface coal mines are not on the EPA list of 28 major emitting facilities for PSD regulation, and point-source emissions from individual mines do not exceed the PSD emissions threshold of 250 tons per year.

Sources subject to the PSD permit review procedure are also required to demonstrate potential impacts to AQRVs. 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 Congress on August 7, 1977, which included wilderness areas greater than 5,000 acres in size, as well as 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 project area for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS is designated PSD Class II with less stringent requirements.

AGENCY ROLES AND AUTHORITIES

EPA

The EPA administers the federal Clean Air Act (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 PSD 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, based on the results of a PSD increment consumption model, decides to implement a federal implementation plan (FIP). Based on future regulatory modeling in cooperation with MDEQ, EPA and the Bureau of Indian Affairs (BIA) may require either tribe to apply **BACM** to unimproved roads in Indian country or other control measures sufficient to avoid exceeding the Class I and Class II increment limits for PM_{10}.

Wyoming DEQ

Wyoming regulates pollutants emitted into the air through the Wyoming Environmental Quality Act (W.S. 35-11-101 et. seq.). Wyoming is also authorized by an approved state implementation plan (SIP) to administer all requirements of the PSD permit program under the CAA. Additionally, the approved Wyoming SIP contains a number of programs which provide for the implementation, maintenance, and enforcement of the NAAQS, including a new source review program for minor source permitting which requires, among other things, application of BACT for all new or modified sources regardless of size or source category. Included as well are authorities for the control of particulate emissions, including fugitive particulate emissions from haul roads, access roads, or general facility boundaries. Wyoming is also delegated responsibility to operate an approved ambient air quality monitoring network for the purpose of demonstrating compliance with the National and Wyoming ambient air quality standards.

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 SIPs regarding the control and abatement of air pollution. Before an RMP or an amendments to an RMP is approved, the state director is to submit any known inconsistencies with SIPs 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).

Forest Service

The FS administers nine wilderness areas (WAs) that could be affected by direct effects associated with the proposed development considered in the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS: Bridger; Fitzpatrick; North Absaroka, Absaroka-Beartooth, and Washakie WAs, next to Yellowstone National Park; Teton WA; U.L. Bend WA; Cloud Peak WA; and Popo Agie WA with mandatory Class I designation. As federal land mangers, the FS 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 FS determine impairment of WAs, then BLM, the state, and/or EPA may need to mitigate this predicted adverse air quality effect.

National Park Service

Three areas administered by the NPS--Yellowstone National Park, Devils Tower National Monument, and Bighorn Canyon National Recreation Area--could be affected by direct effects associated with the proposed development considered in the Wyoming

PRB Oil and Gas Project EIS and Montana Statewide EIS. As federal land managers, the NPS 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.

AIR QUALITY IMPACT ASSESSMENT

Chapter 4 of this EIS discusses the air quality impact modeling results for the Buckskin Mine and the cumulative air quality impact assessment that was conducted for the Wyoming PRB Oil and Gas Project EIS and the Montana Statewide EIS. An extensive air quality impact assessment technical support document was also prepared by Argonne National Laboratory (Argonne 2002) and is available for review. Argonne analyzed potential impacts from: individual proposed Alternatives 1, 2A, 2B, and 3 of the Wyoming PRB Oil and Gas EIS; "Other" (non-alternative) emission sources, including surface coal mining in the Wyoming and Montana PRB; and all sources cumulatively by alternative. Alternatives 1, 2A and 2B of the Wyoming PRB Oil and Gas EIS have similar emission inventories, except half of the booster (field) compressors would be electrified under Alternative 2A, and all of the booster (field) compressors would be electrified under Alternative 2B.

The air quality impact assessment conducted for the Wyoming PRB Oil and Gas Project EIS and Montana Statewide EIS 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 incorporated. For example, the air quality impact assessment assumed that the maximum CBM, conventional oil, coal and other development would occur simultaneously, whereas actual development would occur under different time schedules.

Potential air pollutant emissions from the emission sources under the Proposed Alternative for the Wyoming PRB Oil and Gas Project EIS were combined with other (non-alternative) sources to determine the total potential cumulative air quality impacts. These other (non-alternative) sources included development associated with emission sources permitted: 1) by the WDEQ/AQD; 2) by the MTDEQ-AWM; and 3) within the states of North Dakota, South Dakota and Nebraska; plus 4) the Montana Statewide EIS Alternative sources (BLM 2002).

Potential direct, indirect, and cumulative air quality impacts from the Proposed Action and Alternatives for the Wyoming PRB Oil and Gas Project EIS, and other (non-alternative) sources, including surface coal mining in the Wyoming and Montana PRB, were analyzed and reported solely under the requirements of the National Environmental Policy Act (NEPA), in order to assess and disclose reasonably foreseeable impacts to both the public and the BLM decision maker. Due to the preliminary nature of this NEPA analysis, it should be considered an estimate of

predicted impacts. Actual impacts at the time of development (subject to air pollutant emission source permitting) are likely to be different.

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 CBM well and CBM pipeline 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% 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 hazardous air pollutant (HAP) impacts during operation. Operation emissions would primarily occur due to increased CBM pipeline compression requirements, including booster (field) and pipeline (sales) 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, BLM uses the best available scientific information to identify thresholds of significant adverse impacts. Thresholds have been identified for HAP exposure, potential ANC changes to sensitive lake water chemistry, and a 1.0 dv “just noticeable change” in potential visibility impacts.

Since neither the WDEQ/AQD 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 10% 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 10% change in the extinction coefficient (corresponding to a 2% to 5% change in contrast, for a 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 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 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 PSD 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 FLMs 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 "natural background" screening method (based on both the FLAG and WDEQ/AQD 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 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.

Estimation of Emission Factors: AP-42

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 areawide 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.

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 of CBM in the Wyoming and Montana PRB (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 **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 co-probability of such a scenario actually occurring over an entire year (or even 24-hours) is small.

- In developing the emissions inventory and model, there is uncertainty regarding ultimate oil and gas development (i.e., number of wells, equipment to be used, specific locations, etc.) Most (90%) proposed CBM wells and 30% 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 9,900 horsepower, six-unit, 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, it is possible that conditions close to this could occur in some isolated areas.

- The emissions inventory and model assumed a NO_x emission rate for compressor engines of 1.5 g/hp-hr in Montana and 1.0 g/hp-hr in Wyoming. 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 Wyoming or Montana DEQ, and on Indian lands by EPA, for field and sales compressor engines. Actual 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% change in 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. Wetting was assumed for maintenance traffic, which is not likely to occur, but this is considered to be a small effect because of limited traffic.

- Induced or secondary growth related to increases in vehicle miles traveled (VMT) (believed to be on the order of 10% 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 **RFFD** sources. Other existing increment consuming sources such as Campbell County 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 preconstruction permit applications that examine potential project-specific air quality impacts. 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.

Modeling Results

The following tables present the detailed atmospheric dispersion modeling results for the alternatives considered in the Wyoming PRB Oil and Gas Project EIS. These results are summarized in chapter 4, "Cumulative Environmental Consequences" (Air Quality). As discussed in chapter 4, the cumulative impacts predicted by the PRB air quality impact assessment would be the same under the Proposed Action and the alternatives for leasing or not leasing federal coal considered in this EIS. This is because the air quality impact analysis used market demand predictions in order to estimate levels of coal production in the PRB for modeling purposes. There is enough coal leased to the existing mines in the PRB to supply this market demand during the time of maximum CBM development activity in the PRB, which is the time when the maximum overlapping impacts to air quality would occur.

TABLE AQ-4
PREDICTED HAZARDOUS AIR POLLUTANT IMPACTS AND SIGNIFICANCE THRESHOLDS

(in $\mu g/m^3$)

Pollutant	Averaging Time	Direct Modeled Impact	Range of State Acceptable Ambient Concentration Levels[1]
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)

[1]**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

Source: Argonne (2002)

TABLE AQ-5
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 1 - PREDICTED CRITERIA POLLUTANT IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

(in µg/m^3)

Pollutant	Avg Time [a]	Location	Increment	Alt 1	Other	Cum	Background	Total	National	Wyoming
Carbon monoxide	1-hour	near-field	- - -	223	142	224	3,500	3,724	40,000	40,000
		far-field [1]	- - -	5	100	100	3,500	3,600	40,000	40,000
	8-hours	near-field	- - -	156	124	156	1,500	1,656	10,000	10,000
		far-field [2]	- - -	19	70	78	1,500	1,578	10,000	10,000
nitrogen dioxide	Annual	near-field	25	8.0	3.3	10.5	17	27	100	100
		far-field [3]	25	0.4	5.1	5.4	17	22	100	100
		far-field [2]	**2.5**	0.3	**3.9** [b]	**4.2** [b]	17	21	100	100
$PM_{2.5}$	24-hours	near-field	- - -	16.0	8.6	24.4	19	43	65	65
		far-field [3]	- - -	5.1	9.7	14.7	19	34	65	65
	Annual	near-field	- - -	1.7	0.7	2.3	8	10	15	15
		far-field [3]	- - -	0.2	1.1	1.2	8	9	15	15
PM_{10}	24-hours	near-field	**30**	20.2	9.3	**30.8** [b]	42	73	150	150
		far-field [4]	30	0.5	29.7	29.7	42	72	150	150
		far-field [2]	**8**	3.9	**9.4** [b]	**12.8** [b]	42	55	150	150
		far-field [5]	**8**	2.2	7.0	**9.2** [b]	42	51	150	150
	Annual	near-field	17	3.3	0.9	4.1	17	21	50	50
		far-field [4]	17	<0.1	2.7	2.7	17	20	50	50
sulfur dioxide	3-hours	near-field	512	3.3	4.5	4.6	8	13	1,300	1,300
		far-field [3]	512	0.7	17.1	17.1	8	25	1,300	1,300
	24-hours	near-field	91	1.7	1.8	3.2	8	11	365	260
		far-field [3]	91	0.3	5.3	5.3	8	13	365	260
	Annual	near-field	20	0.5	0.2	0.6	3	4	80	60
		far-field [3]	20	<0.1	0.4	0.4	3	3	80	60

TABLE AQ-5: FOOTNOTES

[a]Annual impacts are the first maximum value; short-term impacts are the second maximum value.

[b]It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area, and the PSD Class II increment near the maximum potential development. A regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate air quality regulatory agency.

Notes:

Alt 1 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 1 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including projected surface coal mining in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 1** and **Other** impacts, which can occur at different locations.

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

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming 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

Source: Argonne (2002)

TABLE AQ-6
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 1 - PREDICTED ATMOSPHERIC DEPOSITION IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

			Total Sulfur Deposition (kg/ha-yr)				Total Nitrogen Deposition (kg/ha-yr)				Acid Neutralizing Capacity (percent)				
Location	**PSD Class**	**Lake**	**Alt 1**	**Other**	**Cum**	**Thld**	**Alt 1**	**Other**	**Cum**	**Thld**	**Bkgd (µeq/l)**	**Alt 1**	**Other**	**Cum**	**Thld**
Bridger WA	I	Black Joe	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	69.0	0.7	1.9	2.6	10
		Deep	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	61.0	0.8	2.1	2.9	10
		Hobbs	<0.01	0.01	0.01	5	0.01	0.01	0.02	3	68.0	0.4	1.1	1.5	10
		Upper Frozen	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	5.8[a]	0.5[a]	**1.3**[a]	**1.8**[a]	**1**[a]
Fitzpatrick WA	I	Ross	<0.01	0.01	0.01	5	0.01	0.02	0.02	3	61.4	0.5	1.6	2.1	10
Absaroka-Beartooth WA	II	Stepping	<0.01	0.02	0.02	5	0.01	0.03	0.03	3	27.0	0.3	2.2	2.5	10
		Stone	<0.01	0.02	0.02	5	0.01	0.03	0.03	3	36.0	0.2	1.6	1.8	10
		Twin Island													
Cloud Peak WA	II	Emerald	<0.01	0.03	0.03	5	0.04	0.07	0.10	3	53.3	1.7	4.2	5.9	10
		Florence	<0.01	0.03	0.03	5	0.04	0.07	0.11	3	32.7	3.1	7.2	**10.4**[b]	**10**[b]
Popo Agie WA	II	Lower Saddlebag	<0.01	0.01	0.01	5	0.01	0.02	0.04	3	55.5	1.0	2.6	3.6	10

Notes:

[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 **Other** and **Cum** emission sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

[b]Potential changes in acid neutralizing capacity is predicted to exceed the applicable significance level by less than one percent due to **Cum** emission sources

Alt 1 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 1 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including projected surface coal mining in the Wyoming and Montana PRB the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 1** and **Other** impacts.

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

WA - Wilderness Area.

Source: Argonne (2002)

TABLE AQ-7
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 1 - DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS

(number of days =1.0 dv per year)

Sensitive Location	PSD Classification	Alt 1	Other	Cum
Badlands WA	mandatory federal Class I	3	13 to 17	24 to 28
Bridger WA	mandatory federal Class I	4	7 to 9	10 to 12
Fitzpatrick WA	mandatory federal Class I	4	6 to 9	10 to 12
Gates of the Mountains WA	mandatory federal Class I	0	3 to 4	4 to 4
Grand Teton NP	mandatory federal Class I	1	3 to 5	6 to 8
North Absaroka WA	mandatory federal Class I	4	9 to 13	12 to 15
Red Rock Lakes WA	mandatory federal Class I	0	0 to 1	1 to 3
Scapegoat WA	mandatory federal Class I	0	2 to 2	3 to 3
Teton WA	mandatory federal Class I	3	6 to 9	10 to 11
Theodore Roosevelt NMP (North)	mandatory federal Class I	0	0 to 1	2 to 3
Theodore Roosevelt NMP (South)	mandatory federal Class I	1	1 to 3	4 to 7
U.L. Bend WA	mandatory federal Class I	1	4 to 5	6 to 8
Washakie WA	mandatory federal Class I	5	10 to 14	15 to 18
Wind Cave NP	mandatory federal Class I	4	17 to 21	28 to 32
Yellowstone NP	mandatory federal Class I	3	8 to 11	11 to 13
Fort Peck IR	Tribal designated Class I	0	1 to 3	2 to 5
Northern Cheyenne IR	Tribal designated Class I	17	27 to 82	42 to 92
Absaroka-Beartooth WA	federal Class II	4	28 to 32	30 to 33
Agate Fossil Beds NM	federal Class II	2	8 to 11	15 to 19
Bighorn Canyon NRA	federal Class II	9	17 to 30	23 to 34
Black Elk WA	federal Class II	4	17 to 20	26 to 31
Cloud Peak WA	federal Class II	13	17 to 30	30 to 39
Crow IR	federal Class II	20	59 to 108	69 to 116
Devils Tower NM	federal Class II	9	17 to 25	39 to 47
Fort Belknap IR	federal Class II	1	60 to 61	61 to 62
Fort Laramie NHS	federal Class II	2	10 to 14	17 to 20
Jewel Cave NM	federal Class II	4	19 to 23	32 to 36
Mount Rushmore NMem	federal Class II	3	13 to 17	22 to 26
Popo Agie WA	federal Class II	4	7 to 9	10 to 13
Soldier Creek WA	federal Class II	2	10 to 13	18 to 21

Alt 1 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 1 impacts.
Other- Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including projected surface coal mining operations in the Montana and Wyoming PRB and the Montana Statewide EIS sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (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 1** and **Other** impacts, which can occur at different locations.
Locations: **IR**-Indian Reservation; **NHS**-National Historic Site; **NM**-National Monument; **NMP**-National Memorial Park; **NMem**-National Memorial;**NP**-National Park; **NRA**-National Recreation Area; **WA**-Wilderness Area.
Source: Argonne (2002).

TABLE AQ-8
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 2A - PREDICTED CRITERIA POLLUTANT IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

(in µg/m^3)

Pollutant	Avg Time [a]	Location	Increment	Alt 2A	Other	Cum	Back-ground	Total	National	Wyoming
carbon monoxide	1-hour	near-field	- - -	158	142	197	3,500	3,697	40,000	40,000
		far-field [1]	- - -	4	100	100	3,500	3,600	40,000	40,000
	8-hours	near-field	- - -	93	124	132	1,500	1,632	10,000	10,000
		far-field [2]	- - -	14	70	76	1,500	1,576	10,000	10,000
nitrogen dioxide	Annual	near-field	25	7.2	3.3	9.6	17	27	100	100
		far-field [3]	25	0.4	5.1	5.4	17	22	100	100
		far-field [2]	**2.5**	0.2	**3.9** [b]	**4.1** [b]	17	21	100	100
$PM_{2.5}$	24-hours	near-field	- - -	13.0	8.6	21.3	19	40	65	65
		far-field [3]	- - -	4.5	9.7	14.0	19	33	65	65
	Annual	near-field	- - -	1.5	0.7	2.1	8	10	15	15
		far-field [3]	- - -	0.2	1.1	1.2	8	9	15	15
PM_{10}	24-hours	near-field	30	17.5	9.3	27.7	42	70	150	150
		far-field [4]	30	0.4	29.7	29.7	42	72	150	150
		far-field [2]	**8**	3.4	**9.4** [b]	**12.4** [b]	42	54	150	150
		far-field [5]	**8**	1.8	7.0	**8.8** [b]	42	51	150	150
	Annual	near-field	17	3.1	0.9	3.9	17	21	50	50
		far-field [4]	17	<0.1	2.7	2.7	17	20	50	50
sulfur dioxide	3-hours	near-field	512	3.3	4.5	4.6	8	13	1,300	1,300
		far-field [3]	512	0.7	17.1	17.1	8	25	1,300	1,300
	24-hours	near-field	91	1.7	1.8	3.2	8	11	365	260
		far-field [3]	91	0.3	5.3	5.3	8	13	365	260
	Annual	near-field	20	0.5	0.2	0.6	3	4	80	60
		far-field [3]	20	<0.1	0.4	0.4	3	3	80	60

TABLE AQ-8: FOOTNOTES

Notes:

[a]Annual impacts are the first maximum value; short-term impacts are the second maximum value.

[b]It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate air quality regulatory agency.

Alt 2A - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2A impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2A**, including projected surface coal mining operations in the Montana and Wyoming PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 2A** and **Other** impacts, which can occur at different locations.

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

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming 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

Source: Argonne (2002)

TABLE AQ-9
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 2A - PREDICTED ATMOSPHERIC DEPOSITION IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

			Total Sulfur Deposition (kg/ha-yr)				Total Nitrogen Deposition (kg/ha-yr)				Acid Neutralizing Capacity (percent)				
Location	**PSD Class**	**Lake**	**Alt 2A**	**Other**	**Cum**	**Thld**	**Alt 2A**	**Other**	**Cum**	**Thld**	**Bkgd (µeq/l)**	**Alt 2A**	**Other**	**Cum**	**Thld**
Bridger WA	I	Black Joe	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	69.0	0.6	1.9	2.5	10
		Deep	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	61.0	0.7	2.1	2.8	10
		Hobbs	<0.01	0.01	0.01	5	0.01	0.01	0.02	3	68.0	0.3	1.1	1.5	10
		Upper Frozen	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	5.8[a]	0.5[a]	**1.3[a]**	**1.8[a]**	**1[a]**
Fitzpatrick WA	I	Ross	<0.01	0.01	0.01	5	0.01	0.02	0.02	3	61.4	0.5	1.6	2.0	10
Absaroka-Beartooth WA	II	Stepping Stone	<0.01	0.02	0.02	5	<0.01	0.03	0.03	3	27.0	0.3	2.2	2.5	10
		Twin Island	<0.01	0.02	0.02	5	<0.01	0.03	0.03	3	36.0	0.2	1.6	1.8	10
Cloud Peak WA	II	Emerald	<0.01	0.03	0.03	5	0.03	0.07	0.10	3	53.3	1.5	4.2	5.7	10
		Florence	<0.01	0.03	0.03	5	0.03	0.07	0.10	3	32.7	2.8	7.2	10.0	10
Popo Agie WA	II	Lower Saddlebag	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	55.5	0.9	2.6	3.5	10

TABLE AQ-9: FOOTNOTES

Notes:

[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 **Other** and **Cum** emission sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

Alt 2A - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2A impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2A**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 2A** and **Other** impacts.

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

WA - Wilderness Area.

Source: Argonne (2002)

TABLE AQ-10
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 2A – DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS

(number of days =1.0 dv per year)

Sensitive Location	PSD Classification	Alt 2A	Other	Cum
Badlands WA	mandatory federal Class I	3	13 to 17	24 to 27
Bridger WA	mandatory federal Class I	4	7 to 9	10 to 12
Fitzpatrick WA	mandatory federal Class I	3	6 to 9	9 to 12
Gates of the Mountains WA	mandatory federal Class I	0	3 to 4	4 to 4
Grand Teton NP	mandatory federal Class I	1	3 to 5	6 to 7
North Absaroka WA	mandatory federal Class I	3	9 to 13	12 to 14
Red Rock Lakes WA	mandatory federal Class I	0	0 to 1	1 to 3
Scapegoat WA	mandatory federal Class I	0	2 to 2	2 to 3
Teton WA	mandatory federal Class I	3	6 to 9	9 to 11
Theodore Roosevelt NMP (North)	mandatory federal Class I	0	0 to 1	2 to 3
Theodore Roosevelt NMP (South)	mandatory federal Class I	0	1 to 3	4 to 6
U.L. Bend WA	mandatory federal Class I	1	4 to 5	5 to 8
Washakie WA	mandatory federal Class I	4	10 to 14	14 to 18
Wind Cave NP	mandatory federal Class I	3	17 to 21	27 to 30
Yellowstone NP	mandatory federal Class I	2	8 to 11	11 to 13
Fort Peck IR	Tribal designated Class I	0	1 to 3	2 to 5
Northern Cheyenne IR	Tribal designated Class I	16	27 to 82	39 to 91
Absaroka-Beartooth WA	federal Class II	3	28 to 32	29 to 33
Agate Fossil Beds NM	federal Class II	1	8 to 11	14 to 17
Bighorn Canyon NRA	federal Class II	8	17 to 30	22 to 34
Black Elk WA	federal Class II	3	17 to 20	25 to 29
Cloud Peak WA	federal Class II	12	17 to 30	28 to 38
Crow IR	federal Class II	16	59 to 108	69 to 115
Devils Tower NM	federal Class II	6	17 to 25	36 to 44
Fort Belknap IR	federal Class II	1	60 to 61	61 to 61
Fort Laramie NHS	federal Class II	2	10 to 14	17 to 19
Jewel Cave NM	federal Class II	3	19 to 23	30 to 35
Mount Rushmore NMem	federal Class II	2	13 to 17	21 to 25
Popo Agie WA	federal Class II	3	7 to 9	10 to 12
Soldier Creek WA	federal Class II	1	10 to 13	17 to 21

TABLE AQ-10: FOOTNOTES

Notes:

Alt 2A - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2A impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in Wyoming PRB Oil and Gas Project EIS **Alt 2A**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (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 2A** and **Other** impacts, which can occur at different locations.

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

Source: Argonne (2002)

TABLE AQ-11
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 2B - PREDICTED CRITERIA POLLUTANT IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

(in $\mu g/m^3$)

Pollutant	Avg Time [a]	Location	Increment	Alt 2B	Other	Cum	Background	Total	National	Wyoming
carbon monoxide	1-hour	near-field	- - -	157	142	170	3,500	3,670	40,000	40,000
		far-field [1]	- - -	3	100	100	3,500	3,600	40,000	40,000
	8-hours	near-field	- - -	77	124	124	1,500	1,624	10,000	10,000
		far-field [2]	- - -	9	70	74	1,500	1,574	10,000	10,000
nitrogen dioxide	Annual	near-field	25	6.3	3.3	8.8	17	26	100	100
		far-field [3]	25	0.3	5.1	5.3	17	22	100	100
		far-field [2]	**2.5**	0.2	**3.9** [b]	**4.1** [b]	17	21	100	100
$PM_{2.5}$	24-hours	near-field	- - -	10.7	8.6	19.0	19	38	65	65
		far-field [3]	- - -	3.8	9.7	13.4	19	32	65	65
	Annual	near-field	- - -	1.3	0.7	2.0	8	10	15	15
		far-field [3]	- - -	0.1	1.1	1.2	8	9	15	15
PM_{10}	24-hours	near-field	30	15.2	9.3	25.5	42	67	150	150
		far-field [4]	30	0.4	29.7	29.7	42	72	150	150
		far-field [2]	**8** [b]	3.0	**9.4** [b]	**12.1** [b]	42	54	150	150
		far-field [5]	**8**	1.5	7.0	**8.5** [b]	42	50	150	150
	Annual	near-field	17	2.9	0.9	3.7	17	21	50	50
		far-field [4]	17	<0.1	2.7	2.7	17	20	50	50
sulfur dioxide	3-hours	near-field	512	3.3	4.5	4.6	8	13	1,300	1,300
		far-field [3]	512	0.7	17.1	17.1	8	25	1,300	1,300
	24-hours	near-field	91	1.7	1.8	3.2	8	11	365	260
		far-field [3]	91	0.3	5.3	5.3	8	13	365	260
	Annual	near-field	20	0.5	0.2	0.6	3	4	80	60
		far-field [3]	20	<0.1	0.4	0.4	3	3	80	60

TABLE AQ-11: FOOTNOTES

Notes:

[a] Annual impacts are the first maximum value; short-term impacts are the second maximum value.

[b] It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 2B - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2B impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2B**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 2B** and **Other** impacts, which can occur a different locations.

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

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming 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

Source: Argonne (2002)

TABLE AQ-12

WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 2B - PREDICTED ATMOSPHERIC DEPOSITION IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

			Total Sulfur Deposition (kg/ha-yr)				Total Nitrogen Deposition (kg/ha-yr)				Acid Neutralizing Capacity (percent)				
Location	**PSD Class**	**Lake**	**Alt 2B**	**Other**	**Cum**	**Thld**	**Alt 2B**	**Other**	**Cum**	**Thld**	**Bkgd (µeq/l)**	**Alt 2B**	**Other**	**Cum**	**Thld**
Bridger WA	I	Black Joe	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	69.0	0.6	1.9	2.4	10
		Deep	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	61.0	0.6	2.1	2.7	10
		Hobbs	<0.01	0.01	0.01	5	<0.01	0.01	0.02	3	68.0	0.3	1.1	1.4	10
		Upper Frozen	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	5.8[a]	0.4 [a]	**1.3 [a]**	**1.7 [a]**	**1 [a]**
Fitzpatrick WA	I	Ross	<0.01	0.01	0.01	5	0.01	0.02	0.02	3	61.4	0.4	1.6	2.0	10
Absaroka-Beartooth WA	II	Stepping Stone	<0.01	0.02	0.02	5	<0.01	0.03	0.03	3	27.0	0.2	2.2	2.5	10
		Twin Island	<0.01	0.02	0.02	5	<0.01	0.03	0.03	3	36.0	0.2	1.6	1.8	10
Cloud Peak WA	II	Emerald	<0.01	0.03	0.03	5	0.03	0.07	0.10	3	53.3	1.3	4.2	5.5	10
		Florence	<0.01	0.03	0.03	5	0.03	0.07	0.10	3	32.7	2.5	7.2	9.7	10
Popo Agie WA	II	Lower Saddlebag	<0.01	0.01	0.01	5	0.01	0.02	0.03	3	55.5	0.8	2.6	3.4	10

Notes:

[a]Since the background acid neutralizing capacity at Upper Frozen Lake is less than 25 ?eq/l, the applicable significance threshold is less than a 1 µeq/l change. This threshold is exceeded by **Other** sources alone, as well **Cum** sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001.

Alt 2B - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2B impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2B**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 2B** and **Other** impacts.

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

WA - Wilderness Area.

Source: Argonne (2002)

TABLE AQ-13

WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 2B - DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS

(number of days =1.0 dv per year)

Sensitive Location	PSD Classification	Alt 2B	Other	Cum
Badlands WA	mandatory federal Class I	1	13 to 17	22 to 26
Bridger WA	mandatory federal Class I	3	7 to 9	9 to 11
Fitzpatrick WA	mandatory federal Class I	3	6 to 9	9 to 11
Gates of the Mountains WA	mandatory federal Class I	0	3 to 4	4 to 4
Grand Teton NP	mandatory federal Class I	0	3 to 5	5 to 7
North Absaroka WA	mandatory federal Class I	2	9 to 13	12 to 14
Red Rock Lakes WA	mandatory federal Class I	0	0 to 1	1 to 2
Scapegoat WA	mandatory federal Class I	0	2 to 2	2 to 3
Teton WA	mandatory federal Class I	2	6 to 9	9 to 11
Theodore Roosevelt NMP (North)	mandatory federal Class I	0	0 to 1	1 to 3
Theodore Roosevelt NMP (South)	mandatory federal Class I	0	1 to 3	3 to 6
U.L. Bend WA	mandatory federal Class I	1	4 to 5	5 to 7
Washakie WA	mandatory federal Class I	4	10 to 14	14 to 17
Wind Cave NP	mandatory federal Class I	2	17 to 21	25 to 28
Yellowstone NP	mandatory federal Class I	1	8 to 11	11 to 13
Fort Peck IR	Tribal designated Class I	0	1 to 3	2 to 4
Northern Cheyenne IR	Tribal designated Class I	14	27 to 82	38 to 90
Absaroka-Beartooth WA	federal Class II	3	28 to 32	29 to 33
Agate Fossil Beds NM	federal Class II	0	8 to 11	13 to 16
Bighorn Canyon NRA	federal Class II	7	17 to 30	21 to 33
Black Elk WA	federal Class II	2	17 to 20	24 to 28
Cloud Peak WA	federal Class II	9	17 to 30	27 to 37
Crow IR	federal Class II	14	59 to 108	68 to 115
Devils Tower NM	federal Class II	5	17 to 25	34 to 42
Fort Belknap IR	federal Class II	1	60 to 61	61 to 61
Fort Laramie NHS	federal Class II	1	10 to 14	16 to 19
Jewel Cave NM	federal Class II	2	19 to 23	29 to 33
Mount Rushmore NMem	federal Class II	1	13 to 17	21 to 24
Popo Agie WA	federal Class II	3	7 to 9	10 to 12
Soldier Creek WA	federal Class II	1	10 to 13	16 to 20

TABLE AQ-13: FOOTNOTES

Notes:

Alt 2B - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 2B impacts.

Other- Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 2B**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS "sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (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 2B** and **Other** impacts, which can occur at different locations.

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

Source: Argonne (2002)

TABLE AQ-14
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 3 - PREDICTED CRITERIA POLLUTANT IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

(in µg/m^3)

Pollutant	Avg Time [a]	Location	Increment	Alt 3	Other	Cum	Background	Total	National	Wyoming
carbon monoxide	1-hour	near-field	- - -	261	142	261	3,500	3,761	40,000	40,000
		far-field [1]	- - -	2	100	100	3,500	3,600	40,000	40,000
	8-hours	near-field	- - -	183	124	183	1,500	1,683	10,000	10,000
		far-field [2]	- - -	8	70	75	1,500	1,575	10,000	10,000
nitrogen dioxide	Annual	near-field	25	3.0	3.3	5.8	17	23	100	100
		far-field [3]	25	0.3	5.1	5.3	17	22	100	100
		far-field [2]	**2.5**	0.1	**3.9** [b]	**4.1** [b]	17	21	100	100
$PM_{2.5}$	24-hours	near-field	- - -	5.7	8.6	13.5	19	32	65	65
		far-field [4]	- - -	0.2	12.7	12.7	19	32	65	65
	Annual	near-field	- - -	0.7	0.7	1.3	8	9	15	15
		far-field [4]	- - -	0.0	1.2	1.2	8	9	15	15
PM_{10}	24-hours	near-field	30	7.1	9.3	15.6	42	58	150	150
		far-field [4]	30	0.2	29.7	29.7	42	72	150	150
		far-field [2]	**8**	1.5	**9.4** [b]	**10.7** [b]	42	53	150	150
		far-field [5]	8	0.9	7.0	7.8	42	50	150	150
	Annual	near-field	17	1.2	0.9	1.9	17	19	50	50
		far-field [4]	17	<0.1	2.7	2.7	17	20	50	50
sulfur dioxide	3-hours	near-field	512	1.2	4.5	4.6	8	13	1,300	1,300
		far-field [3]	512	0.3	17.1	17.1	8	25	1,300	1,300
	24-hours	near-field	91	0.6	1.8	2.2	8	10	365	260
		far-field [3]	91	0.1	5.3	5.3	8	13	365	260
	Annual	near-field	20	0.2	0.2	0.3	3	3	80	60
		far-field [3]	20	<0.1	0.4	0.4	3	3	80	60

TABLE AQ-14: FOOTNOTES

Notes:

[a]Annual impacts are the first maximum value; short-term impacts are the second maximum value.

[b]It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 3 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 3 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 3**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 3** and **Other** impacts, which can occur a different locations.

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

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming 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

Source: Argonne (2002)

TABLE AQ-15
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 3 - PREDICTED ATMOSPHERIC DEPOSITION IMPACTS AND APPLICABLE SIGNIFICANCE THRESHOLDS

			Total Sulfur Deposition (kg/ha-yr)				Total Nitrogen Deposition (kg/ha-yr)				Acid Neutralizing Capacity (percent)				
Location	**PSD Class**	**Lake**	**Alt 3**	**Other**	**Cum**	**Thld**	**Alt 3**	**Other**	**Cum**	**Thld**	**Bkgd (µeq/l)**	**Alt 3**	**Other**	**Cum**	**Thld**
Bridger WA	I	Black Joe	<0.01	0.01	0.01	5	<0.01	0.02	0.03	3	69.0	0.3	1.9	2.1	10
		Deep	<0.01	0.01	0.01	5	<0.01	0.02	0.02	3	61.0	0.3	2.1	2.4	10
		Hobbs	<0.01	0.01	0.01	5	<0.01	0.01	0.02	3	68.0	0.2	1.1	1.3	10
		Upper Frozen	<0.01	0.01	0.01	5	<0.01	0.02	0.02	3	5.8[a]	0.2[a]	**1.3[a]**	**1.5[a]**	**1[a]**
Fitzpatrick WA	I	Ross	<0.01	0.01	0.01	5	<0.01	0.02	0.02	3	61.4	0.2	1.6	1.7	10
Absaroka-Beartooth WA	II	Stepping Stone	<0.01	0.02	0.02	5	<0.01	0.03	0.03	3	27.0	0.1	2.2	2.4	10
		Twin Island	<0.01	0.02	0.02	5	<0.01	0.03	0.03	3	36.0	0.1	1.6	1.7	10
Cloud Peak WA	II	Emerald	<0.01	0.03	0.03	5	0.01	0.07	0.08	3	53.3	0.7	4.2	4.9	10
		Florence	<0.01	0.03	0.03	5	0.02	0.07	0.08	3	32.7	1.3	7.2	8.5	10
Popo Agie WA	II	Lower Saddlebag	<0.01	0.01	0.01	5	<0.01	0.02	0.03	3	55.5	0.4	2.6	3.0	10

Notes:

[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 **Other** sources alone, as well **Cum** sources. However, the background concentration is based on only six samples taken on four days between 1997 and 2001

Alt 3 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 3 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 3**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D 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 3** and **Other** impacts.

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

WA - Wilderness Area.

Source: Argonne (2002).

TABLE AQ-16
WYOMING PRB OIL AND GAS PROJECT EIS ALTERNATIVE 3 - DAILY FLAG REFINED METHOD - VISIBILITY IMPACT ANALYSIS

(number of days =1.0 dv per year)

Sensitive Location	PSD Classification	Alternative 3	Other	Cumulative
Badlands WA	mandatory federal Class I	0	13 to 17	18 to 21
Bridger WA	mandatory federal Class I	1	7 to 9	8 to 10
Fitzpatrick WA	mandatory federal Class I	1	6 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	3 to 5	4 to 6
North Absaroka WA	mandatory federal Class I	0	9 to 13	11 to 13
Red Rock Lakes WA	mandatory federal Class I	0	0 to 1	0 to 2
Scapegoat WA	mandatory federal Class I	0	2 to 2	2 to 3
Teton WA	mandatory federal Class I	0	6 to 9	7 to 10
Theodore Roosevelt NMP (North)	mandatory federal Class I	0	0 to 1	1 to 2
Theodore Roosevelt NMP (South)	mandatory federal Class I	0	1 to 3	2 to 4
U.L. Bend WA	mandatory federal Class I	0	4 to 5	5 to 6
Washakie WA	mandatory federal Class I	1	10 to 14	12 to 16
Wind Cave NP	mandatory federal Class I	0	17 to 21	22 to 25
Yellowstone NP	mandatory federal Class I	0	8 to 11	9 to 12
Fort Peck IR	Tribal designated Class I	0	1 to 3	2 to 4
Northern Cheyenne IR	Tribal designated Class I	7	27 to 82	33 to 87
Absaroka-Beartooth WA	federal Class II	0	28 to 32	28 to 32
Agate Fossil Beds NM	federal Class II	0	8 to 11	10 to 14
Bighorn Canyon NRA	federal Class II	3	17 to 30	19 to 32
Black Elk WA	federal Class II	0	17 to 20	20 to 24
Cloud Peak WA	federal Class II	3	17 to 30	23 to 35
Crow IR	federal Class II	10	59 to 108	65 to 113
Devils Tower NM	federal Class II	1	17 to 25	26 to 34
Fort Belknap IR	federal Class II	0	60 to 61	61 to 61
Fort Laramie NHS	federal Class II	0	10 to 14	13 to 16
Jewel Cave NM	federal Class II	0	19 to 23	24 to 28
Mount Rushmore NMem	federal Class II	0	13 to 17	17 to 20
Popo Agie WA	federal Class II	1	7 to 9	8 to 11
Soldier Creek WA	federal Class II	0	10 to 13	13 to 16

TABLE AQ-16: FOOTNOTES

Notes:

Alt 3 - Direct modeled Wyoming PRB Oil and Gas Project EIS Alternative 3 impacts.

Other - Direct modeled "Reasonably Foreseeable Development" impacts. The impact from all air pollutant emission sources not included in **Alt 3**, including projected surface coal mining operations in the Wyoming and Montana PRB and the Montana Statewide EIS sources. The range of values corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (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 3** and **Other** impacts, which can occur at different locations.

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

Source: Argonne (2002)

Mitigation Options

Mitigation may be applied to fugitive dust and nitrogen oxide (NO_x) impacts. Fugitive dust refers to any particulate matter that is not deliberately emitted by a well-defined source. Fugitive dust sources typically include windblown dust from unvegetated lands and unpaved roads. Table AQ-17 shows several fugitive dust mitigation options available. Other mitigation measures that are utilized by surface coal mines in Wyoming to control fugitive dust emissions are listed in chapter 3.

Nitrogen oxide emissions are associated with combustion. Table AQ-18 shows several options available to mitigate NOx impacts related to production of oil and gas, including CBM. Mitigation measures that the mines have instituted or that WDEQ may require related to coal mining operations are listed in chapter 3.

TABLE AQ17
PREDICTED VISIBILITY IMPACTS IN CLASS I AREAS – DAILY FLAG REFINED METHOD (maximum cumulative deciview change)

Class I area	Alt 1	Alt 2a	Alt 2b	Alt 3
Badlands Wilderness Area[1]	10.91	10.67	10.43	9.46
Bridger Wilderness Area	13.28	12.67	12.21	11.15
Fitzpatrick Wilderness Area	16.57	15.83	15.21	14.01
Gates of the Mtns Wilderness Area	14.99	14.61	14.22	13.17
Grand Teton National Park	6.95	6.67	6.44	5.8
North Absaroka Wilderness Area	14.89	14.12	13.51	12.21
Red Rock Lakes Wilderness Area	2.85	2.75	2.67	2.37
Scapegoat Wilderness Area	9.89	9.58	9.35	8.55
Teton Wilderness Area	14.59	13.97	13.46	12.38
Theodore Roosevelt NMP[2] (North Unit)	3.65	3.46	3.29	2.75
Theodore Roosevelt NMP[2] (South Unit)	4.62	4.37	4.14	3.51
U.L. Bend Wilderness Area	29.05	27.97	26.97	24.01
Washakie Wilderness Area	24.79	23.82	22.96	21.48
Wind Cave National Park	9.05	8.81	8.59	8.06
Yellowstone National Park	12.79	12.19	11.59	10.25
Northern Cheyenne Reservation[3]	54.75	52.8	50.71	45.02

TABLE AQ-18
FUGITIVE DUST MITIGATION MEASURES (PM_{10})
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[2]	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[3] 65% for 20 mph[3] 25% for 30 mph[3]	30% reduction	90% reduction
Estimated Cost		$4000/mile	$2,000 to $4,000/mile per year	Unknown	$9,000/mile	$11,000 to $60,000/mile

Notes:
[1]Improved and County roads
[2]Wetting of construction roads during the construction period. Wetting of construction roads not required for once a month maintenance trips to well pads.
[3]Reductions assume 40 mile per hour base speed.

TABLE AQ19
NITROGEN OXIDES (NO_X) MITIGATION MEASURES EFFICIENCY

	NO_x Emissions Sources			
	Field Compressors	**Sales Compressors**	**Temporary Diesel Generators[1]**	**Heavy Equipment**
Mitigation Options/ Efficiency	Implement best available control technology.[2] Typically results in a NO_x emission rate of about 1 g/bhp-hr.	Implement best available control technology.[2] Typically results in a NO_x emission rate of about 1 g/bhp-hr.	Register with state; WDEQ regulate as appropriate.	Voluntary use of diesel engines.

Notes:
[1]Wyoming is currently registering these generators to determine if NO_x emissions are significant.
[2]BACT could include electric compression.