The following section replaces the Air Quality affected environment that was in the Draft EIS on pages 3.12 through 3.15, and the direct and indirect "Impacts Related to Oil and Gas Development" on pages 3.18 through 3.25. The analysis of Cumulative Impacts below supplements the Cumulative Impacts analysis on pages 3.35 through 3.36 of the Draft EIS.

INTRODUCTION

The primary goal of air quality management is to protect air quality within, and adjacent to, the SJPL. The management objectives related to this goal are to:

- Ensure that the air quality within the SJPL meets State and Federal air quality standards and regulations;
- Protect visibility at Class I areas and at scenic and important vistas; and
- Cooperate directly with the State of Colorado, the EPA, and the National Park Service (NPS), with regard to air quality issues at nearby Federal Class I (Clean Air Act) areas.

Under the Federal Land Policy and Management Act of 1976 (FLPMA) and the Clean Air Act, the BLM and USFS cannot conduct or authorize any activity that does not conform to all applicable local, county, State, Native American tribal, and other Federal air quality laws, statutes, regulations, standards, and implementation plans. Therefore, an air quality effects analysis based upon atmospheric dispersion modeling was conducted to analyze potential impacts.

The San Juan Public Lands (SJPL) includes the Weminuche Wilderness Class I area, and is adjacent to Mesa Verde National Park Class I area. Class I areas have been designated within the Clean Air Act as certain areas deserving the highest level of air-quality protection. Congress designated (42 U.S.C. § 7472)(CAA § 162) 158 areas as Class I areas, including national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres, in existence on August 7, 1977. These "mandatory" Class I areas may not be re-designated to a less protective classification. Because air quality protection is legally mandated for Class I areas, this air quality impact analysis focuses more detail on the potential air quality changes at Class I areas within the Four Corners region.

In comparison to oil and gas drilling and production, other management actions on the SJPL considered throughout this analysis are expected to result in minor and short duration impacts to air quality. The modeled impacts assess the maximum reasonable scenario for oil and gas development over a 15-year period as characterized in the RFD (SJPL, 2010).

AFFECTED ENVIRONMENT

The SJPL administers the Weminuche Wilderness Class I area, located in the San Juan Mountains. Mesa Verde National Park Class I area is adjacent to the southwest portion of the SJPL. The terrain of the SJPL is considered complex, with lands to the west dominated by mesas and canyons of the Colorado Plateau and the remaining lands dominated by mountains, foothills, and river valleys of the San Juan Mountains.

Table S.3.1.1 summarizes the existing air quality data in southwestern Colorado and northwestern New Mexico for selected air pollutants. Background data were conservatively selected from the monitoring station with the highest concentrations during the "reporting period". Data have been taken from air quality measurement stations in La Plata, Colorado; Ignacio, Colorado; Farmington, New Mexico; and Mesa Verde National Park, Colorado.

Table S-3.1.1 - Background Air Quality Data

Pollutant (Units of Measurement)	Measured Ambient Concentrations ($\mu g/m^3$)	Monitoring Station
NO_2 – Annual Concentration	17	La Plata, CO
SO_2 – Annual Concentration	5.3	Farmington, NM
SO_2 – 24-hr Highest 2nd High Concentration	21	Farmington, NM
SO_2 – 3-hr Highest 2nd High Concentration	69	Farmington, NM
CO – 8-hr Highest 2nd High Concentration	1,864	Ignacio, CO
CO – 1-hr Highest 2nd High Concentration	2,330	Ignacio, CO
PM_{10} – Annual Concentration	21	La Plata, CO
PM_{10} – 24-hr Highest 2nd High Concentration	64	La Plata, CO
$PM_{2.5}$ – Annual Concentration	6.9	Farmington, NM
$PM_{2.5}$ – 24-hr Highest 2nd High Concentration	22.5	Mesa Verde NP, CO
O_3 – 8-hr Highest 2nd Concentration	142	Mesa Verde NP, CO
O_3 – 1-hr Highest 2nd Concentration	154	Mesa Verde NP, CO

In general, the ambient air measurements show that existing air quality in the project area is good. Concentrations for the various air pollutants are well below the applicable state and federal ambient air quality standards. One exception would be for ozone (O_3), where the existing air quality concentrations are approaching the ambient 8-hour air quality standard of 150 $\mu g/m^3$ (75 ppb for an 8-hour average). Ozone is not emitted directly from sources, but instead is formed through photochemical conversions in the atmosphere from other precursor pollutants, primarily VOCs and NO_x.

The SJPL operates a reference NO_2 monitoring station northeast of Bayfield, Colorado. The data from this station are summarized in Table S-3.1.2 below and show low 1-hour NO_2 concentrations in southwest Colorado compared to the National Ambient Air Quality Standard of 100 ppb.

Table S-3.1.2 - Four Highest Daily 1-hour Average NO_2 Measurements in 2008 and 2009 at Shamrock Station near Bayfield, Colorado (Air Resource Specialists, 2009 and 2010)

Date	Daily Maximum 1-Hour Average (ppb)	Date	Daily Maximum 1-Hour Average (ppb)
12/8/2008	18	1/5/2009	31
12/7/2008	17	1/23/2009	22
1/16/2008	16	12/17/2009	22
6/10/2008	16	12/1/2009	19

Ozone

The standard for ground-level ozone is an 8-hour average of 75 ppb (3 year average of the 4th highest annual 8-hour average measurement). Ozone in the Four Corners region is elevated and monitoring stations show that the region is just below the current ozone standard. Although the current ozone standard has not been exceeded in the Four Corners area, State and Federal agencies as well as industry and the public are concerned about potential non-attainment. EPA has also proposed lowering the ozone standard which could result in the designation of non-attainment areas in the Four Corners region. The SJPL operates a reference ozone monitoring station northeast of Bayfield, Colorado. The data from this station show the elevated ozone levels in southwest Colorado (Table S-3.1.3).

Table S-3.1.3 - Four Highest 8-hour Average Ozone Measurements in 2008 and 2009 at Shamrock Station near Bayfield, Colorado (Air Resource Specialists, 2008 and 2009)

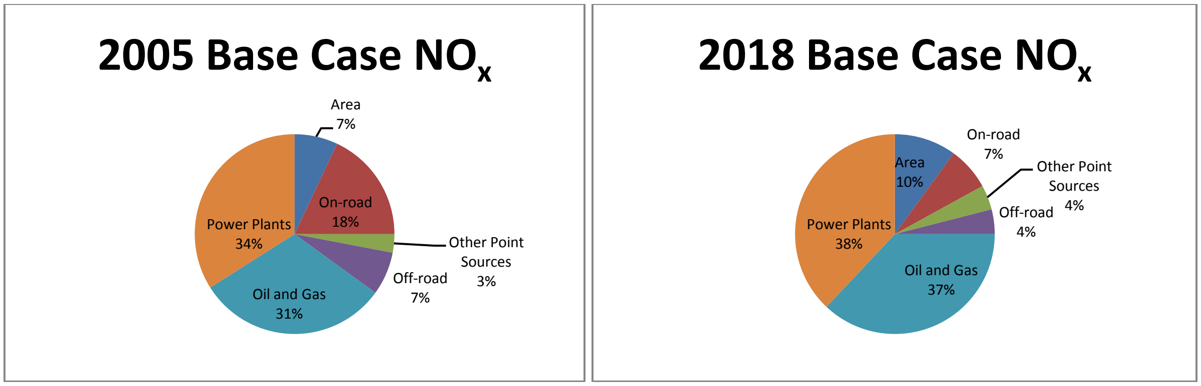
Date	Daily Maximum 8-Hour Average (ppb)	Date	Daily Maximum 8-Hour Average (ppb)
6/4/2008	74	4/17/2009	76
6/10/2008	73	4/16/2009	74
6/13/2008	71	6/19/2009	72
5/30/2008	69	6/22/2009	71

Regional air quality modeling was conducted by the states of New Mexico and Colorado in 2009 (New Mexico Environment Department, 2009). The Air Quality Modeling Study for the Four Corners Area assessed ozone impacts to Mesa Verde National Park and other areas in the Four Corners Region. Mesa Verde and Weminuche Wilderness Class I areas as well as the SJPL are located within the high resolution 4 km modeling domain used in the study.

Ground-level ozone is a pollutant resulting from complex chemical reactions between NO_x and VOC's in the presence of heat and sunlight. Models which predict the formation and transport of ozone use NO_x and VOC emission inventories because these are the chemical precursors of ozone. NO_x and VOC pollution source information was considered by the SJPL in the development of mitigation measures that would be most beneficial to reducing ozone.

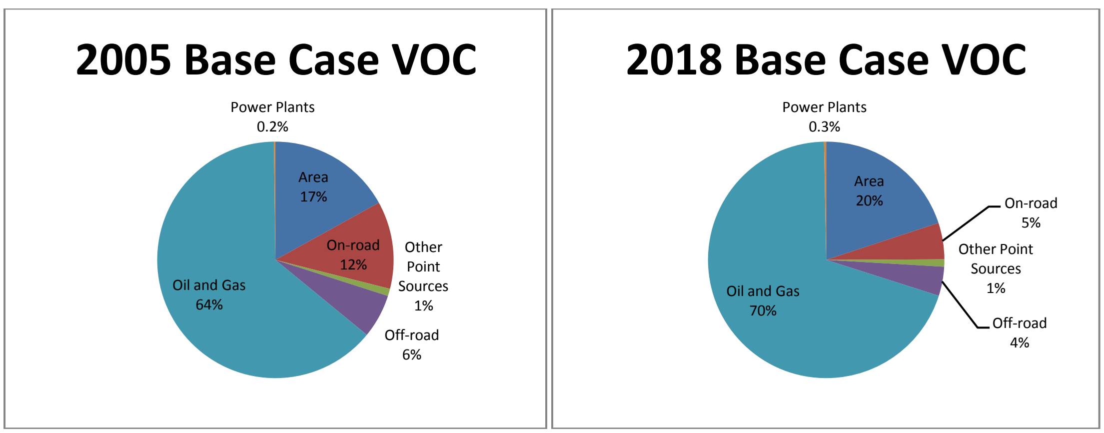
For the Air Quality Modeling Study for the Four Corners Area, a photochemical model (CAM_x) was run to predict ozone formation. The oil and gas industry accounts for about 31% of the human-caused NO_x in 2005 within the Four Corners Region 4km domain (Figure S-3.1.1). By 2018, and 37% of the human-caused NO_x would be attributable to the oil and gas industry.

Figure S-3.1.1 - Human Caused NO_x Emissions within the Four Corners Region (4 km domain) Source Colorado Department of Public Health and Environment and New Mexico Environment Department



The model emission inventories show that VOC pollution would increase by about 11% from 2005 to 2018. This is due in large part, to the continued build-out of the oil and gas sector in the Four Corners region. Oil and gas accounts for 64% VOC of emissions in 2005 and 70% VOC of emissions in 2018.

Figure S-3.1.2 - Human Caused VOC Emissions within the Four Corners Region (4 km domain) Source Colorado Department of Public Health and Environment and New Mexico Environment Department



The Air Quality Modeling Study for the Four Corners Area provides detailed information about major pollution sources affecting the formation of ozone at Mesa Verde Class I area. The largest pollution source contributing to 1-hour average ozone concentrations during July at Mesa Verde come from long-range sources outside of the region and outside the 4 km boundary. When considering only local pollution sources within the 4 km domain, oil and gas operations in New Mexico and Colorado are the largest local contributors to ozone on high concentration days over 70 ppb. Other large contributors include electric generating utilities (coal plants), and biogenics (natural sources such as trees and other vegetation).

Atmospheric Deposition

Elevated levels of sulfur and nitrogen oxides are of significant concern because they can lead to the acidification of precipitation and surface waters. These chemicals can cause significant changes in wilderness ecosystems. The source of nitrogen in high elevation lakes in the Weminuche Wilderness is largely atmospheric. Atmospheric (wet) deposition monitoring at Molas Pass shows that since the 1990’s there has been a significant increasing trend in NO_3 concentrations. There is also a corresponding significant decreasing trend of SO_4 concentration in precipitation (National Atmospheric Deposition Program, 2010).

The USFS has been sampling the water chemistry of lakes as a way to monitor atmospheric deposition over the last decade. Pure water lakes in the Weminuche Wilderness should be very limited in nutrients and other chemicals, but data suggests they are becoming seasonally saturated with nitrogen (Musselman and Slausen, 2002).

Elevated deposition of sulfur and nitrogen oxides are also of concern because they can lead to changes in terrestrial ecosystems. The National Park Service (NPS) has expressed a concern that nitrogen deposition near a threshold of 3.0 kg/ha-yr may increase biomass production and therefore create an exponential increase in fire risk (NPS, 2010). The park also expressed a concern that increased nitrogen deposition may change native species composition in favor of non-native species. Table S-3.1.4 below summarizes the background deposition estimates for Mesa Verde National Park, which are assumed to be representative of the project area as a whole.

Table S-3.1.4 - Background Deposition Data, Mesa Verde National Park

AQRV (Units of Measurement)	Background Deposition	Monitoring Station
Nitrogen Deposition (kg/ha-yr)	2.3	Mesa Verde
Sulfur Deposition (kg/ha-yr)	1.2	Mesa Verde

The deposition of mercury is another concern on and near the SJPL. The SJPL has been monitoring wet and dry mercury deposition at Molas Pass since 2009. The monitors have not been operating long enough for annual reports to be compiled. Precipitation near Vallecito reservoir shows mercury concentrations as high as 72 ng/L (MSI, 2010). Atmospheric deposition of mercury often accumulates in terrestrial and aquatic ecosystems. Lakes on and adjacent to the SJPL are impacted by elevated mercury deposition. McPhee Reservoir and nearby Narraguinnep, Puett, and Totten Reservoirs, as well as Vallecito Reservoir adjacent to the Weminuche Wilderness have fish consumption advisories because of mercury contamination(CDPHE, 2006). Total Maximum Daily Loads have been developed by the State of Colorado to address water mercury contamination issues in McPhee and Narraguinnep Reservoirs (CDPHE, 2003). Although the source of mercury has not been conclusively identified, mercury in the atmosphere, and subsequent deposition in the aquatic environment, is commonly associated with coal-fired power plants (EPA, 2005).

Visibility

Existing visibility measurements from the Interagency Monitoring of Protected Visual Environments (IMPROVE) Monitoring Program are shown in Figures S-3.1.3 and S-3.1.4 below. Higher values of extinction infer poorer visibility. Data are shown for six Class I areas within or near the SJPL where IMPROVE measurements have been collected: Mesa Verde National Park (MEVE1), Bandelier National Monument (BAND1), Canyonlands National Park (CANY1), San Pedro Parks Wilderness (SAPE1), Weminuche Wilderness (WEMI1), and White River National Forest (WHRI1). The data in Figures S-3.1.3 and S-3.1.4 (below) represent visibility conditions at each area over the period 2000 through 2006, 7 years total.

Figure S-3.1.3 - Mean Extinction 2000 - 2006 by Class I Area. The unit of measurement for visibility extinction is Mm^{-1}. Extinction sources are sea salt, coarse material, soil, elemental carbon, organic mass by carbon (source typically fire), NO_3 and SO_4 and Rayleigh

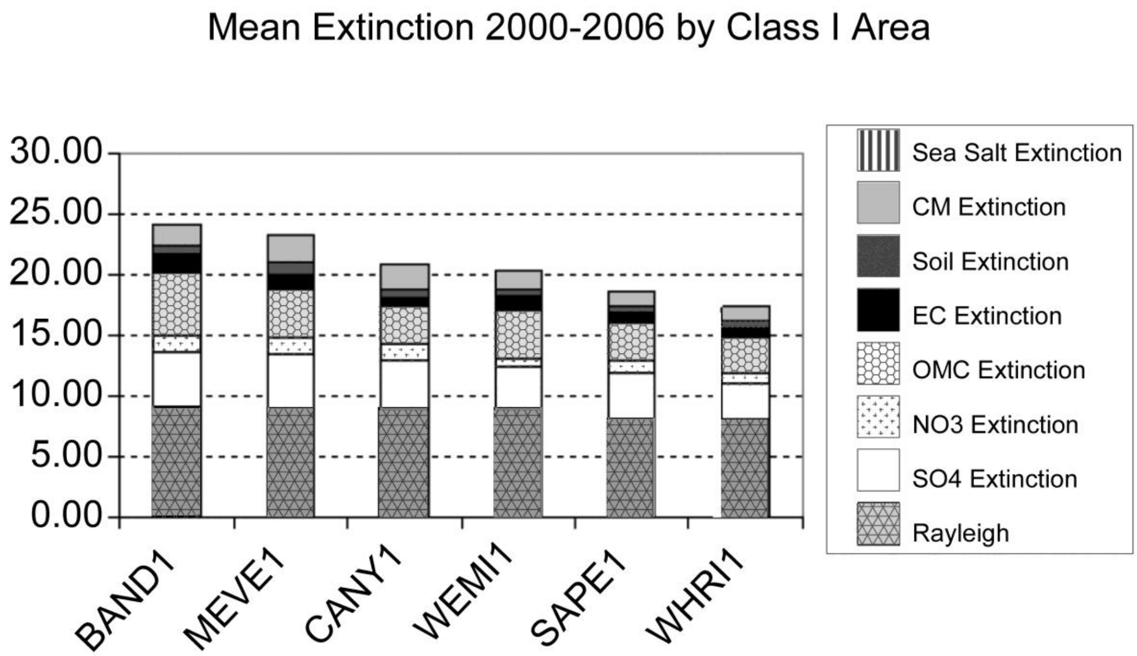
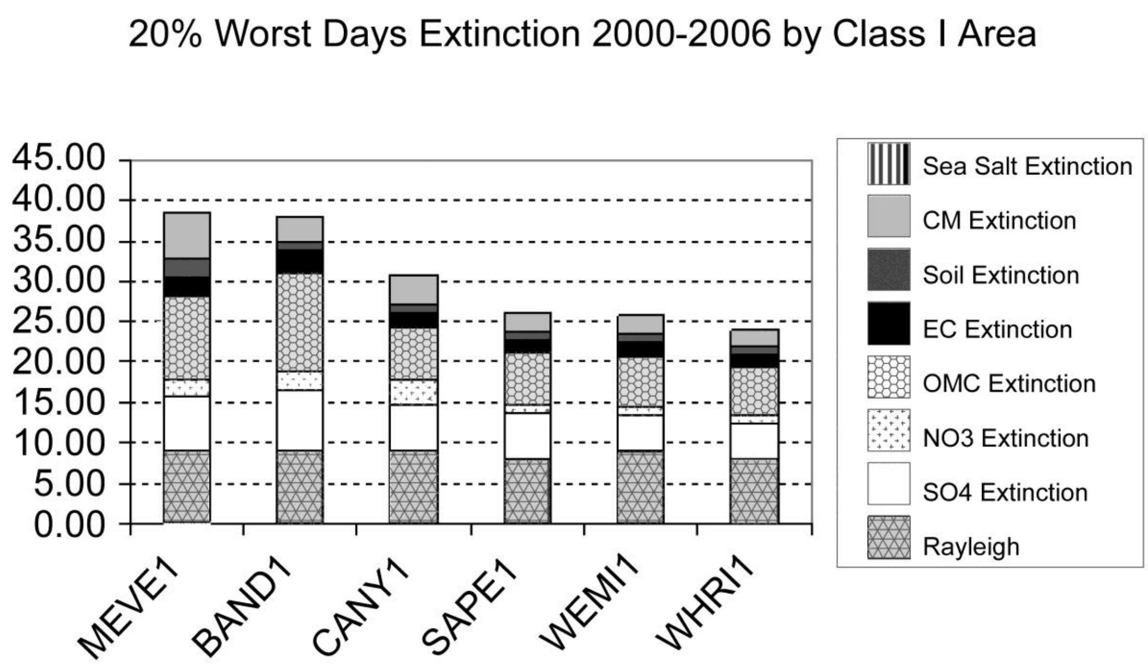


Figure S-3.1.4 - 20% Worst Days Extinction 2000 - 2006 by Class I Area. The unit of measurement for visibility extinction in Mm^{-1}



Visibility impacts are generally assessed in terms of "natural background" or the expected visibility in the absence of human emission sources. The Federal Land Managers responsible for Class I areas have developed natural background visibility estimates for Class I areas (FLAG, 2000). This document suggests natural background visibility ranges between 15.6 to 18 Mm^{-1} for Class I areas in the western United States.

At Mesa Verde National Park, monitoring data indicates visibility is degraded by 123% compared to natural background visibility for the 20% worst visibility days.

Figures S-3.1.3 and S-3.1.4 (above) also show the chemical constituents that cause visibility impairment. The biggest difference between monitoring sites appears to be the organic mass by carbon (OMC) component. Organic carbon is often an indicator of fire emissions. Those sites with poorest visibility (Mesa Verde and Bandelier) appear to have been impacted by more fire emissions compared to other sites in the region.

The IMPROVE monitored visibility data were used to provide a check of the modeling results used for the air quality impacts analysis. The CALPUFF model returns a total extinction value (in Mm^{-1}) which was compared to the IMPROVE measurements to provide a general assessment of model performance.

AIR QUALITY IMPACT ANALYSIS

Consultation and Cooperation with Other Agencies

The SJPL completed this air quality impact analysis in collaboration with other Federal and State agencies. A special technical workgroup of State and Federal agencies was convened for the air quality assessment process used for this analysis. The SJPL Air Quality Impact Analysis Stakeholders Group members were:

- Colorado Department of Public Health and Environment (CDPHE)
- U.S. Environmental Protection Agency (EPA) Region 8
- National Park Service (NPS)
- Bureau of Lands Management (BLM)
- U.S. Forest Service (USFS)

In addition to the stakeholders mentioned above, the SJPL also actively participates in the Four Corners Air Quality Task Force Policy Oversight Group (POG). Through the POG, the SJPL cooperated with EPA Region 8 and 9, Utah Department of Environmental Quality, Southern Ute Indian Tribe, State of New Mexico Environment Department, NPS, and BLM/USFS in New Mexico. These agencies worked cooperatively to develop and adopt many mitigation strategies to reduce air pollution emissions from oil and gas projects.

The SJPL Air Quality Impact Analysis Stakeholders Group collaborated with the SJPL in providing technical input and data. The POG was of great assistance in developing and prioritizing air pollution mitigation options. Specifically, the Stakeholders Group and the POG assisted with the following elements of the Air Quality Effects Analysis:

- Cumulative effects area
- Air Quality Standards, Increments, and AQRV Criteria to be included in analysis
- Ozone analysis strategy
- Class I and Sensitive Class II areas included in analysis
- Emission inventory (also provided by Southern Ute Indian Tribe and Navajo Nation)
- Model selection
- Modeling protocol
- Technical review
- Analysis assumptions (e.g. background ammonia concentrations)
- Mitigation measures and other air pollution reduction strategies

- Pre and post-project monitoring

New Air Quality Standards and Guidelines

The following Air Quality Standards and Guidelines replace the standards and guidelines that were published in the Draft LMP, Part Three on page 250. These standards and guidelines have been developed to minimize impacts from projected GSGP and other oil and gas development activities on SJPL.

AIRSTANDARDS

A. All new facilities and installations will use engines that meet the following standards within a stationary facility for fluid minerals. Engines less than 300 horsepower (excluding very small engines less than 40 horsepower) must have a mandatory NO_x limit of 2.0 grams per horsepower-hour or the minimum acceptable limit as determined by the Four Corners Air Quality Task Force process or the State of Colorado. If rich burn engines are selected, operators must demonstrate compliance with the SJPL NO_x limit standards.

B. All replacement or reconditioned reciprocating internal combustion engines less than 300 horsepower (excluding very small engines less than 40 horsepower) must also meet NO_x limit of 2.0 grams per horsepower-hour or the minimum acceptable limit, as determined by the Four Corners Air Quality Task Force process or the State of Colorado.

C. All new facilities and installations will use engines that meet the following standards within a stationary facility for fluid minerals. Engines 300 horsepower or greater must have a mandatory NO_x limit of 1.0 gram per horsepower-hour or the minimum acceptable limit, as determined by the Four Corners Air Quality Task Force process or the State of Colorado.

D. All replacement or reconditioned reciprocating internal combustion engines 300 horsepower or greater must have a mandatory NO_x limit of 1.0 gram must also meet NO_x limit of 1.0 gram per horsepower-hour or the minimum acceptable limit, as determined by the Four Corners Air Quality Task Force process or the State of Colorado.

E. Reduced emission completions and workovers (i.e. "green completions" or "clean technology" as defined by EPA) using mobile well completion equipment for oil and gas wells is required to prevent venting or flaring of methane gas and other air pollutants into the atmosphere. Green mobile well equipment includes mobile tanks, portable separators, sand traps, and portable gas dehydration. Venting of methane gas during the well completion process will not be allowed except during emergency situations. This standard is required for all non-wildcat wells and will be implemented in all places where technically feasible.

F. For exploration and production tanks, hatches must be closed, valves must be maintained in a leak-free condition, pressurized recovery, storage and transport of condensate must be used to reduce the venting of VOCs and HAP emissions by at least 95% from uncontrolled emissions.

G. Low bleed pneumatic devices are required for all new and retrofitted oil and gas production sites to reduce methane emissions.

H. All new glycol dehydrators must use low or zero VOC emission technology or desiccant dehydrators if located within ¼ mile of the power grid. Dehydrators located more than ¼ mile from the power grid must use desiccant dehydrators to reduce the emissions of methane, VOCs and HAPs.

AIR GUIDELINES

I. Construction activities that disturb a surface area greater than 1 acre and are of a duration greater than five days should use effective dust-suppression materials and techniques to prevent dust from visibly transporting from the area of disturbance (e.g. well pad, landing, parking area, mine) or drift more than 50 feet from the road prism. In addition, these activities must handle, transport, and store material in such a way to prevent particulate matter (dust) from visibly transporting from the storage area or area of disturbance. There will be no oil, solvents, or other unacceptable contaminates in water used for dust abatement.

J. Vapor recovery units, inert gas blankets, or floating roof tanks should be installed on all petroleum exploration, production and condensate storage tanks to limit VOC and other liquid petroleum emissions.

K. For new lease or new development areas, co-locate and/or centralize new mineral development facilities. Facilities include roads, well pads, utilities, pipelines, compressors, power sources and fluid storage tanks. Co-location of wells (more than one well per pad) should be required. Optimization (use of fewer, larger, and more efficient engines with lower emission rates, rather than using many small engines with higher emission and less efficiency and higher cumulative horse power) should be required.

Additional Referenced Guidance

BLM 7300, Air Resource Management, Climate and Air Quality; FSM 2580, Air Resource Management; FSM 5100, Fire Management; the Clean Air Act, as amended (42 USC 7401 et seq.); the Wilderness Act of 1964; the Federal Land Policy Management Act of 1976; EPA Interim Air Quality Policy on Wildlands and Prescribed Fires, 1998; Weminuche Wilderness Monitoring Plan for AQRV (USFS 1991), and Federal Land Managers AQRV Workgroup Phase I Report (FLAG 2010).

AIR QUALITY IMPACT ANALYSIS METHODOLOGY

The air quality standards, increments, and AQRV criteria to which potential impacts are compared to, are summarized in Table S-3.1.5. The air quality thresholds of significance developed by the USFS and NPS were used in determining potential impacts to Class I areas and sensitive Class II areas. This is because the USFS and NPS manage the majority of Class I and sensitive Class II areas within the modeling domain. The one exception, Canyons of the Ancients National Monument, is managed by the BLM. It should be noted the BLM uses different thresholds of significance than the USFS and NPS. For example, the visibility thresholds of significance are less stringent for BLM, being 1 deciview of change for direct, indirect, and cumulative impacts.

Table S-3.1.5 - Air Quality Standards, Increments, and AQRV Criteria

Pollutant/AQRV	Averaging Interval	NAAQS	Class II PSD Increment (µg/m³)	Class I PSD Increment (µg/m³)	AQRV Thresholds (incremental/cumulative)
NO_2	1-Hour Annual	100 ppb 53 ppb	-- 25	-- 2.5	-- --
SO_2	1-Hour 3-Hour 24-Hour Annual	75 ppb[1] -- 0.14 ppm 0.03 ppm	-- 512 91 20	-- 25 5 2	-- -- --
PM_{10}	24-Hour	150 µg/m³	30	10	--
$PM_{2.5}$	24-Hour Annual	35 µg/m³ 15 µg/m³	-- --	-- --	-- --
CO	1-Hour 8-Hour	35 ppm 9 ppm	-- --	-- --	-- --
O_3	8-Hour	0.075 ppm	--	--	--
Pb	Quarterly	1.5 µg/m³	--		--
Visibility (% change)[2]	24-Hour	--	--	--	5% / 10%
Nitrogen Disposition (kg/ha-yr)[3]	Annual	--	--	--	0.005 / 3.0
Sulfur Deposition (kg/ha-yr)[3]	Annual	--	--	--	0.005 / 3.0

Notes:
[1] The State of Colorado has also established a 3-hour SO_2 ambient air quality standard of 700 µg/m³, as well as a program similar to the federal PSD increments limiting additional amounts of SO_2 above baseline conditions.
[2] A change in extinction of 10% or greater is believed to be perceptible to most observers. When the change in extinction is 5% or greater, a source is believed to be contributing to any existing visibility impairment. The change in extinction is measured in comparison to a pristine "natural" background that is not impaired by existing emissions.
[3] The USFS has established cumulative deposition impacts thresholds of concern.

Far-Field Impacts (Class I)

Potential air quality impacts were analyzed to determine the maximum "far-field" effects on ambient air pollutant concentrations, visibility, and atmospheric deposition of sulfur and nitrogen. Far field impacts were assessed using three different types of receptors across the modeling domain; Class I areas, Class II Sensitive receptors, and spatial grid receptors. Because the specific locations of wells is not known at this time, it was assumed that the wells would be spaced somewhat equidistantly across a grid and the well emissions were modeled as area sources, not as point sources.

Near-Field Impacts (Class II)

Near-field modeling, specifically ozone analysis, will be completed in the future when projects are submitted with some site-specificity. Near-field and ozone modeling were not completed for this analysis for the following reasons:

- This is not a project-level analysis but a planning analysis of a decision whether to lease Federal lands for minerals development.
- The GSGP area is a new, speculative, and unproven gas play.
- The locations of wells are unknown at this time. The site specificity needed for near-field modeling and ozone analysis are not available.

USFS and BLM have consulted with SJPL Air Quality Impact Analysis Stakeholders Group (see above section “Consultation and Cooperation with Other Agencies”) regarding the ozone analysis conducted for the San Juan Plan. It was agreed among the Stakeholder Group that ozone modeling will not occur at this land use plan/lease availability phase of NEPA analysis. Ozone analysis will occur when more site specific NEPA can be conducted, at the Project Development NEPA analysis stage when development can be adequately defined in terms of geographic areas, drilling methods, well and road locations, well density, well drilling rates, and production rates. (See explanation of oil and gas NEPA analysis stages and decisions in the Introduction of Chapter Three of this Supplement.) The strategy for ozone analysis and monitoring is as follows:

1) The BLM and USFS will purchase and deploy a continuous ozone monitoring station to evaluate actual ozone concentrations downwind of the Paradox Basin in cooperation with the CDPHE. This station will provide, at a minimum, three years of data (EPA reference quality). This ozone monitoring station was purchased and deployed during the summer of 2010 at a site cooperatively selected by CDPHE, BLM, and USFS.

2) The SJPLC will commit to the long-term operation of the air monitoring station at Shamrock Mines. SJPL will continue to monitor ozone, NO_x, NO_2, meteorology, and aerosols.

3) The BLM and USFS have authority to apply resource-protective stipulations and mitigation measures on new leases. The agencies may also condition the approval of permits on existing leases if resource conditions warrant (per BLM Interagency Memo CO-2010-028; also see explanation in the Introduction of Chapter Three of this Supplement.) The San Juan Plan will identify the lease stipulations and permit COA for new oil and gas development. Specific mitigation measures that will limit the release of ozone precursors are discussed in the Air Quality Impact Analysis section entitled “Mitigation Options”.

4) Ozone modeling will be implemented when 210 wells have been permitted in the GSGP area or when project-level or field development NEPA analysis is conducted, whichever occurs first. Two-hundred ten (210) wells are about 10% of the overall projected number of wells to be drilled over the next 15 years in the Paradox Basin. The 210-well threshold includes all wells permitted by COGCC and the SJPLC beginning in the year 2008 on all mineral-estates, not just federal mineral estate. Once the 210-well threshold is reached, there will be better information about the play area, including drilling data to verify the RFD development projections and the economic viability of the play. Furthermore, whether triggered by the 210-well threshold or project proposal for GSGP development (i.e., project-NEPA analysis stage), there will be more project specific details (such as number of wells, well and road locations, the methodologies for transporting water and drilling materials to and from the well sites, etc.) that can be used for ozone modeling and impacts analysis than is available at this time. The SJPLC will work closely with the operators and COGCC to track the number of gas shale well permits, the success rates, and developable acreage.

Air Quality Analysis Technical Support Document

Detailed information regarding atmospheric dispersion model setup, emission inventories, and model results, can be found in the Air Quality Analysis TSD for the SJPLC (Air Resource Specialists, 2009).

Atmospheric Dispersion Model Setup

Atmospheric dispersion models, including the one used for this environmental impact analysis, are computer programs designed to simulate how pollutants in the atmosphere disperse and in some cases, how they react in the atmosphere. The dispersion models are used to estimate the downwind concentration of air pollutants that can impact ambient air quality.

The SJPL Air Quality Impact Analysis Stakeholders Group worked with the SJPL to determine the appropriate dispersion model and modeling protocol to be used for this analysis. CALPUFF is the EPA-approved model that was selected and agreed upon by all stakeholders. CALPUFF is a non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal. CALPUFF can be applied for long-range transport and for complex terrain. The air quality analysis, modeling protocols, and emission inventory development are described in detail in the Air Quality Analysis TSD.

All dispersion models, regardless of their level of complexity, are mathematical approximations of the behavior of the atmosphere. The results need to be appropriately viewed as *estimates* of possible future concentrations and not as exact predictions in time and space. The dispersion modeling uses the best available information and methods (EPA-approved models, emission factors, etc.) when possible, combined with the best scientific and professional judgment in an attempt to ensure that projections of future air quality are neither under-predicted nor unrealistically over-predicted.

CALPUFF was used to evaluate both direct project and cumulative Class I increment impacts and deposition AQRV analyses at nine (9) Class I areas in Colorado, New Mexico, Arizona, and Utah. The Class I areas and sensitive Class II receptors included in the modeling domain were selected cooperatively by the State and Federal agencies of the SJPL Air Quality Impact Analysis Stakeholders Group.

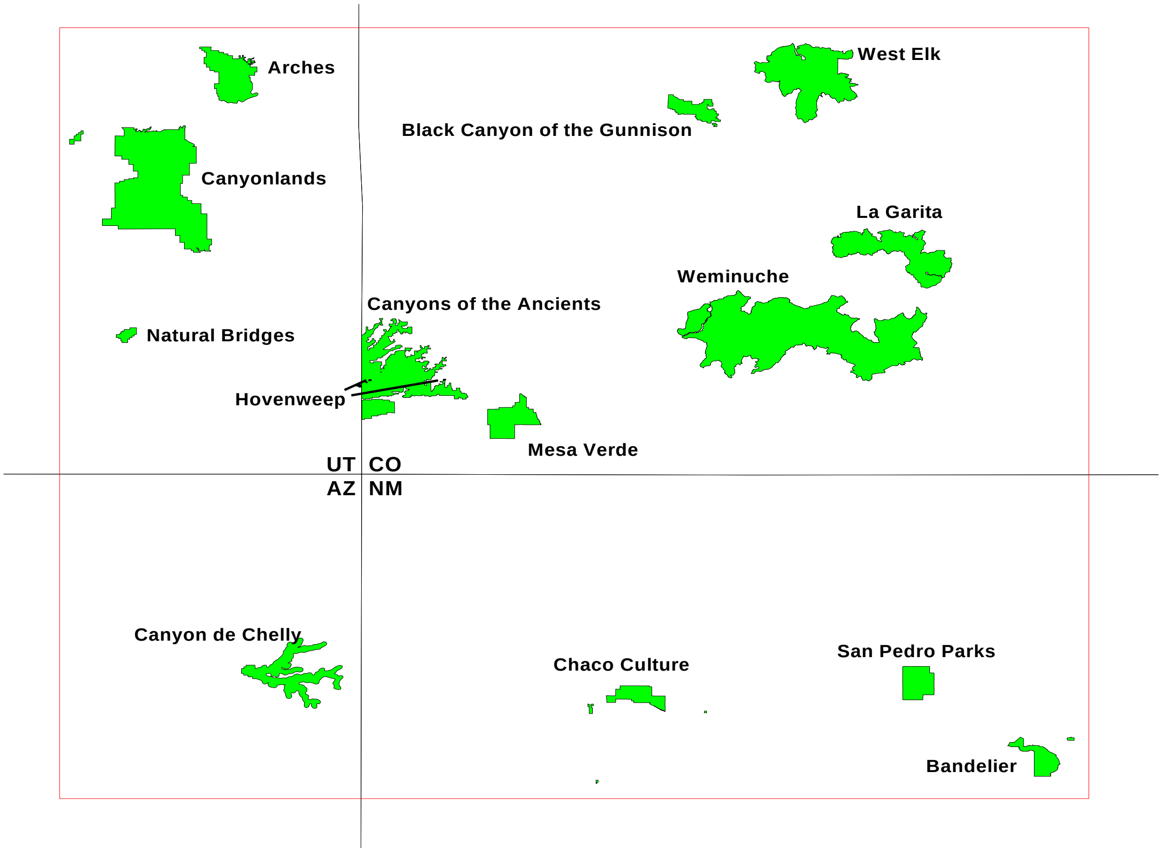
The Class I Areas within the modeling domain are:

- Weminuche Wilderness
- Mesa Verde National Park
- Arches National Park
- Bandelier National Park
- Black Canyon of the Gunnison
- Canyonlands National Park
- La Garita Wilderness
- San Pedro Parks Wilderness
- West Elk Wilderness

Sensitive Class II Receptors – National Parks and State of Colorado Scenic Vistas:

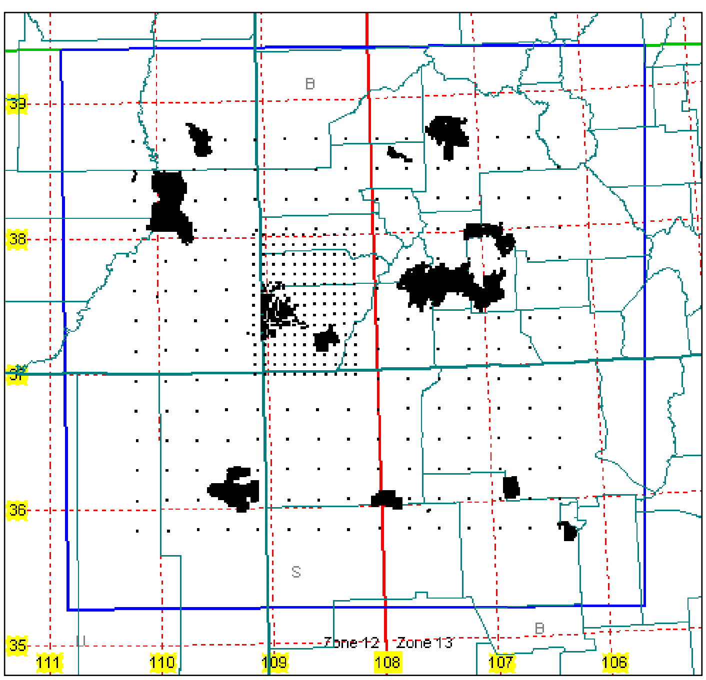
- Canyon de Chelly National Monument
- Canyons of the Ancients National Monument
- Chaco Culture National Historic Park
- Hovenweep National Monument
- Natural Bridges National Monument
- Lizard Head Pass Overlook
- Chalk Mountain, South San Juan Wilderness
- Dolores Canyon Overlook

Figure S-3.1.5 - CALPUFF Modeling Domain, with Class I and Class II Areas to be Evaluated



In addition to the Class I and sensitive Class II areas, the BLM suggested an additional nested fine grid of Class II receptors at 8 kilometer resolution exists around the project area and a coarse grid of Class II receptors at 24 kilometer resolution extends over the rest of the domain (Figure S-3.1.6).

Figure S-3.1.6 - Fine Grid (8 km) Receptors in the San Juan Public Lands Region, and Coarse Grid (24 km) Receptors Over the Rest of the Domain (Black areas = Class I and Class II areas)



Emission Inventories

For this analysis, three air emissions inventories were developed. An emission inventory was used to model background air quality. It should be noted that this is a standard methodology for many federal and state agencies, but it is not the standard methodology for the BLM. First, the project inventory for the SJPL leasing decision included reasonably foreseeable GSGP wells in the Paradox Basin proposed for currently unleased Federal minerals. This inventory also included reasonably foreseeable Paradox conventional gas wells proposed for currently unleased Federal minerals. The San Juan Sag foreseeable oil development was not included in this emissions inventory because it is assumed a maximum of only two exploration wells might be drilled per year, and none are expected to be productive.

The second inventory was a cumulative oil and gas inventory which considered emissions from existing oil and gas sources and reasonably foreseeable future sources within the study area summarized as:

- Paradox conventional gas wells on existing federal leases, state and private lands
- Paradox GSGP wells on existing federal leases, state and private lands
- Northern San Juan Basin EIS (SJPL)
- Northern San Juan Basin 80-Acre infill wells (SJPL)
- Southern Ute Indian Tribe EIS
- Southern Ute Indian Tribe Programmatic EA 80-Acre infill wells (including Reservation minor sources)
- Jicarilla Oil and Gas Leasing EIS (Carson National Forest)
- BLM Farmington Field Office RMP
- Canyons of the Ancients National Monument RMP (SJPL)

The third inventory considered the cumulative inventory for other sources within the modeling domain and includes:

- Existing source emission inventories obtained from the States of New Mexico, Colorado, Utah, Arizona
- Existing source emission inventories for tribal lands in New Mexico, Colorado, Arizona (not including oil and gas sources listed above)
- Proposed Desert Rock Power Plant

DIRECT, INDIRECT AND CUMULATIVE IMPACTS

Actions Common to all Alternatives

If no additional Federal lands are offered for lease, some wells in the Paradox Basin (GSGP and conventional Paradox wells) would still be drilled. This is because some USFS and BLM land is already leased and there are State and private lands which can be developed. Table S-3.1.6 summarizes the wells that could be drilled in the Paradox Basin even if no additional Federal lands are leased.

Table S-3.1.6 - Well Numbers Current Federal Leases and on State and Private Lands

	USFS Leased Lands	BLM Leased Lands	State and Private Lands	Total
Paradox Conventional	25 production 10 drilled/reclaimed	125 production 20 drilled/reclaimed	50	230
Paradox/GSGP	105 production 10 drilled/reclaimed	235 production 25 drilled/reclaimed	760	1,135
			Grand Total (Paradox Conventional + GSGP)	1,365

Reasonable Foreseeable Development (RFD)

The RFD scenario was modeled to estimate the maximum possible air quality impacts from potential oil and gas development in the Paradox Basin. It was assumed that for all action alternatives, the impacts would be equal or less than the RFD scenario. The total number of wells analyzed for the RFD scenario was 2,148 wells. The breakdown of wells that could be drilled in the Paradox Basin on unleased Federal lands is displayed in Table S-3.1.7 below. The total 2,148 wells was calculated by adding wells on unleased lands (783 wells) and wells that could be drilled on leased Federal lands plus state and private lands (1,365 wells).

Table S-3.1.7 - Well Numbers for Maximum Potential Development (RFD) on Currently Un-leased Lands

	Productive Wells	Unproductive Wells	Total
Paradox Conventional	120	28 drilled/reclaimed	148
Paradox - GSGP	575	60 drilled/reclaimed	635
		Grand Total (Paradox Conventional + GSGP)	783

National Ambient Air Quality Standards

The CALPUFF model considered impacts of the regulated air pollutants nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter with diameter less than 10 microns (PM_{10}), and particulate matter with diameter less than 2.5 microns ($PM_{2.5}$).

Nitrogen Dioxide

All oxides of nitrogen (NO_x) emissions were conservatively assumed to be in the form of NO_2, which is the regulated Clean Air Act pollutant. The incremental impacts to NO_2 concentrations associated with well development in the Paradox basin on already leased lands, currently un-leased lands, and for the RFD scenario are displayed in Table S-3.1.8.

Table S-3.1.8 - Incremental Impacts to NO_2 Concentrations from Leased and Unleased Lands in the Paradox Basin

NO_2	Wells on Currently Leased, State, and Private Lands (1,365 Wells)	Wells on Currently Unleased Federal Lands (783 Wells)	RFD Scenario (2,148 Wells)
Maximum Direct Annual Impact (year)	2.18 μg/m^3 (2003)	1.45 μg/m^3 (2002)	3.63 μg/m^3 (2003) (estimate)
Location of Max Annual Impact (latitude, longitude)	Fine grid (37.20817702, 108.8426431)	Fine grid (37.64718859, 108.5549065)	Fine grid NW Montezuma County
Maximum Direct 1-Hour Impact	19.46μg/m^3 (2003)	2.81 μg/m^3 (2003)	22.28μg/m^3(2003) (estimate)
Location of Max 1-Hour Impact	Mesa Verde National Park	Mesa Verde National Park	Mesa Verde National Park

The summary model results of the RFD scenario compared to National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments are displayed in Table S-3.1.9 below. Detailed model results for all Class I area and Class II area receptors can be found in the Air Quality Analysis TSD. The modeling demonstrated that the oil and gas development direct and indirect impacts of the RFD scenario are well below the NO_2 NAAQS for any Class I or Class II receptor in the modeling domain.

Table S-3.1.9 - Comparison of Maximum Predicted NO_2 Impacts Compared to NAAQS and PSD Increments

NO_2	RFD Scenario Direct/Indirect	RFD Scenario Cumulative
NAAQS 1-Hour	192 μg/m^3 (100 ppb)	192 μg/m^3 (100 ppb)
NAAQS Annual	100 μg/m^3 (53 ppb)	100 μg/m^3 (53 ppb)
PSD Class I Annual	2.5 μg/m^3	2.5 μg/m^3
PSD Class II Annual	25 μg/m^3	25 μg/m^3
Max Annual Impact Class I Areas	0.6 μg/m^3 Mesa Verde National Park	4.285 μg/m^3 Mesa Verde National Park
Max Annual Impact Class II Areas	3.63 μg/m^3 (estimate) Fine Grid NW Montezuma County	62.6 μg/m^3 Near Four Corners Power Plant, NM
Max 1-Hour Impact Class I Areas	22.3 μg/m^3(estimate) Mesa Verde National Park	157 μg/m^3 Mesa Verde National Park
Max 1-Hour Impact Class II Areas	19.1 μg/m^3 Canyons of the Ancients National Monument	326 μg/m^3 Chaco Culture National Historic Park

Cumulatively, the 1-hour concentrations of 326.00 μg/m^3 at Chaco Culture National Historic Park are higher than the 1-hour NO_2 NAAQS (192μg/m^3). These cumulative impacts do not signify an actual violation. Rather they show that cumulative impacts from existing sources may pose a problem and need to be carefully examined by the regulatory agencies prior to issuing permits for new construction in the area. The high NO_2 results at Chaco Culture National Historic Park are likely related to oil and gas and power plant pollution sources in New Mexico since the NO_2 1-hour concentrations are much lower at all receptors near the Paradox Basin well field.

The informal PSD information presented in Table S-3.1.9 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. Its usefulness is to better understand potential project impacts to Class I areas. Most oil and gas emission sources are not considered “PSD major sources” under the Clean Air Act and therefore the comparison is not a formal PSD increment analysis nor is it intended to replace such an analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

The direct project impacts of the RFD scenario would not exceed the NO_2 Class I PSD Increment (2.5 $\mu g/m^{3)}$ or the Class II PSD Increment (25 $\mu g/m^3$). The cumulative impacts to Class I PSD increment for NO_2 would be exceeded at Mesa Verde National Park at 4.285 $\mu g/m^3$. Cumulative visibility impacts to Class I areas have long been recognized and are widely understood to be a problem across the country. This was the primary reason Congress promulgated the Regional Haze Rule.

The model results show that cumulative impacts to annual Class II PSD increment (25$\mu g/m^3$) would be exceeded within the coarse grid of the modeling domain with a maximum annual NO_2 concentration of 62.6 $\mu g/m^3$. This location is less than 7.5 km (~ 4.7 miles) from the Four Corners Power Plant. This power plant emits over 49,000 tons per year of NO_x, and is less than 13.7 km from the San Juan Generating Station, which emits over 40,000 tons per year of NO_x. These are likely the significant contributing sources to the high localized NO_2 concentration. In addition, numerous existing oil and gas wells are in this part of New Mexico, and additional NO_2 sources are anticipated in this area in conjunction with the Farmington RMP RFD.

Again, the informal PSD information presented in Table S-3.1.9 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

Sulfur Dioxide

The incremental impacts to SO_2 concentrations associated with well development in the Paradox Basin on already leased lands, currently un-leased lands, and for the RFD scenario are displayed in Table S-3.1.10. Detailed model results for all Class I area and Class II area receptors can be found in the Air Quality Analysis TSD. The direct contributions of the RFD scenario to SO_2 concentrations at all receptors within the modeling domain are insignificant due to the low level of project-related SO_2 emissions. Project SO_2 emissions would be generated primarily by the short-term use of diesel engines needed to drill and complete new wells.

Table S-3.1.10 - Incremental Impacts to SO_2 Concentrations from Leased and Unleased Lands in the Paradox Basin

SO_2	Currently Leased, State, and Private Lands (1,365 new wells)	Currently Unleased Federal Lands (783 new wells)	RFD Scenario (2,148 wells)
Maximum Direct Annual Impact (meteorological year)	0.157µg/m^3 (2003)	0.15 µg/$m^3$7 (2002)	0.313µg/m^3 (2003) (estimate)
Maximum Direct 24-Hour Impact (meteorological year)	0.38 µg/m^3 (2003)	0.368 µg/m^3 (2003)	0.748µg/m^3 (2003) (estimate)
Maximum Direct 3-Hour Impact (meteorological year)	1.12 µg/m^3 (2003)	0.970µg/m^3 (2003)	2.09 µg/m^3 (2003) (estimate)
Maximum Direct 1-Hour Impact (meteorological year)	0.84 µg/m^3(2003)	0.34 µg/m^3 (2003)	1.18 µg/m^3(2003) (estimate)
Location of Max Annual Impact* (latitude, longitude)	(37.2070686, 108.750069)	(37.64718859, 108.5549065)	Approx center of project area
Location of Max 24-Hour Impact* (latitude, longitude)	(37.2070686, 108.750069)	(37.20459604, 108.5649312	About 20 km N of Mesa Verde
Location of Max 3-Hour Impact* (latitude, longitude)	(37.2070686, 108.750069)	(37.64718859, 108.5549065)	Approx center of project area
Location of Max 1-Hour Impact*	Mesa Verde National Park	Mesa Verde National Park	Mesa Verde National Park

**All maximum annual, 24-hour, and 3-hour concentrations occur within the fine grid receptors of the modeling domain.*

Table S-3.1.11 below demonstrates that the direct contributions of the RFD scenario produce very small concentrations of SO_2 for all averaging times and for all receptors in the modeling domain. The direct and indirect oil and gas development associated with the RFD scenario do not exceed the 1-hour, 24-hour and annual O_2 NAAQS.

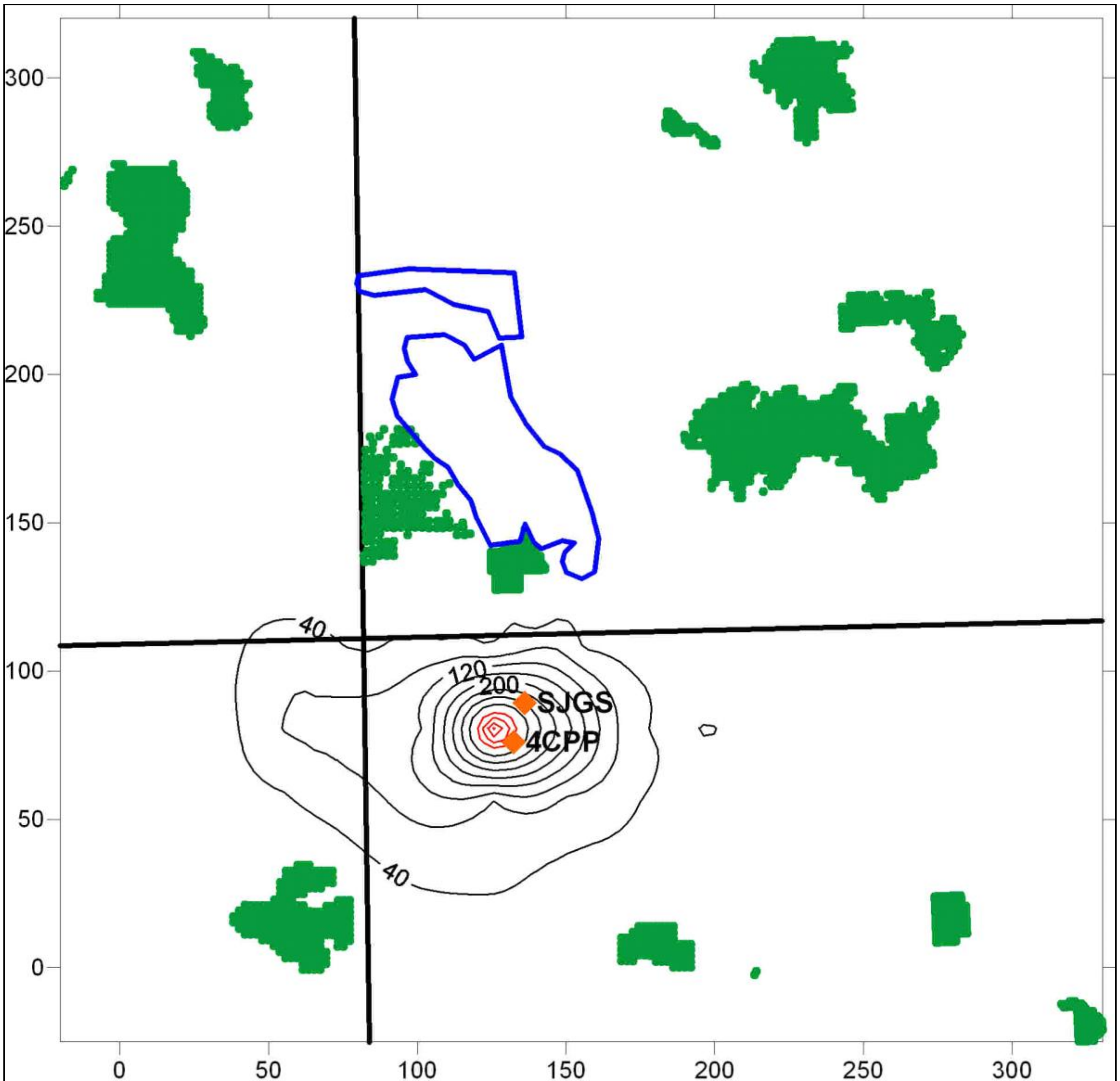
Table S-3.1.11 - Comparison of Maximum Predicted SO_2 Impacts Compared to NAAQS and PSD Increments

SO_2		RFD Scenario	RFD Scenario Cumulative
NAAQS 1-Hour		200 µg/m^3 (75 ppb)	200 µg/m^3 (75 ppb)
NAAQS 24-Hour		365µg/m^3 (14 ppm)	365µg/m^3 (14 ppm)
NAAQS Annual		80 µg/m^3 (0.03 ppm)	80 µg/m^3 (0.03 ppm)
PSD Class I (µg/m^3)	3-Hour	25	25
	24-Hour	5	5
	Annual	2	2
PSD Class II (µg/m^3)	3-Hour	512	512
	24-Hour	91	91
	Annual	20	20
Max Impact Class I Areas (meteorological year)	1-Hour	1.18 µg/m^3 Mesa Verde National Park(2003)	187 µg/m^3 Mesa Verde National Park
	3-Hour	0.575 µg/m^3 Mesa Verde National Park (2003)	132 µg/m^3 Mesa Verde National Park
	24-Hour	0.209 µg/m^3 Mesa Verde National Park (2002)	25 µg/m^3 Mesa Verde National Park
	Annual	0.072 µg/m^3 Mesa Verde National Park(2002)	2.53 µg/m^3 Mesa Verde National Park
Max Impact Class II Areas (meteorological year)	1-Hour	0.669 µg/m^3 Canyons of the Ancients (2002)	209.45 µg/m^3 Canyon DeChelly National Monument
	3-Hour	2.09 µg/m^3 (2003) Approx center of project area	2745 µg/m^3 Near Four Corners Power Plant
	24-Hour	0.748 µg/m^3 (2003) About 20 km N of Mesa Verde	469 µg/m^3 Near Four Corners Power Plant
	Annual	0.313 µg/m^3 (2003) Approx center of project area	58.3 µg/m^3 Near Four Corners Power Plant

Cumulatively, the 1-hour SO_2 concentrations at Mesa Verde National Park could be higher than the 1-hour SO_2 NAAQS. The 24-hour and annual SO_2 NAAQS (365µg/m^3) could be surpassed at 469 µg/m^3 in the vicinity of the Four Corners Power Plant and San Juan Generating Stations (see Figure S-3.1.7 for a map showing high concentration areas). The location of the coarse grid high SO_2 impacts is in the same spot as the high concentrations of coarse grid NO_x and PM_{10}, which is near the Four Corners Power Plant (which emits over 27,000 tons per year of SO_2), and near the San Juan Generating Station (which emits over 32,000 tons per year of SO_2). It is important to note that the GSGP and Paradox Conventional projects will not emit appreciable SO_2; therefore, the modeled maximum concentrations for SO_2 are wholly due to existing sources and other reasonable foreseeable projects and not due to the projects under review for this EIS.

These cumulative impacts do not signify an actual violation. Rather they show that cumulative impacts from existing sources may pose a problem and need to be carefully examined by the regulatory agencies prior to issuing permits for new construction in the area. The very high SO_2 results near the New Mexico power plants should be viewed with caution. First, CALPUFF is not the preferred air quality model for receptors in the near-field (within 50 km of the source). Second, for this model analysis, emission sources with similar stack parameters were combined in order to keep the number of sources modeled manageable. Therefore, Four Corners Power Plant and San Juan Generating Station were each modeled as a single stack. Although elevated SO_2 concentrations would be expected in the vicinity of the power plants, the accuracy of CALPUFF for these possible NAAQS violations is less certain. Again, the extremely low project emissions associated with the RFD scenario (24-hour max concentrations 0.748 $\mu g/m^3$) would not contribute to cumulative high SO_2 concentrations in New Mexico.

Figure S-3.1.7 - Composite of the Cumulative Highest Second-Highest 24-Hour SO2 Modeled Impacts for 2001-2003 including the RFD Scenario Wells



Contours from 40 to 320 micrograms per cubic meter in black, with a contour interval of 40 micrograms per cubic meter.
Contours from 365 to 255 micrograms per cubic meter (above the 24-hour NAAQS for SO2) in red with a contour interval of 30 micrograms per cubic meter.
Cumulative impacts include existing, other RFD, and maximum development sources but no additional background concentration.
Locations of the Four Corners Power Plant (4CPP) and San Juan Generating Station (SJGS) are shown in orange.
Approximate extent of project area is outlined in blue.

The informal PSD information presented in Table S-3.1.11 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. Most oil and gas emission sources are not considered "PSD major sources" under the Clean Air Act and, therefore, the comparison is not a formal PSD increment analysis nor is it intended to replace such an analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

The direct project impacts of the RFD scenario are well below any Class I PSD increment for SO_2 and are also well below all Class II PSD increments. This is due to the very low SO_2 emissions associated with the project.

The cumulative impacts to Class I PSD increment for SO_2 would be exceeded at Mesa Verde National Park for all SO_2 concentration averaging times. Cumulative visibility impacts to Class I areas have long been recognized and are widely understood to be a problem across the country. This was the primary reason Congress promulgated the Regional Haze Rule.

The cumulative impacts to Class II PSD increments for SO_2 would be exceeded for all SO_2 concentration averaging times within the coarse grid receptors of the modeling domain. Again, the informal PSD information presented in Table S-3.1.11 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

Particulate Matter (PM_{10} and $PM_{2.5}$)

The incremental impacts to PM_{10} and $PM_{2.5}$ concentrations associated with well development in the Paradox basin on already leased lands, currently un-leased lands, and for the RFD scenario are displayed in Table S-3.1.12. Detailed model results for all Class I area and Class II area receptors can be found in the Air Quality Analysis TSD.

Table S-3.1.12 - Incremental Impacts to PM10 and PM2.5 Concentrations from Leased and Unleased Lands in the Paradox Basin

$PM_{2.5}$	Wells on Currently Leased, State and Private Lands (1,365 wells)	Wells on Currently Unleased Federal Lands (783 wells)	RFD Scenario (2,148 wells)
Maximum Direct Annual Impact (year)	0.334µg/m^3 (2003)	0.374µg/m^3 (2002)	0.704µg/m^3(2003) (estimate)
Maximum Direct 24-Hour Impact	0.922µg/m^3 (2003)	0.998 µg/m^3 (2002)	1.815µg/m^3(2003) (estimate)
Location of Max Annual Impact (latitude, longitude)	(37.2070686, 108.750069)	(37.64718859, 108.5549065)	About 20 km N of Mesa Verde
Location of Max 24-Hour Impact (latitude, longitude)	(37.49677787, 108.3722814)	(37.64718859, 108.5549065)	About 30 km N of Mesa Verde
PM_{10}			
Maximum Direct 24-Hour Impact	2.53µg/m^3 (2003)	2.78µg/m^3 (2002)	5.0µg/m^3(2003) (estimate)
Location of Max 24-Hour Impact (latitude, longitude)	(37.49677787, 108.3722814)	(37.64718859, 108.5549065)	About 30 km N of Mesa Verde

The summary model results of the RFD scenario compared to NAAQS and PSD increments are displayed in Table S-3.1.13 below. The modeling demonstrated that the oil and gas development RFD scenario would not cause exceedance of the PM_{10} and $PM_{2.5}$ NAAQS for any Class I or Class II receptor in the modeling domain.

Table S-3.1.13 - Comparison of Maximum Predicted $PM_{2.5}$ Impacts Compared to NAAQS and PSD Increments

$PM_{2.5}$	RFD Scenario	RFD Scenario Cumulative
NAAQS Annual (µg/m^3)	15.0	15.0
NAAQS 24-Hour (µg/m^3)	35.0	35.0
Max Annual Impact Class I Areas (meteorological year)	0.156 µg/m^3 Mesa Verde National Park(2002)	1.092 µg/m^3 Mesa Verde National Park
Max Annual Impact Class II Areas (meteorological year)	0.704 µg/m^3 About 20 km N of Mesa Verde (2003)	2.84 µg/m^3 Lat 37.19862825, Long 108.1947035 (2003)
Max 24-Hour Impact Class I Areas (meteorological year)	0.465 µg/m^3 Mesa Verde National Park (2003)	7.07 µg/m^3 Mesa Verde National Park
Max 24-Hour Impact Class II Areas (meteorological year)	1.815 µg/m^3 About 30 km N of Mesa Verde(2003)	15.2 Lat 36.72532681, Long 108.5526668

Table S-3.1.14 - Comparison of Maximum Predicted PM_{10} Impacts Compared to NAAQS and PSD Increments

PM_{10}	RFD Scenario	RFD Scenario Cumulative
NAAQS 24-Hour µg/m^3	150	150
PSD Class I Annual (µg/m^3)	10	10
PSD Class II Annual (µg/m^3)	30	30
Max Annual Impact Class I Areas (meteorological year)	0.429 µg/m^3 Mesa Verde National Park (2002)	10.121 µg/m^3 Mesa Verde National Park
Max Annual Impact Class II Areas (meteorological year)	2.0 µg/m^3 About 20 km N of Mesa Verde(2002)	27.7 µg/m^3 Lat 37.19862825, Long 108.1947035
Max 24-Hour Impact Class I Areas (meteorological year)	1.28 µg/m^3 Mesa Verde National Park(2003)	66.977 µg/m^3 Mesa Verde National Park
Max 24-Hour Impact Class II Areas (meteorological year)	5.0 µg/m^3 (estimate) About 30 km N of Mesa Verde (2003)	130.7 µg/m^3 Lat 37.19862825, Long 108.1947035

The informal PSD information presented in Table S-3.1.14 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis and is for information purposes only. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

The direct project impacts of the RFD scenario would not exceed the PM_{10} Class I PSD Increment (10 µg/m$^{3)}$ or the Class II PSD Increment (30 µg/m^3). The cumulative impacts to Class I PSD increment for PM_{10} would be exceeded at Mesa Verde National Park at 10.121µg/m^3. The model results show that cumulative impacts to annual Class II PSD increment would not be exceeded within the modeling domain.

Again, the informal PSD information presented in Table S-3.1.14 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

Deposition

The modeling also considered the impacts of nitrogen and sulfur deposition compared to AQRV thresholds of significance for NPS and USFS Class I areas. For the direct impacts of the RFD scenario, the NPS Deposition Analysis Threshold of 0.005 kg/ha-yr for nitrogen and sulfur for Class I areas was used to assess significant impacts. With the exception of Mesa Verde, the predicted nitrogen and sulfur deposition was below the Deposition Analysis Threshold at all Class I and Class II receptors. Mesa Verde maximum nitrogen deposition was 0.1156 kg/ha-yr, and maximum sulfur deposition was 0.026 kg/ha-yr. Mesa Verde National Park is adjacent to the proposed development areas in the Paradox Basin. The cumulative NPS Deposition Analysis Threshold of 3.0 kg/ha-yr for nitrogen and sulfur deposition was not exceeded at any Class I area in the modeling domain. Detailed model results for all Class I area receptors can be found in the Air Quality Analysis Technical TSD.

Because the NPS Deposition Analysis Threshold was exceeded for nitrogen and sulfur deposition at Mesa Verde National Park, additional analysis and agency consultation was conducted. In addition to the general concern about the regional trend of increasing nitrogen deposition, the NPS has expressed concern about the potential indirect impacts of increased fire risk from increased biomass production as a result of nitrogen fertilization. The other concern was potential species composition shifts from native to non-native vegetation as a result of nitrogen deposition (NPS, 2010). Additional suggestions by the NPS are discussed in the Options for Mitigation section.

Table S-3.1.15 - Nitrogen and Sulfur Deposition at Mesa Verde National Park Class I area from Leased and Unleased Lands in the Paradox Basin

Mesa Verde National Park Nitrogen and Sulfur Deposition	Wells on Currently Leased, State, and Private Lands (1,365 wells)	Wells on Currently Unleased Federal Lands (783 wells)	RFD Scenario (2,148 wells)	Cumulative RFD Scenario
Maximum Direct N Deposition Impact (year)	0.0928 kg/ha-yr (2002)	0.0229 kg/ha-yr (2003)	0.1156 kg/ha-yr (2003)	1.6 kg/ha-yr (2001)
Maximum Direct S Deposition Impact (year)	0.02 kg/ha-yr (2003)	0.006 kg/ha-yr (2003)	0.026 kg/ha-yr (2003)	1.7 kg/ha-yr (2003)

Acid Neutralizing Capacity of Sensitive Lakes

Deposition of nitrogen and sulfur species can cause changes to water chemistry, especially in lakes with very low acid neutralizing capacity (ANC). Several lakes within the Weminuche Wilderness Class I area have been determined to be very sensitive to changes in atmospheric deposition. These lakes are relatively close to the Paradox Basin project area. Potential air pollution-caused water chemistry changes were evaluated using the USFS screening methodology for calculating ANC (USFS, 2000).

The USFS AQRV threshold for project incremental impacts ANC change is no more than a 10% change from baseline chemistry for those water bodies where the existing ANC is at or above 25 µeq/L and no change for those extremely sensitive water bodies where the existing ANC is below 25 µeq/L (USFS, 2009).

With the exception of Big Eldorado Lake, no sensitive high mountain lake in the Weminuche Wilderness exceeded the ANC threshold when the direct and indirect impacts of the RFD scenario were considered. Big Eldorado Lake has baseline ANC less than 25 μeq/L and small changes (≤ 0.03 μeq/L) to ANC are predicted. Changes to ANC from the RFD scenario are displayed in Table S-3.1.16 below.

Table S-3.1.16 - Percent Change Acid Neutralizing Capacity High Mountain Lakes in Weminuche from Nitrogen and Sulfur Deposition, RFD Scenario

Mountain Lake	Threshold	ANC Change (%)		
		2001	2002	2003
Big Eldorado Lake (change from baseline ANC)	No change	0.127 (0.026 μeq/L)	0.148 (0.03 μeq/L)	0.142 (0.029 μeq/L)
Lower Sunlight Lake	< 10% change	0.037	0.043	0.039
Upper Sunlight Lake	< 10% change	0.109	0.128	0.118
Upper Grizzly Lake	< 10% change	0.106	0.124	0.114

Cumulatively, with the exception of Lower Sunlight Lake, ANC for all lakes was higher than the USFS AQRV threshold limit (10% change) for all lakes evaluated. Cumulative changes to ANC from the RFD scenario are displayed in Table S-3.1.17.

Table S-3.1.17 - Cumulative % Change Acid Neutralizing Capacity High Mountain Lakes in Weminuche from Nitrogen and Sulfur Deposition

Mountain Lake	Threshold	ANC Change (%)		
		2001	2002	2003
Big Eldorado Lake	No change	14.93	16.05	18.57
Lower Sunlight Lake	< 10% change	4.07	4.81	4.51
Upper Sunlight Lake	< 10% change	12.04	14.14	13.38
Upper Grizzly Lake	< 10% change	11.72	13.92	13.06

Visibility

Visibility impacts were calculated using two different methods denoted Method 6 and Method 2. The SJPL used both visibility assessment methods at the request of the State and Federal agencies participating in the SJPL Air Quality Impact Analysis Stakeholders Group. Method 6 is the current EPA-approved procedure under the Best Available Retrofit Technology (BART) regulations to assess whether a source contributes to existing visibility impairment. Method 2 is the current procedure documented in the Federal Land Managers Air Quality Workgroup (FLAG) guidance and uses the predicted concentrations of aerosol species from CALPUFF with the daily average relative humidity data to estimate light extinction parameters.

Actual monitored visibility data were used to provide a check of the modeling performance for both methods. The comparison was based on the "existing sources" subset from the model calculations because emissions from projected future activity would not be reflected in the measured visibility data. Also, since the model user is generally interested in the "worst-case" impacts determined by the model for a given emissions scenario, the model vs. measurements comparisons are limited to the "average of the 20% worst-case days" as determined from the IMPROVE data, which generally correlates to the 90th percentile measurement. The CALPUFF modeling results are summarized below for those Class I areas in the modeling domain that also have IMPROVE monitors.

Table S-3.1.18 - CALPUFF Modeling Results Compared to Class I Areas in the Modeling Domain Having IMPROVE Monitors

Class I Area	IMPROVE Measurement (Average of 20% Worst Case Days, 2000-06)	CALPUFF Method 2 (Mean Highest Extinction, 2001-03)	CALPUFF Method 6 (Mean 8^{th} Highest Extinction, 2001-03)
Bandalier	37	49.9	25.0
Canyonlands	31	65.5	31.1
Mesa Verde	38	77.0	50.3
San Pedro Parks	26	64.4	30.6
Weminuche	26	73.1	30.7

All values listed above are in units of total extinction (Inverse Megameters, 1/Mm)

In general, Method 2 tends to produce consistently higher visibility impacts compared to Method 6 at the Class I areas modeled for this comparison. The Method 6 results tend to more closely match the measured IMPROVE data at each of the Class I areas. At Bandalier, the Method 6 model predictions actually under predict the worst-case visibility conditions (based on the 90^{th} percentile measurement). However, Bandelier is toward the eastern edge of the modeling domain, so not all of the sources that contribute to visibility impacts at Bandelier may have been included in this modeling study. Also, Bandelier shows a relatively high extinction contribution from organic aerosols, which may be an indicator of impacts from local and/or regional wildfires. Wildfire emissions were not modeled in this CALPUFF study.

Otherwise, the CALPUFF model predictions for Method 6 tend to be near or slightly higher than the measured extinction from the IMPROVE program. Since the CALPUFF results for Method 6 in this study correlate better with the IMPROVE measurements, the conclusion is that Method 6 performs better than Method 2 when considering additional impacts analysis for the RFD scenario. Therefore, the visibility analysis relied upon by the SJPL will focus on Method 6. Detailed results for both Method 6 and Method 2 can be found in the TSD.

Three Class I areas had predicted visibility impacts above the 5% change AQRV threshold. Canyonlands National Park was just over at 5.87% on the highest day with 3 days > 5% change. Mesa Verde National Park was 9.76% on the highest day and 7.14% on the 8^{th} high day with 29 days > 5% change. Weminuche Wilderness was also over at 5.85% change on the highest day and 1 day > 5% change. Table S-3.1.19 below displays predicted visibility changes for the RFD calculated using Method 6 for each Class I area.

Table S-3.1.19 - Visibility Method 6 for the RFD Scenario at Class I Areas. Estimated Maximum Change in Extinction Coefficient (b_{ext}), Number of Days with Extinction Changes Greater than 5% and Greater than 10%

Class I Area	RFD SCENARIO			RFD SCENARIO CUMULATIVE		
	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8th High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 5%	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8th High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 10%
Arches	5.05	3.01	1	155	91	104
Bandelier	1.45	0.79	0	114	64	148
Black Canyon of the Gunnison	4.63	1.6	0	108	76	109
Canyonlands	5.87	4.31	3	217	117	137
LaGarita	1.95	0.63	0	174	71	122
Mesa Verde	9.76	7.14	29	452	278	323
San Pedro Parks	3.89	1.15	0	154	96	197
Weminuche	5.85	1.48	1	460	76	194
West Elk	2.86	1.21	0	311	53	111

The cumulative impacts to visibility predicted by the model validate what was already known from existing visibility monitoring data. The existing condition of visibility in the region is already impaired from existing sources. All Class I area receptors modeled show that visibility would be impaired by emissions from the cumulative sources, based on a definition of impairment being a change in extinction of 10% or more compared to natural visibility conditions. It is important to note that the cumulative impacts are identical between the RFD scenario and the No Lease Alternative. This suggests that development of the RFD scenario would not significantly change the existing level of visibility impairment.

With the exception of Chaco Culture National Historic Park, all the selected sensitive receptors for the Class II areas had predicted incremental impacts from the RFD scenario above the 5% AQRV threshold. Table S-3.1.20 below displays the estimated maximum change in extinction coefficient (b_{ext}) for the RFD calculated using Method 6 for each Class I area. Cumulatively, the model results reflect the current impaired visibility from existing sources seen in monitoring data. The cumulative impacts are identical between the RFD scenario and the No Lease Alternative. This suggests that development of the RFD scenario would not significantly change the existing level of visibility impairment.

Table S-3.1.20 - Visibility Method 6 for the RFD Scenario at Class II Areas. Estimated Maximum Change in Extinction Coefficient (b_{ext}), Number of Days with Extinction Changes Greater than 5% and Greater than 10%

Class II Area	RFD SCENARIO			RFD SCENARIO CUMULATIVE		
	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8^{th} High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 5%	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8^{th} High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 10%
Canyon de Chelly	5.49	1.12	1	414	126	182
Canyons of the Ancients	22.92	8.77	40	465	164	360
Chaco Culture	2.77	1.08	0	421	136	210
Hovenweep	7.88	3.11	1	285	133	272
Natural Bridges	5.27	2.04	1	232	88	95

Greenhouse Gas Emissions and Climate Change

The assessment of so-called "greenhouse gas" emissions and climate change is in its formative phase; therefore, it is not yet possible to know with confidence the net impact to climate. However, the Intergovernmental Panel on Climate Change (IPCC 2007) recently concluded that "warming of the climate system is unequivocal" and "most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic [man-made] greenhouse gas concentrations." The lack of scientific tools designed to predict climate change on regional or local scales limits the ability to quantify potential future impacts. Potential impacts to air quality due to climate change are likely to be varied and dependant on which climate scenario plays out.

Oil and gas development activities on the SJPL are predicted to produce greenhouse gas emissions. The amount of carbon dioxide (CO_2) and methane (CH_4) emissions associated with well development on new federal leases for the RFD scenario were estimated for well drilling, well completion, and gas production. Greenhouse gas emissions were not modeled in CALPUFF. Estimates of greenhouse gas emissions for oil and gas activities were calculated using assumptions from EPA AP-42 tables for different engines used for oil and gas drilling and production. The results are summarized in Table S-3.1.21.

The RFD scenario is estimated to emit a total of 88,281 tons of CO_2 per year and 399 tons of methane per year (9,975 tons of CO2 equivalents as methane). By comparison, the CO_2 equivalent emissions of La Plata County for 2005 were estimated to be 5,019,511 tons and in 2020 it is estimated they will decrease to 3,523,663 tons (La Plata County, 2008).

Table S-3.1.21 - Greenhouse Gas Emissions RFD Scenario

	GOTHIC SHALE GAS WELLS		PARADOX CONVENTIONAL WELLS	
Emission Source	CO_2 (tons/year)	Methane (tons/year)	CO_2 (tons/year)	Methane (tons/year)
Drill Rig Engines	20,697	12	4,385	2.8
Hydraulic Fracturing Engines	2,996	2	155	0.1
Compressor Engines	29,594	334	4120	46.9
Well Pad Separator/Heaters	22,110	0.5	4224	.1
Total	**75,397**	**349**	**12,884**	**49.9**

The air quality impacts from Alternatives A, B, C, and D would be the same, or very slightly less than the RFD scenario for all air quality parameters. This is because there is very little difference in the number of proposed wells for the RFD scenario compared to all alternatives.

NO LEASE ALTERNATIVE

The No Lease Alternative was also analyzed to bracket the air quality impacts of oil and gas development in the Paradox Basin. The RFD scenario would represent the maximum possible impacts and the No Lease Alternative represents the minimum impacts that could occur. The total number of wells analyzed for the No Lease Alternative was 1,365 wells. The breakdown of wells that could be drilled in the Paradox Basin on already leased Federal lands and State and Private lands are displayed in Table S-3.1.22.

Table S-3.1.22 - Well Numbers Current Federal Leases and on State and Private Lands

	USFS Leased Lands	BLM Leased Lands	State and Private Lands	Total
Paradox Conventional	25 production 10 drilled/reclaimed	125 production 20 drilled/reclaimed	50	230
Paradox/GSGP	105 production 10 drilled/reclaimed	235 production 25 drilled/reclaimed	760	1,135
Grand Total (Paradox Conventional + GSGP)				1,365

Nitrogen Dioxide

All oxides of nitrogen (NO_x) emissions were conservatively assumed to be in the form of NO_2, which is the regulated Clean Air Act pollutant. The summary model results of the No Lease Alternative compared to NAAQS and PSD increments are displayed in Table S-3.1.23 below. The modeling demonstrated that the incremental (direct and indirect) impacts of the No Lease Alternative would not cause exceedance of the NO_2 NAAQS for any Class I or Class II receptor in the modeling domain.

Table S-3.1.23 - Comparison of Maximum Predicted NO_2 Impacts Compared to NAAQS and PSD Increments, No Lease Alternative

NO_2	No Lease Alternative	No Lease Alternative Cumulative
NAAQS 1-Hour	192 µg/m^3 (100 ppb)	192 µg/m^3 (100 ppb)
NAAQS Annual	100 µg/m^3 (53 ppb)	100 µg/m^3 (53 ppb)
PSD Class I Annual	2.5 µg/m^3	2.5 µg/m^3
PSD Class II Annual	25 µg/m^3	25 µg/m^3
Max Annual Impact Class I Areas	0.531 µg/m^3 Mesa Verde National Park	4.282 µg/m^3 Mesa Verde National Park
Max Annual Impact Class II Areas (latitude, longitude)	2.18 µg/m^3 (37.20817702, 108.8426431)	62.6 µg/m^3 Near Four Corners Power Plant
Max 1-Hour Impact Class I Areas	19.47 µg/m^3 Mesa Verde National Park	157 µg/m^3 Mesa Verde National Park
Max 1-Hour Impact Class II Areas	18.45 µg/m^3 Canyons of the Ancients National Monument	326 µg/m^3 Chaco Culture National Historic Park

Cumulatively, the 1-hour concentrations of 326.00 µg/m^3 at Chaco Culture National Historic Park are higher than the 1-hour NO_2 NAAQS (192µg/m^3). These cumulative impacts do not signify an actual violation. Rather they show that cumulative impacts from existing sources may pose a problem and need to be carefully examined by the regulatory agencies prior to issuing permits for new construction in the area. The high NO_2 results at Chaco Culture National Historic Park are likely related to oil and gas and power plant pollution sources in New Mexico since the NO_2 1-hour concentrations are much lower at all receptors close to the Paradox Basin well field.

The informal PSD information presented in Table S-3.1.23 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. Its usefulness is to better understand potential project impacts to Class I areas. Most oil and gas emission sources are not considered "PSD major sources" under the Clean Air Act and therefore the comparison is not a formal PSD increment analysis nor is it intended to replace such an analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

The direct project impacts of the No Lease Alternative would not exceed the NO_2 Class I PSD Increment (2.5 µg/m^3) or the Class II PSD Increment (25 µg/m^3). The cumulative impacts to Class I PSD increment for annual NO_2 would be exceeded at Mesa Verde National Park at 4.282 µg/m^3. The model results show that cumulative impacts to annual Class II PSD increment (25µg/m^3) would be exceeded within the coarse grid of the modeling domain with a maximum annual NO_2 concentration of 62.6 µg/m^3. This location is less than 7.5 km (~ 4.7 miles) from the Four Corners Power Plant. This power plant emits over 49,000 tons per year of NO_x, and is less than 13.7 km from the San Juan Generating Station, which emits over 40,000 tons per year of NO_x. These are likely the significant contributing sources to the high localized NO_2 concentration. In addition, numerous existing oil and gas wells are in this part of New Mexico, and additional NO_2 sources are anticipated in this area in conjunction with the Farmington RMP RFD.

Again, the informal PSD information presented in Table S-3.1.23 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

Sulfur Dioxide

The direct contributions of the No Lease Alternative to SO_2 concentrations at all receptors within the modeling domain are very small due to the low level of project-related SO_2 emissions (Table S-3.1.24 below). Project SO_2 emissions would be generated primarily from short-term well construction activities.

Table S-3.1.24 - Comparison of Maximum Predicted SO_2 Impacts Compared to NAAQS and PSD Increments

SO_2		No Lease Alternative	No Lease Alternative Cumulative
NAAQS 1-Hour		200 µg/m^3 (75 ppb)	200 µg/m^3 (75 ppb)
NAAQS 24-Hour		365µg/m^3 (14 ppm)	365µg/m^3 (14 ppm)
NAAQS Annual		80 µg/m^3 (0.03 ppm)	80 µg/m^3 (0.03 ppm)
PSD Class I (µg/m^3)	3-Hour	25	25
	24-Hour	5	5
	Annual	2	2
PSD Class II (µg/m^3)	3-Hour	512	512
	24-Hour	91	91
	Annual	20	20
Max Impact Class I Areas	1-Hour	0.84 µg/m^3 Mesa Verde National Park	187 µg/m^3 Mesa Verde National Park
	3-Hour	0.454 µg/m^3 Mesa Verde National Park	131.83 µg/m^3 Mesa Verde National Park
	24-Hour	0.168 µg/m^3 Mesa Verde National Park	25.27 µg/m^3 Mesa Verde National Park
	Annual	0.060 µg/m^3 Mesa Verde National Park	2.53 µg/m^3 Mesa Verde National Park
Max Impact Class II Areas	1-Hour	0.6 µg/m^3 Canyons of the Ancients National Monument	209 µg/m^3 Canyon DeChelly National Monument
	3-Hour (latitude, longitude)	1.12 µg/m^3 (37.2070686, 108.750069	2745 µg/m^3 (36.72532681, 108.5526668)
	24-Hour (latitude, longitude)	0.748 µg/m^3 (37.2070686, 108.750069)	469 µg/m^3 Near Four Corners Power Plant Coarse Grid
	Annual (latitude, longitude)	0.313 µg/m^3 (37.2070686, 108.750069)	58.3 µg/m^3 Near Four Corners Power Plant

Table S-3.1.24 above demonstrates that the direct contributions of the No Lease Alternative produce very small concentrations of SO_2 for all averaging times and for all receptors in the modeling domain. The direct and indirect oil and gas development associated with the No Lease Alternative would not significantly contribute to any exceedance of the 1-hour, 24-hour and annual SO_2 NAAQS.

The modeling indicates that cumulatively, the 24-hour and annual SO_2 NAAQS (365µg/m^3) could be surpassed at 469 µg/m^3 in the vicinity of the Four Corners Power Plant and San Juan Generating Stations The location of the coarse grid maximum SO_2 impacts is in the same spot as the maximum concentrations of coarse grid NO_X and PM_{10}, which is near the Four Corners Power Plant (which emits over 27,000 tons per year of SO_2), and near the San Juan Generating Station (which emits over 32,000 tons per year of SO_2). It is important to note that the GSGP and Paradox conventional projects will not emit appreciable SO_2; therefore, these modeled NAAQS exceedances for SO_2 are wholly due to existing sources and other reasonable foreseeable projects and not due to the projects under review for this EIS.

These cumulative impacts do not signify an actual violation. Rather they show that cumulative impacts from existing sources may pose a problem and need to be carefully examined by the regulatory agencies prior to issuing permits for new construction in the area. The very high SO_2 results near the New Mexico power plants should be viewed with caution. First, CALPUFF is not the preferred air quality model for receptors in the near-field (within 50 km of the source). Second, for this model analysis, emission sources with similar stack parameters were combined in order to keep the number of sources modeled manageable. Therefore, Four Corners Power Plant and San Juan Generating Station were each modeled as a single stack. Although elevated SO_2 concentrations would be expected in the vicinity of the power plants, the accuracy of CALPUFF for these possible NAAQS violations is less certain. Again, the extremely low project emissions associated with the No Lease Alternative (24-hour max concentrations 0.748 µg/m^3) would not contribute to cumulative SO_2 NAAQS exceedances in New Mexico.

Cumulatively, the 1-hour SO_2 concentrations at Canyon de Chelly National Monument at 209 µg/m^3 are higher than the 1-hour SO_2 NAAQS (200 µg/m^3). This receptor is not close to the Paradox Basin, and the No Lease Alternative would emit extremely small quantities of SO_2 emissions. The high cumulative SO_2 1-hour concentrations are likely related to emission sources located in New Mexico, and not to the wells in the Paradox Basin associated with this project.

The informal PSD information presented in Table S-3.1.24 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. Most oil and gas emission sources are not considered "PSD major sources" under the Clean Air Act and therefore the comparison is not a formal PSD increment analysis nor is it intended to replace such an analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

The direct project impacts of the No Lease Alternative are well below any Class I PSD increment for SO_2 and are also well below all Class II PSD increments. This is due to the very low SO_2 emissions associated with the project.

The cumulative impacts to Class I PSD increment for SO_2 would be exceeded at Mesa Verde National Park for all SO_2 concentration averaging times. Cumulative visibility impacts to Class I areas have long been recognized and are widely understood to be a problem across the country. This was the primary reason Congress promulgated the Regional Haze Rule.

The cumulative impacts to Class II PSD increments for SO_2 would be exceeded for all SO_2 concentration averaging times within the coarse grid receptors of the modeling domain. Again, the informal PSD information presented in Table S-3.1.24 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

Particulate Matter (PM_{10} and $PM_{2.5}$)

The summary model results of the No Lease Alternative compared to NAAQS and PSD increments are displayed in Table S-3.1.25 below. The modeling demonstrated that the oil and gas development for the No Lease Alternative would not cause exceedance of the PM_{10} and $PM_{2.5}$ NAAQS for any Class I or Class II receptor in the modeling domain.

Table S-3.1.25 - Comparison of Maximum Predicted $PM_{2.5}$ Impacts Compared to NAAQS and PSD Increments

$PM_{2.5}$	No Lease Alternative	No Lease Alternative Cumulative
NAAQS Annual (µg/m^3)	15.0	15.0
NAAQS 24-Hour (µg/m^3)	35.0	35.0
Max Annual Impact Class I Areas (µg/m^3)	0.129 Mesa Verde National Park	1.086 Mesa Verde National Park
Max Annual Impact Class II Areas (µg/m^3)	0.334 Lat 37.2070686, Long 108.750069	2.84 Lat 37.19862825, Long 108.1947035
Max 24-Hour Impact Class I Areas (µg/m^3)	0.354 Mesa Verde National Park	7.07 Mesa Verde National Park
Max 24-Hour Impact Class II Areas (µg/m^3)	0.922 Lat 37.49677787, Long 108.3722814	15.2 Lat 36.72532681, Long 108.5526668

Table S-3.1.26 - Comparison of Maximum Predicted PM_{10} Impacts Compared to NAAQS and PSD Increments

PM_{10}	No Lease Alternative	No Lease Alternative Cumulative
NAAQS 24-Hour µg/m^3	150	150
PSD Class I Annual (µg/m^3)	10	10
PSD Class II Annual (µg/m^3)	30	30
Max Annual Impact Class I Areas (µg/m^3)	0.355 Mesa Verde National Park	10.12 Mesa Verde National Park
Max Annual Impact Class II Areas (µg/m^3)	0.921 Lat 37.2070686, Long 108.750069	27.7 Lat 37.19862825, Long 108.1947035
Max 24-Hour Impact Class I Areas (µg/m^3)	0.978 Mesa Verde National Park	66.97 Mesa Verde National Park
Max 24-Hour Impact Class II Areas (µg/m^3)	2.53 Lat 37.49677787, Long 108.3722814)	130.7 Lat 37.19862825, Long 108.1947035

The informal PSD information presented in Table S-3.1.26 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

The direct project impacts of the No Lease Alternative would not exceed the PM_{10} Class I PSD Increment (10 µg/m^3) or the Class II PSD Increment (30 µg/m^3). The cumulative impacts to Class I PSD increment for PM_{10} would be exceeded at Mesa Verde National Park at 10.121µg/m^3. The model results show that cumulative impacts to annual Class II PSD increment would not be exceeded within the modeling domain.

Again, the informal PSD information presented in Table S-3.1.26 (above) is provided at the request of the EPA who was a stakeholder in the SJPL air quality impact analysis. BLM and USFS do not have the authority to conduct regulatory PSD increment analysis.

Deposition

The NPS Deposition Analysis Threshold of 0.005 kg/ha-yr for nitrogen and sulfur for Class I areas was used to assess significant deposition impacts. Mesa Verde maximum nitrogen deposition was 0.0928 kg/ha-yr and maximum sulfur deposition was 0.020 kg/ha-yr. Mesa Verde National Park is adjacent to the proposed development areas in the Paradox Basin. The cumulative Federal Land Manager (FLM) significance threshold of 3.0 kg/ha-yr for nitrogen and sulfur deposition was not exceeded at any Class I area in the modeling domain. Detailed model results for all Class I area receptors can be found in the Air Quality Analysis TSD.

Because the incremental FLM threshold of 0.005 kg/ha-yr was exceeded for nitrogen deposition at Mesa Verde National Park, additional analysis and agency consultation was conducted (please see discussion for RFD Scenario deposition impacts above).

Table S-3.1.27 - Nitrogen and Sulfur Deposition at Mesa Verde National Park Class I area from Leased and Unleased Lands in the Paradox Basin

Nitrogen and Sulfur Deposition Mesa Verde National Park	Wells on Currently Leased State and Private Lands (1365 wells)	No Lease Alternative Cumulative
Maximum Direct N Deposition Impact (year)	0.0928 kg/ha-yr (2002)	1.603 kg/ha-yr (2001)
Maximum Direct S Deposition Impact (year)	0.020 kg/ha-yr (2003)	1.652 kg/ha-yr (2003)

Acid Neutralizing Capacity of Sensitive Lakes

With the exception of Big Eldorado Lake, no sensitive high mountain lake in the Weminuche Wilderness exceeded the ANC threshold when the direct and indirect impacts of the RFD scenario were considered. Big Eldorado Lake has baseline ANC less than 25 µeq/L and small changes (≤ 0.03 µeq/L) to ANC are predicted. For Big Eldorado Lake, the USFS ANC threshold is zero change. The changes to ANC from the RFD scenario are displayed in Table S-3.1.28 below.

Table S-3.1.28 - % Change Acid Neutralizing Capacity High Mountain Lakes in Weminuche from Nitrogen and Sulfur Deposition, RFD Scenario

Mountain Lake	Threshold	ANC Change (%)		
		2001	2002	2003
Big Eldorado Lake (change from baseline ANC)	No change	0.224 (0.026 µeq/L)	0.11 (0.03 µeq/L)	0.142 (0.029 µeq/L)
Lower Sunlight Lake	< 10% change	0.026	0.032	0.026
Upper Sunlight Lake	< 10% change	0.078	0.096	0.077
Upper Grizzly Lake	< 10% change	0.076	0.093	0.074

Cumulatively, with the exception of Lower Sunlight Lake, ANC for all lakes was higher than the USFS AQRV threshold of 10% change. Cumulative changes to ANC from the RFD scenario are displayed in Table S-3.1.29.

Table S-3.1.29 - Cumulative % Change Acid Neutralizing Capacity High Mountain Lakes in Weminuche from Nitrogen and Sulfur Deposition

Mountain Lake	Threshold	ANC Change (%)		
		2001	2002	2003
Big Eldorado Lake	No change	14.9	16.05	15.33
Lower Sunlight Lake	< 10% change	4.06	4.8	4.51
Upper Sunlight Lake	< 10% change	12.04	14.07	13.37
Upper Grizzly Lake	< 10% change	6.77	13.90	13.06

Visibility

Mesa Verde National Park was the only Class I Area with predicted impacts above the 5% change AQRV threshold. The maximum visibility change was 7.8% for 16 days at Mesa Verde National Park. Table S-3.1.30 below displays the estimated maximum change in visibility for the No Lease Alternative calculated using Method 6 for each Class I area.

The cumulative visibility modeling analysis validates what was already known from review of existing visibility monitoring data i.e., visibility in the region is already impaired from existing sources. All of the receptors modeled show that visibility would be impaired by emissions from the cumulative sources, based on a definition of impairment being a change in extinction of 10% or more compared to natural visibility conditions. The cumulative impacts are identical between the RFD scenario and the No Lease Alternative. This suggests that development of the RFD scenario would not significantly change the existing level of visibility impairment.

Table S-3.1.30 - Visibility Method 6 for the No Lease Alternative at Class I Areas. Estimated Maximum Change in Extinction Coefficient (b_{ext}), Number of Days with Extinction Changes Greater than 5% and Greater than 10%

Class I Area	RFD SCENARIO			RFD SCENARIO CUMULATIVE		
	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8th High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 5%	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8th High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 10%
Arches	4.02	2.34	0	155	91	104
Bandelier	1.04	0.57	0	114	64	148
Black Canyon of the Gunnison	3.08	1.15	0	108	76	109
Canyonlands	4.48	3.48	3	217	117	137
LaGarita	1.42	0.47	0	174	71	122
Mesa Verde	7.80	5.88	16	452	278	323
San Pedro Parks	2.76	0.86	0	154	96	197
Weminuche	4.42	1.12	0	460	76	194
West Elk	1.99	0.81	0	311	53	111

Canyons of the Ancients National Monument was the only the Class II areas with predicted incremental impacts from the No Lease Alternative above the 5% change AQRV threshold. Table S-3.1.31 (below) displays the estimated maximum change in extinction coefficient (b_{ext}) for the No Lease Alternative calculated using Method 6 for each Class I area.

Cumulatively, the model results reflect the current impaired visibility from existing sources seen in monitoring data. The cumulative impacts are identical between the RFD scenario and the No Lease Alternative. This suggests that development of the RFD scenario would not significantly change the existing level of visibility impairment.

Table S-3.1.31 - Visibility Method 6 for the No Lease Alternative at Class II Areas. Estimated Maximum Change in Extinction Coefficient (b_{ext}), Number of Days with Extinction Changes Greater than 5% and Greater than 10%

Class II Area	RFD SCENARIO			RFD SCENARIO CUMULATIVE		
	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8th High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 5%	% Change High Day 24-Hour B_{ext} (Mega-m^{-1})	% Change 8th High Day 24-Hour B_{ext} (Mega-m^{-1})	Days > 10%
Canyon de Chelly	4.32	0.85	0	414	126	182
Canyons of the Ancients	20.39	7.43	26	465	164	360
Chaco Culture	1.53	0.85	0	421	136	210
Hovenweep	4.54	2.81	0	285	133	272
Natural Bridges	4.20	1.60	0	232	88	95

Greenhouse Gas Emissions and Climate Change

Greenhouse gas emissions were not modeled in CALPUFF. Estimates of greenhouse gas emissions for oil and gas activities were calculated using assumptions from EPA AP-42 tables. The No Lease Alternative is estimated to emit a total of 54,221 tons of CO_2 per year and 249 tons of methane per year (6,225 tons of CO_2 equivalents as methane). By comparison, the CO_2 equivalent emissions of La Plata County for 2005 were estimated to be 5,019,511 tons and in 2020 it is estimated they will decrease to 3,523,663 tons (La Plata County, 2008).

Table S-3.1.32 - Estimated Greenhouse Gas Emissions, No Lease Alternative

EMISSION SOURCE	GOTHIC SHALE GAS WELLS		PARADOX CONVENTIONAL WELLS	
	CO_2 (tons/year)	Methane (tons/year)	CO_2 (tons/year)	Methane (tons/year)
Drill Rig Engines	13,330	8	1,754	1
Hydraulic Fracturing Engines	1,885	1	62	0.1
Compressor Engines	19,541	221	1,545	18
Well Pad Separator/Heaters	14,520	0.3	1,584	0.3
Total	**49,276**	**230**	**4,945**	**19**

The air quality impacts from Alternatives A, B, C, and D would be greater than the No Lease Alternative but the impacts would be the same or very slightly less than the RFD scenario for all air quality parameters. This is because Alternatives A, B, C, and D have essentially the same number of wells proposed compared to the RFD scenario.

OPTIONS FOR MITIGATION

The air quality impact analysis indicated that some potentially significant environmental effects could occur. Mitigation options have been developed to reduce the impacts to air quality and to reduce the project emissions of greenhouse gases. The SJPL may require these mitigation measures or acceptable substitutions if it can be shown these additional options have equal or greater benefits to reducing specific pollutants. There are three NEPA analysis stages for oil and gas leasing, exploration and development. This NEPA analysis is the first stage in which lands available for lease are identified and stipulated. In a subsequent analysis stage, when there is a site specific proposal for development, additional air quality impact analysis would occur. Based upon the analysis results, these mitigation options or others could be considered in more detail.

Reducing NO_x emissions has several environmental benefits including 1) decreased nitrogen deposition and associated ecosystem impacts 2) decreased acidification of water chemistry at sensitive wilderness lakes, 3) reduction of ozone precursors thereby reducing ozone formation, 4) reducing impacts to visibility from nitrogen aerosol species, and 5) improve ambient near-field air quality. Reducing VOC emissions has the benefit of reducing an ozone precursor thereby reducing ozone formation.

As stated in the air quality impacts analysis, the RFD project would produce very low levels of sulfur emissions due to the short duration of drilling and completion activities per well and because the gas produced is very low in sulfur. However, some sulfur reductions can still be achieved with the application of mitigation measures. The environmental benefits of sulfur emission reductions include 1) decrease sulfur atmospheric deposition and acidification of water chemistry at sensitive wilderness lakes, 2) improve ambient near-field air quality, 3) reducing impacts to visibility from sulfur aerosol species.

Reducing PM emissions would 1) improve ambient near-field air quality, 2) reduce impacts to far-field visibility from aerosol particulates 3) improve near-field visibility and public safety. Much emphasis is also put into reducing methane emissions from drilling and gas production activities. Reducing methane emissions would 1) reduce emissions of a powerful greenhouse gas and 2) increase methane gas revenue sales benefitting both the Producer and the Federal Government.

The Air Quality Modeling Study for the Four Corners Area (NMED, 2010) demonstrates that ozone reductions and improvement to visibility at Mesa Verde are possible if high-level controls are implemented for both oil and gas operations and power plants throughout the Four Corners Region. The controls considered in detail for the oil and gas sector were VOC control for pneumatic devices, flaring, and venting. The controls considered for NO_x were emission reductions on existing engines. The SJPL considered these findings when developing air quality mitigation measures for potential future oil and gas development on public lands in Colorado. Many SJPL standards, guidelines and mitigation measures focus on the VOC and NO_x controls developed by the Four Corners Air Quality Task Force as a result of the Air Quality Modeling Study for the Four Corners Area.

In response to the concerns of the SJPL and the National Park Service, several mitigation measures were considered to reduce the deposition of nitrogen within Weminuche Wilderness and Mesa Verde National Park Class I areas. Methane gas emission reduction measures were also considered to minimize the production of greenhouse gases related to management activities on the SJPL. The mitigation options and potential emission reduction benefits are summarized in Table 3.1.33. Some of the mitigation options in the table are proposed in the new air quality and water standards and guidelines disclosed in this Supplement; while others represent additional mitigation measures that could be required. The SJPLC is particularly interested in receiving public comments about these proposed mitigations. Which of these mitigations should be required? Have we identified the most effective mitigations, or are there better ways to reduce emissions?

Table S-3.1.33 - Summary of Mitigation Options Considered to Reduce Air Pollution Emissions, RFD Scenario

Mitigation Option	Potential Emission Reductions RFD Scenario	*Mitigation Option Ranking	Implementation Mechanisms
Reduce Truck Traffic Emissions	40 tpy PM_{10}, 6 tpy $PM_{2.5}$, 946 tpy CO, 733 tpy NO_x, 20 tpy SO_2, 365 tpy VOC	H	Record of Decision, Plan of Development, Conditions of Approval
Electric Small Wellhead Engines	Gothic well reductions would be 4.11 tpy PM_{10}, 4.11 tpy $PM_{2.5}$, 91 tpy CO, 45 tpy NO_x, 0.01 tpy SO_2, 1.37 tpy VOC. Paradox Conventional well reductions would be 0.82 tpy PM_{10}, 0.82 tpy $PM_{2.5}$, 79.13 tpy CO, 40 tpy NO_x, 0.04 tpy SO_2, 20 tpy VOC.	M	Record of Decision, Proposed Plan Guideline Plan of Development
Centralized Liquid Gathering Systems and Liquid Transport Pipelines	Reduce tailpipe emissions by 14.9 tons PM_{10}, 2.2 tons $PM_{2.5}$, 4.2 tons CO, 3.3 tons NO_x, 0.09 tons SO_2, 1.64 tons VOC per year. Eliminate 90% of well field tanks and reduce tank venting emissions by 80%.	H	Record of Decision, Plan of Development, Conditions of Approval
Solar Powered Telemetry and Well Automation	74.3 tons PM_{10}, 11 tons $PM_{2.5}$, 21.2 tons CO, 16.5 tons NO_x, 0.46 tons SO_2, 8.2 tons VOC per year. Eliminate 90% of well field tanks and reduce tank venting emissions by 90%.	M	Record of Decision, Plan of Development
NO_x Emission Limit for Engines < 300 hp	High when applied to all new wells on SJPL	H	Record of Decision, Proposed Plan Standard
NO_x Emission Limit for Engines > 300 hp	Moderate when applied to all new large engines on SJPL	H	Record of Decision, Proposed Plan Standard
Reduced Emission Completions	Capture an average of 53% of methane gas and condensate typically vented or flared during well completions and well work over	H	Record of Decision, Plan of Development
Low Emission Drill Rig Engines	NO_x emissions would be reduced by 50% compared to SJPL Standards for NO_x emission limits.	M/L	Record of Decision
SCR for New Lean Burn Drill Rig Engines	90% NO_x reduction is 101.1 tons for life of project for federal wells (Gothic and Paradox Conventional)	M/L	Record of Decision
Use Low Bleed Pneumatics for New Wells	90% methane reduction compared to high bleed devices is 118.5 MMcf/year methane emissions reduced (conservative estimate)	H	Record of Decision, Proposed Plan Standard
Replace High-Bleed Pneumatics with Low-Bleed Pneumatic Devices on Existing Wells	Reduce methane emissions from pneumatic devices by a conservative 100 Mcf/year per well (90% reduction methane emissions).	M	Record of Decision

**Mitigation option ranking – options ranked in order of emissions reduction effectiveness and SJPL preference. H = highly favorable, M = moderately favorable, L= low favorability*

Reduce Truck Traffic Emissions

Design Feature: Transport water for hydraulic fracturing activities via pipeline or ditch to centralized reservoirs for shale gas wells.

Description: Over 100,000 barrels or 4,200,000 gallons per well would be needed to hydraulically fracture a typical Gothic shale gas well. This analysis assumed that water would be hauled in by truck to tank batteries or reservoirs. The truck hauling round-trip calculations assumed an average of 40% recycling of flow-back water from each well. Total tailpipe emissions for the RFD scenario associated with Gothic Shale gas well completions were 48.3 tons PM_{10}, 7.19 tons $PM_{2.5}$, 1152 tons CO, 894 tons NO_x, 24.8 tons SO_2, 445 tons VOCs per year.

Environmental Benefits: For the RFD scenario for shale gas wells, assuming 70% of round-trips to haul water could be eliminated by transporting water for hydraulic fracturing activities via temporary pipeline or ditches, this could translate into a conservative 50% reduction in tailpipe emissions associated with well completion truck round-trips. For the RFD scenario, total emission reductions from this mitigation measure could be 24 tons PM_{10}, 3.6 tons $PM_{2.5}$, 576 tons CO, 447 tons NO_x, 12.4 tons SO_2, 22.5 tons VOC per year.

Electric Compression and Low Emission Dehydration Units

Design Feature: Require electric powered well pad engines and instrumentation where wells are within ½ mile of the electric power grid. This applies to both Paradox Basin conventional and shale gas wells.

Description: There is limited access to electric power in the Paradox Basin. It was estimated that 15% of Paradox Basin conventional and shale gas wells on federal lands could be within ½ mile of the electric power grid. Wells within ½ mile of the electric power grid would be required to use electricity to eliminate gas combustion for small wellhead engines as well as for electric instruments, controllers, actuators for automatic valves, and small pumps. This option would also allow the use of zero or low emission dehydrator units (almost no or low emission of methane, VOC, HAP). On average, small wellhead engines for production of the Gothic Shale were assumed to be 0.03 tpy PM_{10}, 0.03 tpy $PM_{2.5}$, 0.664 tpy CO, 0.33 tpy NO_x, 0.0001 tpy SO_2, 0.01 tpy VOC. For Paradox Conventional wells, small wellhead engine emissions for each well pad were assumed to be 0.02 tpy PM_{10}, 0.02 tpy $PM_{2.5}$, 1.93 tpy CO, 0.97 tpy NO_x, 0.001 tpy SO_2, 0.48 tpy VOC.

Environmental Benefits: Emissions reductions for Gothic shale gas well reductions would be 4.11 tpy PM_{10}, 4.11 tpy $PM_{2.5}$, 91 tpy CO, 45 tpy NO_x, 0.01 tpy SO_2, 1.37 tpy VOC. Paradox Conventional well reductions would be 0.82 tpy PM_{10}, 0.82 tpy $PM_{2.5}$, 79.13 tpy CO, 40 tpy NO_x, 0.04 tpy SO_2, 20 tpy VOC.

Centralized Liquid Gathering Systems and Liquid Transport Pipelines

Design Feature: Require pipelines to transport condensate and other liquids for non-wildcat wells via pipelines and use centralized liquids gathering systems. This applies to both Paradox Basin conventional and shale gas wells.

Description: The current practice for Paradox Basin conventional and shale gas wells is to store condensate and other produced liquids in tanks on the well pad and transport liquids by truck. Storage tank venting is a large source of methane and VOC emissions within the oil and gas sector accounting for 11% of gas industry methane emissions (EPA, 2009). Pipeline transport of fluids would reduce tailpipe emissions related to liquid transport and eliminates leaking tank emissions. Treating fluids at a centralized production and collection facility will allow more control of emissions. It is assumed that approximately 261,300 round trips per year are necessary to service producing Gothic shale gas wells at full build out. Emissions from well production related vehicle traffic would be 148.6 tons PM_{10}, 22 tons $PM_{2.5}$, 42.4 tons CO, 33 tons NO_x, 0.9 tons SO_2, 16.4 tons VOC per year.

Environmental Benefits: Reduced truck traffic emissions, eliminated venting from storage tanks, efficient emission control. It is assumed that this option would eliminate 10% of truck traffic associated with production wells and would eliminate 80% of well field tanks with 100% elimination of venting emissions where there are no tanks. Reduce tailpipe emissions by 10% or 14.9 tons PM_{10}, 2.2 tons $PM_{2.5}$, 4.2 tons CO, 3.3 tons NO_x, 0.09 tons SO_2, 1.64 tons VOC per year. Eliminate 90% of well field tanks and reduce tank venting emissions by 80%.

Solar Telemetry and Well Automation

Design Feature: Require telemetry to remotely monitor and control production wells and associated equipment. This mitigation option was suggested by the National Park Service (NPS, 2010), and developed as a mitigation option by the Four Corners Air Quality Task Force (FCAQTF, 2007).

Description: Remote control and monitoring technology reduces tailpipe emissions related to service truck traffic. It is assumed that approximately 38,430 round trips per year are necessary to service producing Gothic shale gas wells at full build-out. Emissions from well production related vehicle traffic are 148.6 tons PM_{10}, 22 tons $PM_{2.5}$, 42.4 tons CO, 33 tons NO_x, 0.9 tons SO_2, 16.4 tons VOC per year.

Environmental Benefits: Remote telemetry could eliminate 50% of truck traffic associated with production wells. This would reduce tailpipe emissions by 74.3 tons PM_{10}, 11 tons $PM_{2.5}$, 21.2 tons CO, 16.5 tons NO_x, 0.46 tons SO_2, 8.2 tons VOC per year. An additional environmental benefit would be reduced emissions from gas-generated power necessary to run the instrumentation, although this reduction is not easily quantifiable.

NO_x Emission Limit for Stationary Engines > 300 hp and < 300 hp

See new proposed air quality standards and guidelines listed in Chapter Two of this Supplement. Emission control benefits from this measure were already accounted for in model results.

Reduced Emission Completions/Recompletions (Green Completions)

Mitigation Measure: Reduced emission completions (as defined by the EPA Gas STAR program) are required for all oil and gas wells where technically feasible and would apply to most non-wildcat wells on SJPL.

Description: The current practice for drilling Paradox Basin wells is to vent methane gas directly into the atmosphere or flare methane gas as part of the well clean-out process. Venting and flaring is the largest source of methane emissions in the oil and gas sector (EPA, 2009). Equipment is now available that will recover natural gas, condensate and other materials that flow out of the well during clean out. Reduced emission well completion equipment includes mobile tanks, portable separators, sand traps, and portable gas dehydration units. The emission control benefits from this measure were already accounted for in model results. See new proposed air quality standards and guidelines listed in Chapter Two of this Supplement. Emission control benefits from this measure were already accounted for in model results.

Environmental Benefits: Capture an average of 53% of methane gas and condensate vented or flared during well completions and workovers.

Low Emission Drill Rig Engines

Control Measure: Require the use of natural gas powered drill rigs for new wells and re-completed wells in the Paradox Basin or use Tier 4 drill rig engines beginning in 2011(or best available technology).   The required use of Tier 4 engines by the year 2011 was a recommendation by the CDPHE and the EPA.

Description: Use drill rigs with Tier 4 EPA engine standards for all new or recompleted wells in the paradox Basin. The use of natural gas engine powered drill rigs is an acceptable substitute to Tie 4 drill rig engines.

Environmental Benefits: The air quality model assumed 2 g/hp-h NO_x emission limits for stationary engines < 300 hp and 1 g/hp-h NO_x emission limits for stationary engines > 300 hp. Using Tier 4 engine standards would require that the largest engines used for oil and gas development and production, for example drill rig engines and compressor engines, must emit even lower emissions than SJPL Plan standards and guidelines. The air quality model assumed drill rig engines of 1,500 hp. The 2011 Tier 4 standards for engines > 750 hp are 0.5 g/hp-h NO_x emissions, and 0.075 g/hp-h PM emissions.   Note that these large engine Tier 4 Standards would not apply to the small engines found on most well pads. It is assumed that the use of natural gas powered drill rigs would have NO_x and CO emissions that are somewhat higher than engines meeting 2011 Tier 4 engine standards.

SCR for NO_x Control on Lean Burn Drill Rig Engines

Control Measure: Drill rigs in the Paradox Basin utilize selective catalytic reduction (SCR) large drill rig engines. This option requested by the National Park Service and developed as a mitigation option by the Four Corners Air Quality Task Force.

Description: Drill rig engines are a source of NO_x emissions for the project. Assuming 1,338 wells (Paradox Basin Conventional and Gothic shale gas wells) are drilled on federal lands this would produce 449 tons NO_x over the life of the project. SCR technology applied to lean burn drill rig engines can reduce NO_x emissions up to 90% (manufacturer data).

Environmental Benefits: It is assumed that 25% of diesel drill rigs in southern Colorado use lean burn engines. The number of wells drilled would vary from year to year.   This option could reduce 101.1 tons NO_x over the life of the project assuming SCR technology can reduce NO_x emissions on lean burn engines by 90%.

Low-Bleed Pneumatic Devices on all New Wells

Control Measure: Require low bleed pneumatic devices on all new wells in the Paradox Basin and on SJPL to reduce methane emissions. This measure was developed through the EPA Gas STAR program and is a new proposed air quality standard (see Chapter Two of this Supplement for list of new standards and guidelines).

Description: For producing wells, pneumatic devices are the largest source of methane losses in the oil and gas production sector. Installing low bleed pneumatic devices for new wells can reduce methane emissions by 90% compared to high bleed devices. Pneumatic devices include controllers, positioners and transducers.

Environmental Benefits: Conservatively assume that low bleed pneumatic devices save 100 Mcf/year per well (90% reduction methane emissions) compared to high bleed devices. Up to 100 Mcf/year methane could be saved if low bleed pneumatics are used compared to high bleed pneumatics.

Replace High-Bleed Pneumatics with Low-Bleed Pneumatic Devices on Existing Wells

Control Measure: Either replace or retrofit high-bleed controllers, positioners, and transducers with low-bleed devices. This is an EPA Gas STAR measure.

Description: The cost to inventory and replace high-bleed pneumatics with low-bleed pneumatic devices on existing wells located on federal land is not high compared to the value of methane gas lost to the atmosphere. Most replacement costs recouped in under one year resulting is large economic benefit for industry. This measure could be applied to any existing gas well on the SJPL. A high bleed pneumatic device is defined as having bleed rates of 6 standard cubic feet/hour

Environmental Benefit: Assume replacement/retrofit saves 100 Mcf/year per well (90% reduction methane emissions).