APPENDIX D

Air Quality Modeling Protocol
for San Juan Public Lands Center Land Management Plan
And Environmental Impact Statements

Prepared January 2, 2009

AIR QUALITY MODELING PROTOCOL
FOR SAN JUAN PUBLIC LANDS CENTER LAND MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT

Forest Service
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FOR SAN JUAN PUBLIC LANDS CENTER LAND MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT

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Modeling Protocol for San Juan Public Lands' Land Management Plan CALPUFF Analysis
December 29, 2008

1.0 INTRODUCTION

San Juan Public Lands (SJPL) has authorized Air Resource Specialists, Inc. (ARS) to provide additional air quality modeling support to complete the final EIS for its Land Management Plan (Plan). Alternatives under consideration for the Plan include two potential new lease areas for oil and gas development: the Paradox Basin Lease Area and the San Juan Sag Lease Area. In addition, infill drilling within active leases in the Northern San Juan Basin will be analyzed. Modeling of air quality impacts to nearby Class I and Class II areas is required for the SJPL Land Management Plan as well as for future NEPA analysis as leases are offered for sale and as drilling permits are issued over the next decade. This document outlines the proposed air dispersion model and procedures which will be used to assess impacts from the Paradox Basin and Northern San Juan Basin development areas, as well as other known or proposed sources and projects in the vicinity (i.e., Reasonably Foreseeable Development, a.k.a. "RFD"). The goal of the modeling is to estimate potential project-specific and cumulative air quality impacts on nearby Class I areas and other Class II areas of concern. The evaluation of impacts will be compared to National Ambient Air quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments, but these comparisons are for disclosure purposes only and will not constitute a regulatory or permitting analysis.

This document describes the procedures to be used in evaluating impacts on nearby Class I and other Class II areas of concern with the CALPUFF model. The evaluation of impacts from Hazardous Air Pollutants (HAPs) or of near field impacts is not included in this analysis. At this stage, the exact locations of the emissions sources from leasing operations are not known with sufficient precision for near field modeling to be performed, and this information would be necessary for the evaluation of HAPs. A CALPUFF domain and resolution appropriate for evaluating long range impacts on Class I and Class II areas of concern would be inappropriate for the assessment of the near field impacts and, in turn HAPs. In the future, when the leases are put up for sale or when APD's are issued, another, more detailed modeling analysis will be conducted that will include near-field analysis.

The Class I and Class II areas of interest for this project are summarized in Table 1-1. Figure 1-1 shows the locations of these areas.

TABLE 1-1. CLASS I AND CLASS II AREAS TO BE INCLUDED IN THE CALPUFF ANALYSIS FOR SAN JUAN PUBLIC LANDS

Class I Area	**Federal Land Manager**
Arches National Park	National Park Service
Bandelier National Monument	National Park Service
Black Canyon of the Gunnison National Park	National Park Service
Canyonlands National Park	National Park Service
La Garita Wilderness	USDA Forest Service
Mesa Verde National Park	National Park Service
San Pedro Parks Wilderness	USDA Forest Service
Weminuche Wilderness	USDA Forest Service
West Elk Wilderness	USDA Forest Service
Class II Area	
Canyon de Chelly National Monument	National Park Service
Canyon of the Ancients National Monument	Bureau of Land Management
Chaco Culture National Historic Park	National Park Service
Hovenweep National Monument	National Park Service
Natural Bridges National Monument	National Park Service

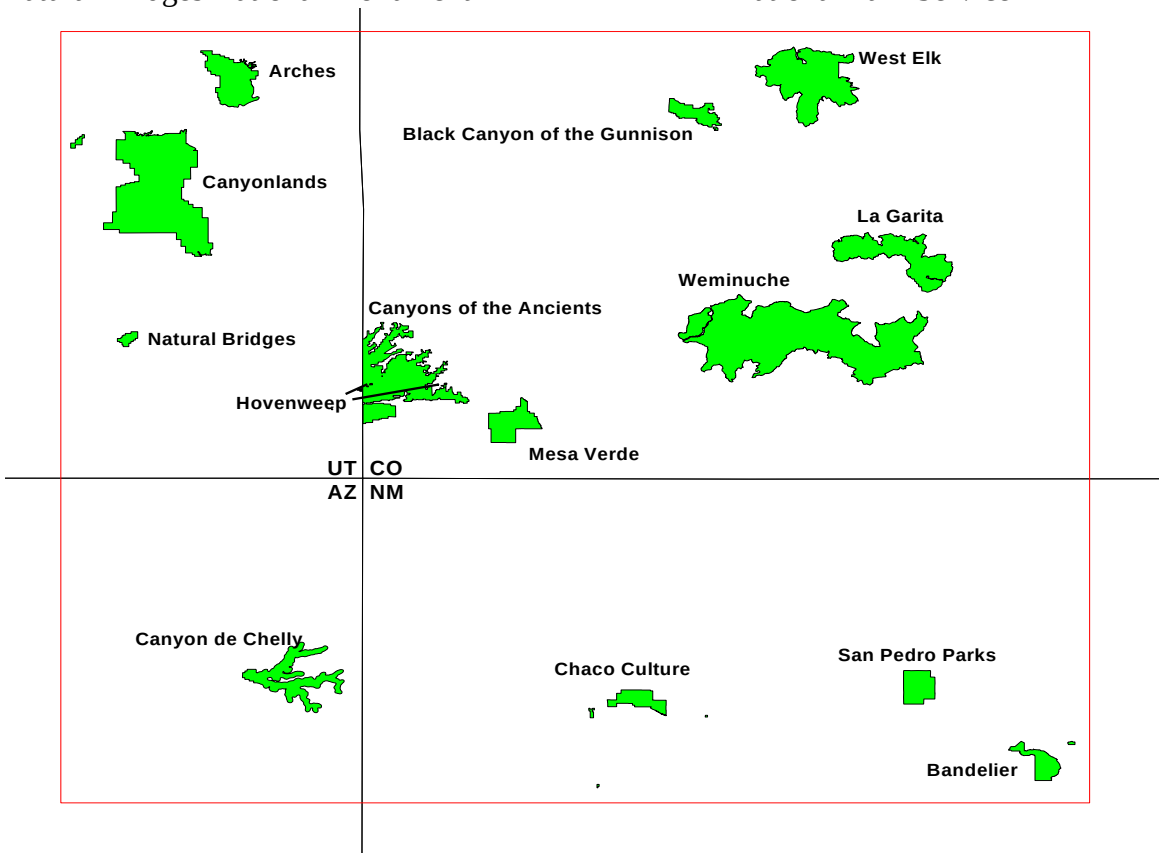

FIGURE 1-1. CALPUFF MODELING DOMAIN, WITH CLASS I AND CLASS II AREAS TO BE EVALUATED.

This CALPUFF analysis supports the Environmental Impact Statement (EIS) for the San Juan Public Lands – Land Management Plan, as overseen by the USDA Forest

Service (FS), San Juan National Forest and the Bureau of Land Management (BLM). Although the work described here will be done with the cooperation of the other agencies such as the Colorado Department of Public Health and Environment (CDPHE), the New Mexico Air Quality Bureau (NMAQB), the Environmental Protection Agency (EPA) and the National Parks Service (NPS), the products derived from this study are for SJPL use and are not intended to perform any regulatory function of CDPHE, NMAQB, or EPA for administering the federal and state Clean Air Act within Colorado or New Mexico.

2.0 INPUT DATA

2.1 EMISSIONS INFORMATION

The specific emissions data for this project have not been finalized. Nevertheless, this section describes the procedures used to develop emissions data inputs.

While the Forest Service (FS) will provide its best estimates of emissions associated with Paradox Basin, Northern San Juan Basin and San Juan Sag projects, emissions from additional sources in the vicinity and other proposed projects need to be included in the cumulative analysis. It is expected that these additional projects would include the following:

- Northern San Juan Basin Coalbed Methane EIS
- Southern Ute EISs
- Jicarilla Oil & Gas Leasing EIS (Carson NF)
- BLM Farmington Field Office Resource Management Plan
- Proposed Desert Rock Power Plant
- Canyons of the Ancients National Monument Resource Management Plan

The above source list may be subject to change as a result of discussions with the SJPL and Federal Land Managers (FLMs). A final emissions inventory will be available to stakeholders when it is complete.

Compiling an emissions inventory from multiple projects and sources can be a time-consuming task; however, many of the above projects have already been modeled for the Four Corners Modeling Project.[1] ARS will acquire the emissions inventory for the Four Corners Modeling Project which would be used "as is" as a master list of projects and sources in the area.[2] ARS will then add to this inventory as necessary, thereby eliminating the bulk of the labor involved in collecting and checking data from so many individual projects.

ARS has requested emissions inventories for existing sources within each of the four states in the modeling domain (i.e., Utah, Arizona, New Mexico and Colorado).

In order to evaluate potential visibility impacts, worst case or maximum 24-hour emission rates from each source must be included in the modeling. The FS will provide these data for the Paradox Basin Lease Area, the Northern San Juan Basin and the San Juan SAG projects, for each of the alternatives presented in Section 2.2. Unless otherwise

[1] http://www.nmenv.state.nm.us/aqb/4c/modeling.html

[2] Sometimes for this type of analysis, a filter is applied that excludes sources on the basis of a combination of the magnitude of emissions and distance from the source or receptors under evaluation. An example of this would be the "20-D rule" which includes only sources with emissions (in tons per year) greater than 20 times the distance (in km) from the source or Class I area under evaluation. ARS does not plan on using such a filter, and would use the emissions inventory created for the Four Corners Modeling Project "as is."

specified, emissions corresponding to the "full build-out" year, which corresponds to 15 years from the date of submission of the EIS, expected to be 2026, will be used. It will be assumed that emission rates for the other RFD areas taken from the Four Corners Modeling Project already represent worst-case 24-hour emission rates.

For deposition modeling, the annual average emissions will be used for model input. All visibility precursor emissions (NO_X, SO_2, PM_{10}) will be included in the modeling.

Where possible, particulate emissions from the project will be speciated between coarse particulate (CPM), fine particulate (FPM), primary sulfate (SO_4), elemental carbon (EC), and secondary organic aerosol (SOA) according to standard FLM recommendations. (See http://www.nature.nps.gov/air/permits/ect/index.cfm.) This speciation allows for the consideration of the different scattering efficiencies of the various PM species. This apportionment is important because some particle classifications, especially EC and SOA, have a greater impact on visibility per unit mass of emissions.

2.2 EIS ALTERNATIVES

SJPL desires to evaluate the impacts from the following alternatives:

1. Unconstrained Development Alternative: Represents full implementation of the Reasonably Foreseeable Development Scenario -- This is the high end of development spectrum to be evaluated.

The reasonably foreseeable development scenario projects development within three basins unconstrained by land management allocations prescribed in the draft resource management plan, such as wilderness recommendations, that would remove land areas within the RFD areas from mineral leasing. Under the full RFD scenario, a total of 2,025,000 acres are available for lease in the SJPL planning area. Table 2-1 describes the number of wells projected to be drilled under the RFD scenario. Table 2-2 describes the total number of "development wells" that would produce over the 15 year projection period net plugged and abandoned wells that would be drilled and reclaimed. Plugged and abandoned wells are wells are well drilled during the planning period that do not produce gas in paying quantities during a reasonable well test period. In contrast to producing wells, plugged and abandoned wells produce emissions only for the short period of time that the wells are drilled and tested.

A projection of wells drilled and plugged, and drilled and producing on a yearly basis for the 15-year projection period will be provided.

TABLE 2-1. REASONABLY FORESEEABLE DEVELOPMENT SCENARIO FOR PLANNING AREA - NUMBER OF WELLS PROJECTED BY JURISDICTION/MINERAL ESTATE

This unconstrained projection applies to all jurisdictions for the purpose of cumulative effects analysis.

Land Ownership	Paradox Basin – conventional gas	Paradox Basin - Gothic Shale	Northern San Juan Basin (remainder of 160-acre spacing units)	Northern San Juan Basin (80-acre spacing units)	San Juan Sag
BLM Public Lands (including federal split mineral estate	185	425	27	57	0
National Forest/federal mineral estate	140	585	111	143	30
State mineral estate	0	0	7	7	0
Private mineral estate	50	760	92	283	0
TOTAL	**375**	**1770**	**237**	**490**	**30**

Note: The Northern San Juan Basin remainder of 160 acre spacing units may already be accounted for in the Four-Corners Task Force inventory.

TABLE 2-2. REASONABLY FORESEEABLE DEVELOPMENT SCENARIO (PRODUCTION WELLS NET OF PLUGGED AND ABANDONED WELLS) ON ALL JURISDICTIONS.

This projection applies to currently leased lands on all jurisdictions for the purpose of cumulative effects analysis.

Land Ownership	Paradox Basin – conventional gas	Paradox Basin - Gothic Shale	Northern San Juan Basin (remainder of 160-acre spacing units)	Northern San Juan Basin (80-acre spacing units)	San Juan Sag
BLM Public Lands (including federal split mineral estate	160	373	27	57	0
National Forest/federal mineral estate	115	513	111	143	15
State mineral estate	0	0	7	7	0
Private mineral estate	41	670	92	283	0
TOTAL	**316**	**1556**	**237**	**490**	**15**

2. Alternative C – this alternative is one of four resource management plan alternatives and the most conservative among the range of alternatives evaluated in the draft LMP analysis.

A total of 1,509,321 acres are available for lease in Alternative C. Management provisions under this alternative emphasize maintaining the undeveloped character of large blocks of contiguous land and non-motorized recreational opportunities to a greater degree than the other alternatives. The large contiguous blocks of roadless areas would be recommended for wilderness and thereby proposed for withdrawal from leasing. Table 2-3 describes total wells drilled under the LMP Alternative C scenario. Table 2-4 describes the total number of development wells over the 15 year projection period net of plugged and abandoned that would be drilled and reclaimed

Alternative C differs from the unconstrained RFD scenario in that most of the inventoried roadless areas in the planning area are recommended for wilderness and not available for lease. Consequently, the number of wells projected is less than the unconstrained RFD scenario. Note, however, the difference between wells projected in the unconstrained RFD scenario and Alternative C are small because most areas recommended for wilderness in Alternative C have no potential for oil and gas. In other words, Alternative C has a minor effect on development of those areas on which RFD is projected, thus the small difference between the unconstrained RFD scenario and Alternative C.

TABLE 2-3. LMP ALTERNATIVE C WELL DEVELOPMENT PROJECTION FOR PLANNING AREA - NUMBER OF WELLS ON ALL JURISDICTIONS.

Land Ownership	Paradox Basin – conventional gas	Paradox Basin - Gothic Shale	Northern San Juan Basin (remainder of 160-acre spacing units)	Northern San Juan Basin (80-acre spacing units)	San Juan Sag
BLM Public Lands (including federal split mineral estate	185	418	27	57	0
National Forest/federal mineral estate	133	568	111	143	17
State mineral estate	0	0	7	7	0
Private mineral estate	50	760	92	283	0
TOTAL	**368**	**1746**	**237**	**490**	**17**

Note: The Northern San Juan Basin remainder of 160 acre spacing units may already be accounted for in the Four-Corners Task Force inventory.

TABLE 2-4. FOREST PLAN ALTERNATIVE C (PRODUCTION WELLS NET OF PLUGGED AND ABANDONED WELLS) ON ALL JURISDICTIONS.
This projection applies to currently leased lands on all jurisdictions for the purpose of cumulative effects analysis.

Land Ownership	Paradox Basin – conventional gas	Paradox Basin - Gothic Shale	Northern San Juan Basin (remainder of 160-acre spacing units)	Northern San Juan Basin (80-acre spacing units)	San Juan Sag
BLM Public Lands (including federal split mineral estate	160	270	27	57	0
National Forest/federal mineral estate	109	498	111	143	10
State mineral estate	0	0	7	7	0
Private mineral estate	41	670	92	283	0
TOTAL	**310**	**1438**	**237**	**490**	**10**

3. No-Leasing Alternative – Low end of spectrum to be evaluated

The no-leasing alternative represents no new leasing on National Forest and BLM public lands. Operationally, on either federal jurisdiction, no lands would be administratively available for leasing during the life of the LRMP/RMP (approximately 15 years), either on currently unleased lands or leased lands when existing leases expire. However gas development would be unaffected on private and State mineral estate and on currently leased federal mineral estate.

A total of 2,161,099 acres of national forest, BLM public lands and federal subsurface would not be available for lease. Table 2-5 describes the total number of wells drilled under the no-leasing scenario. Table 2-6 describes the total number of development wells over the 15 year projection period, net of plugged and abandoned wells that would be reclaimed

Note carefully that Tables 2-5 and 2-6 contain the assumption that oil and gas development would take place on **currently leased** federal mineral estate and on State and private lands. Development projections for currently unleased lands are subtracted out of the well projection totals in Table 2-3.

TABLE 2-5. FOREST PLAN NO-LEASING ALTERNATIVE WELL PROJECTION FOR PLANNING AREA - NUMBER OF WELLS ON ALL JURISDICTIONS.

This projection applies to currently leased lands on all jurisdictions for the purpose of cumulative effects analysis.

Land Ownership	Paradox Basin – conventional gas	Paradox Basin - Gothic Shale	Northern San Juan Basin (remainder of 160-acre spacing units)	Northern San Juan Basin (80-acre spacing units)	San Juan Sag
BLM Public Lands (including federal split mineral estate	128	275	27	57	0
National Forest/federal mineral estate	25	110	111	143	10
State mineral estate	0	0	7	7	0
Private mineral estate	50	760	92	283	0
TOTAL	**200**	**1145**	**237**	**490**	**10**

TABLE 2-6. NO LEASING ALTERNATIVE (PRODUCTION WELLS NET OF PLUGGED AND ABANDONED WELLS) ON ALL JURISDICTIONS

This projection applies to currently leased lands on all jurisdictions for the purpose of cumulative effects analysis.

Land Ownership	Paradox Basin – conventional gas	Paradox Basin - Gothic Shale	Northern San Juan Basin (remainder of 160-acre spacing units)	Northern San Juan Basin (80-acre spacing units)	San Juan Sag
BLM Public Lands (including federal split mineral estate	112	239	27	57	0
National Forest/federal mineral estate	21	95	111	143	10
State mineral estate	0	0	7	7	0
Private mineral estate	41	670	92	283	0
TOTAL	**174**	**1004**	**237**	**490**	**10**

SJPL will provide stakeholders with more detailed information regarding emission factors, types and sizes of drill rig engines and compressor stations, length of drilling operations, etc. when it is available. SJPL anticipates that the exact locations and stack parameters for many of the emissions sources associated with these development projects will not be known with complete certainty at this stage in the planning process. Therefore, emissions may be aggregated into area sources, with professional judgment applied as to source parameters such as release height and area dimensions, based on the expected types of equipment to be used and known parameters for similar equipment already deployed for other projects.

3.0 AIR QUALITY MODELING METHODS FOR PSD CLASS I AREAS

Major sources regulated under the Prevention of Significant Deterioration (PSD) regulations are required to analyze impacts to designated Class I areas. This includes analysis of PSD increment consumption at Class I areas as well as possible impacts to so-called air quality related values (AQRVs), such as visibility and acid deposition. While it is not known whether emissions from the proposed action(s) would be high enough to constitute a major source, the impact of so-called minor sources on Class I and sensitive Class II areas is still a concern, as FLMs are tasked with the responsibility of managing and protecting these areas.

This study will not constitute a formal PSD increment analysis. Impacts from the proposed sources, however, can be compared to PSD increment levels for Class I and Class II areas, as long as it is understood that the impacts do not include a complete analysis of all sources that contribute to, as well as expand, increment.

3.1 MODEL SELECTION AND MODELING DOMAIN

Following EPA's Guideline for Air Quality Models (40 CFR 51, Appendix W), the recommended air dispersion model for receptors located more than 50 km downwind is CALPUFF. The Class I modeling for SJPL will use the EPA CALPUFF modeling system (Version 5.8,), which includes the CALMET meteorological model, a Gaussian puff dispersion model (CALPUFF) with algorithms for chemical transformation and deposition, and postprocessors capable of manipulating, averaging, and ranking the resulting concentrations, visibility impacts, and deposition (POSTUTIL, CALSUM, and/or CALPOST). The CALPUFF modeling system will be applied in a refined mode, using gridded meteorological fields that vary both spatially and temporally. The latest EPA-approved versions (June 2007) of CALPUFF (version 5.8, level 070623), CALMET (version 5.8, level 070623), and CALPOST (version 5.6394, level 070622) will be used.

In this study, the EPA CALPUFF system will be accessed using the CALPUFF-Pro modeling system developed by Bee-Line Software. CALPUFF-Pro provides for a convenient user interface to develop the necessary data inputs and evaluate modeling outputs. CALPUFF-Pro links to the EPA executable code for the CALPUFF modeling system.

A modeling domain will be established to cover the area of interest. The domain will be large enough to provide for a buffer of at least 50-km between the edge of the domain and any emission source and/or Class I receptor of interest. The modeling domain will cover a region of at least 600 km (east-west) by 450 km (north-south), as shown in Figure 1-1.

The horizontal resolution of the CALMET wind field will be 4 km. The vertical resolution of the wind field will include eleven (11) layers, with vertical cell face height

(in meters) as follows: 0, 20, 50, 100, 180, 300, 500, 850, 1500, 2500, 4000, and 5000.[3] Lambert Conformal Coordinates will be used.

3.2 CALMET METHODOLOGY

The CALMET meteorological processor model will be used to generate gridded fields for wind and other meteorological parameters suitable for use by the CALPUFF dispersion model. The CALMET model will utilize meteorological data for three (3) years (2001, 2002, and 2003). The "initial guess" wind field will be derived from MM5 data. CALMET then adjusts the initial guess field for local terrain and land use effects to generate a Step 1 wind field, which is then further refined using surface, precipitation and upper air observations within the modeling domain to create a final Step 2 wind field.

The MM5 data will be obtained from the Western Regional Air Partnership (WRAP) Regional Modeling Center maintained by the University of California-Riverside. (See: http://pah.cert.ucr.edu/aqm/308/bart.shtml.) For this study, the WRAP MM5 data generated for the Arizona-New Mexico modeling domain will be used. This MM5 data set extends offshore from southern California, east into the Texas panhandle; it also extends northward to include most of Southern Colorado and Utah, as shown in Figure 3-1.

Technical options for CALMET will follow the "default" values recommended by the FLMs for Class I modeling analyses, which requires the "regulatory default" switch be used MREG = 1.

There are no upper-air stations within the modeling domain. The closest upper air stations are Grand Junction, Colorado; Albuquerque, New Mexico; Winslow, Arizona; and Salt Lake City, Utah. Because no upper air stations fall within the modeling domain, the use of upper air observations in CALMET would have little influence on the CALMET wind field derivation. Upper air observations can be omitted from the Step 2 analysis (NOOBS = 1 in CALMET). This approach has been approved by the FLMs in recent CALPUFF modeling studies in the Los Angeles Basin, and will be used for San Juan Public Lands.

Surface and precipitation data for 2001-2003 within and near the modeling domain will be imported into CALMET. These data will be obtained from the WRAP BART website (http://pah.cert.ucr.edu/aqm/308/bart.shtml).

[3] An additional vertical layer with a cell face height (ZFACE) of 5000 meters was added at the request of the CDPHE. Also the maximum mixing height (ZIMAX) was increased from 4000 meters to 4500 meters, as requested by the CDPHE "to account for elevated mixing heights expected within the domain."

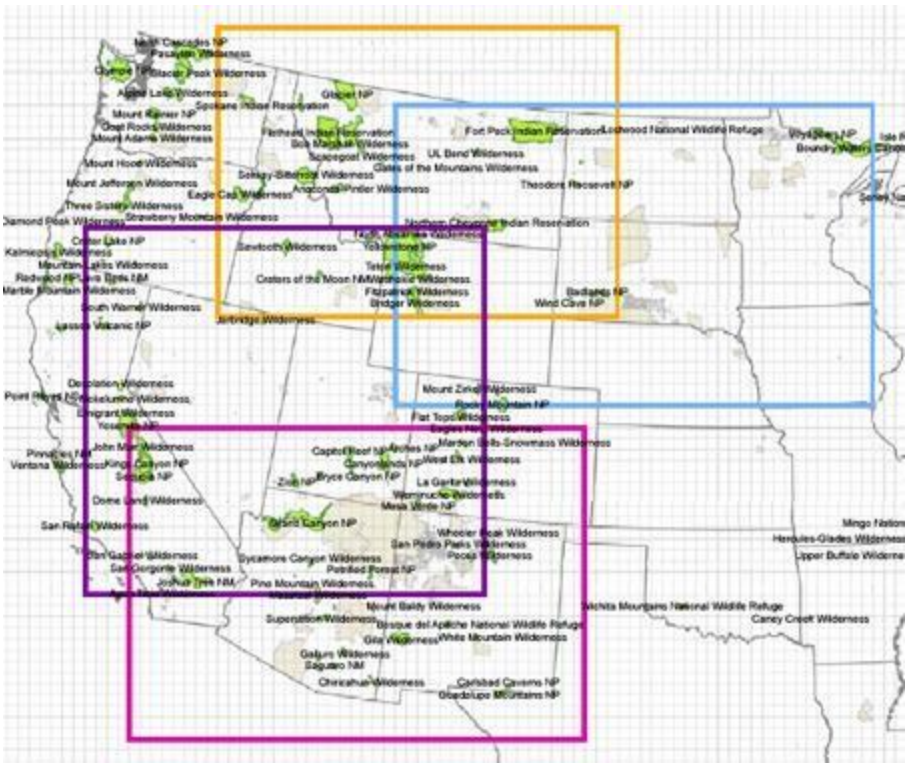

FIGURE 3-1. BART MM5 MODELING DOMAINS.

Surface wind observations are used to adjust the MM5 and terrain derived winds based on the "radius of influence" parameters. The "radius of influence" parameters used to adjust the initial guess wind field for observational data do not have any default values. The recommended values for this study are as follows: RMAX1 = 50, RMAX2 = 100, R1 = 20, R2 = 40, TERRAD = 10.

Precipitation observations are used in CALMET to generate gridded hourly precipitation fields for use in the wet/dry deposition calculations.

CALPUFF-Pro comes with the necessary land use and terrain data to construct the GEO.DAT input files for CALMET. Surface properties such as albedo, Bowen ratio, roughness length, and leaf area index will be computed by the model from the land use values. Terrain data will be taken from USGS 1-degree Digital Elevation Model (DEM) data, also provided with CALPUFF-PRO. Missing land use data (if any) will be filled with a value that is appropriate for the missing area.

3.3 CALPUFF METHODOLOGY

Due to the number of sources, the CALPUFF analysis will be split into multiple runs. Output from these runs can then be combined via CALPOST and other post-processors. If sources are grouped judiciously prior to running CALPUFF, this approach can allow impacts to be broken down by source group, source type, or source location.

The emissions inventory for the Four Corners modeling project has not yet been obtained from Environ; however, previous modeling studies conducted in the area indicate that the following types of sources occur in the region:

- Natural gas plants and compressor stations
- Cement plants
- Gravel mining, crushing, and asphalt production
- Refineries
- Utilities and power plants
- Miscellaneous sources

Once the complete inventory of sources used in the Four Corners modeling study is obtained, additional source groups may be identified. Proposed project alternatives as wel

RFD sources would be modeled separately from existing sources. Also, each of the alternate development scenarios would be modeled separately so that the total impact of each alternative could be summed with the existing and RFD sources to yield the potential total impact (with background added as appropriate) for that alternative.

SJPL is not concerned with separating sources according to their location within the domain, only by industry or source type. At this point further dividing source groups according to region – such as by state, county, or BLM field office jurisdiction — is not planned. However practical or logistical considerations, for example, may result in separating groups by state.

3.3.1 CALPUFF Technical Options

Technical options for CALPUFF will use the FLM-approved "default" parameters where available. These options generally follow EPA's Guideline on Air Quality Models (40 CFR 51, Appendix W) and the IWAQM Phase 2 guidance. As with CALMET, the "regulatory default" switch will be used (MREG = 1).

3.3.2 Background Ozone Data

Background ozone concentrations will be input to CALPUFF via an ozone.dat file, based on ozone observations collected in the modeling domain during 2001-2003. Table 3.1 presents a tentative list of ozone data stations to be used with CALPUFF. Ozone data available from the WRAP CALPUFF modeling database which is maintained by University of California-Riverside (see: http://pah.cert.ucr.edu/aqm/308/bart.shtml), will be employed, but may be supplemented to ensure that concurrent observations from sites within the domain, including Mesa Verde and Gothic are included.[4]

[4] SJPL has requested that data from the Shamrock, Colorado site be included, if possible. The Shamrock site began collecting data in 2004, so the data do not match the 2001-2003 meteorological time frame and cannot be included as model input data. ARS will evaluate the range and temporal variability of these data to help identify which observations could serve as representative "pseudo-stations" for Class I and desired Class II stations that do not have appropriate nearby ozone observations.

TABLE 3-1. OZONE MONITORING SITES

Site	State	Latitude	Longitude	Elev (m)	Land Use	Monitor
1 Mi. NE of Ignacio on County Rd 517	CO	37.137	-107.628	1989	Residential	Tribal Monitors
Mesa Verde National Park	CO	37.198	-108.490	2165	Forest	Non-EPA Federal (CASTNET)
Gothic Experiment Station	CO	38.956	-106.986	2926	Range	Non-EPA Federal (CASTNET)
Las Cruces Well Station #41, Holman Road	NM	32.425	-106.674	1363	Desert	Other
Highway Dept. Yard Near Bernalillo	NM	35.299	-106.548	1541	Residential	SLAMS
162 Highway 544, Bloomfield	NM	36.742	-107.977	1713	Industrial	Other
1.4 Miles WSW Intersection Tramway	NM	35.19472	-106.52	1768	Desert	NAMS, SLAMS
Shiprock/Farmington	NM	36.69667	-108.4725	1622	Unknown	Other
Canyonlands National Park	UT	38.459	-109.817	1809	Desert	Non-EPA Federal (CASTNET)

In the event that ozone observations are missing for a particular time period, an alternate value is used. For this CALPUFF modeling study, the "missing" ozone value will be 80 ppb for all time periods. This should be a conservative approximation of the ozone levels, as it assumes concentrations near the current National Ambient Air Quality Standards (NAAQS).

One concern of the FLMs regarding ozone patterns is that ozone concentrations at higher elevations tend to show different seasonal and diurnal patterns compared to low-level ozone monitoring sites, many of which are in and near urban areas. In CALPUFF, the ozone is mapped to the modeling grid by interpolation, meaning that ozone is influenced by the closest monitoring site, regardless of elevation. In order to create a more realistic ozone concentration pattern that depicts the expected concentrations at higher elevations, the FLMs recommend adding "pseudo-stations" at or near Class I areas without ozone monitoring data. The "pseudo-stations" duplicate the actual ozone observations from a representative high elevation site. The CALPUFF modeling will employ this approach. However, additional discussions with the FLM are needed to choose the location of any needed "pseudo-stations" and the representative

high elevation ozone monitoring site(s).

3.3.3 Class I Receptors

For Class I areas, receptors will be taken from the NPS database for Class I area modeling (National Park Service Convert Class One Areas Utility). The program provides receptor coordinates in the desired coordinate system (either Universal Transverse Mercator or Lambert-Conformal Coordinates; Lambert-Conformal coordinates will be used for this modeling study).

For particular Class II areas of concern, such as Canyon of the Ancients National Monument, receptor sets will be prepared with a 2-km resolution, consistent with the NPS database. Where possible receptors at Class II areas used for previous studies, such as the Desert Rock Power Plant, will be used.

For the evaluation of deposition at sensitive high mountain lakes, receptors will be included for Big Eldorado Lake, Lower Sunlight Lake, Upper Grizzly Lake and Upper Sunlight Lake.

3.4 CALPOST METHODOLOGY

The concentration output files for the various source groups will be combined using CALPUFF's "CALSUM" post-processor.

3.4.1 Visibility

Visibility calculations are performed in the CALPOST processor using ambient concentrations of the visibility precursor pollutants along with hourly relative humidity data. CALPOST determines the percent change in extinction attributable to the project emissions as compared to a user-specified background extinction. For this modeling study, the standard FLAG "natural background" values for the western United States will be used.

The extinction from hygroscopic particles (sulfate and nitrate) is dependent on relative humidity, which is determined from data in the CALMET files. The appropriate RH function will be based on the average daily relative humidity, which is coded as Method 2 in CALPOST. Method 2 is the current recommended method from FLAG for a refined CALPUFF visibility analysis. The relative humidity in CALPOST is capped (RHMAX = 95%) consistent with current FLM recommendations.

Currently, Method 2 is the preferred means of estimated visibility impact and recommended by federal land managers (FLMs). However, proposed changes to FLAG guidance include switching to Method 6, which computes extinction from speciated PM measurements, applying monthly RH adjustment factors to observed and modeled sulfate and nitrate.

For this study, visibility impacts will be evaluated using both Method 2 and Method 6. Employing both methods will allow results to be compared to previous studies that used Method 2, as well as to any future studies that use Method 6, should the new guidance be adopted.

CALPUFF assumes that all of the background ammonia is available for the formation of ammonium nitrate from each puff. However, where these puffs overlap in the model, puffs are actually in competition for the available ammonia. To prevent the overestimation of nitrate, the Ammonia Limiting Method option in the POSTUTIL processor (MNITRATE = 1) will be used to compute the HNO_3/NO_3 concentration partition prior to executing the visibility calculations in CALPOST.

The Interagency Workgroup on Air Quality Modeling[5] (IWAQM, 1998) recommends three ammonia background values for CALPUFF modeling:

- 0.5 ppb for forested lands;
- 1.0 ppb for arid lands; and
- 10 ppb for grasslands.

The modeling domain is generally a mixture of "arid" and "forested" land use, suggesting that the background ammonia across the modeling domain should be in the range of 0.5 to 1.0 ppb, if the IWAQM Phase II values are to be used.

In Colorado, CDPHE recommends the use of even higher background ammonia levels (30 to as high s 44 ppb) for regions along the Front Range of Colorado, 10 ppb for sources in the Arkansas Valley region of southeastern Colorado, and 1 ppb for Northwestern Colorado (based on measurements from the Mt. Zirkel visibility study).[6] No specific APCD recommendations have been adopted for southwestern Colorado.

In the modeling domain, background ammonia has been measured at five sites in southwestern Colorado and northwestern New Mexico.[7] In this study, background ammonia levels measured during 2007 using passive samplers and ranged between 0.2 and 1.5 ppb annual mean, with the lowest levels measured at Mesa Verde National Park and the highest levels measured at Farmington, NM. Individual samples, collected as a three-week integrated sample, ranged from near zero up to about 3.5 ppb.

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[5] Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts. IWAQM, 1998. EPA-454/R-98-019, December, 1998.

[6] CALMET/CALPUFF BART Protocol for Class I Federal Area Individual Source Attribution Visibility Impairment Modeling Analysis. CDPHE, October 24, 2005. http://www.colorado.gov/airquality/documents/Colorado-subject-to-BART-CALPUFFprotocol.pdf or http://www.cdphe.state.co.us/ap/down/BARTCalpuffreport.pdf

[7] Sather, *et al*, Baseline ambient gaseous ammonia concentrations in the Four Corners area and Eastern Oklahoma, USA. Journal of Environmental Monitoring, http://www.nmenv.state.nm.us/aqb/4C/Documents/Ogawa_Ammonia_4Corners_Sather_JEM08.pdf. Measured background ammonia levels at Mesa Verde during 2007 ranged from essentially zero to 0.6 ppb.

In the CALPUFF model, higher the background ammonia levels generally leads to higher ammonium nitrate concentrations in the model predictions. This in turn can result in higher visibility impacts (i.e., greater visibility degradation). However, CALPUFF and POSTUTIL accept only a single monthly background ammonia level for the entire modeling domain. ARS is proposing to use a monthly background ammonia level of 1.0 ppb for the modeling domain. These data match the IWAQM Phase II Report recommendations for "arid" areas (which generally representative of the modeling domain) and also fits the measured background ammonia data for the area (the mean of the five ammonia monitoring stations in the modeling domain is 0.76 ppb). A background value of 1.0 ppb should result in a reasonable, but somewhat conservative representation for the modeling domain and the Class I/Class II areas of interest.

CALPOST returns the predicted change in light extinction for each 24-hour day. These results will be reviewed to determine the number of days where the change in light extinction is at or above 5% change and 10% change at each Class I or Class II area modeled. These impacts will also be discussed in the context of current visibility conditions at the IMPROVE visibility monitoring sites within the modeling domain, listed in Table 3.2

TABLE 3-2. IMPROVE VISIBILITY MONITORING SITES WITHIN THE CALPUFF MODELING DOMAIN

Site ID	Site Location	Latitude	Longitude	Elevation (m)
BAND	Bandelier National Monument, NM	35.7797	-106.2664	1988.33
CANY	Canyonlands National Park, UT	38.4587	-109.821	1798.25
MEVE	Mesa Verde National Park, CO	37.1984	-108.4907	2172.00
SAPE	San Pedro Parks Wilderness, NM	36.0139	-106.8447	2935.00
WEMI	Weminuche Wilderness, CO	37.6594	-107.7999	2750.00
WHRI	White River National Forest, CO	39.1536	-107.8209	3413.50

3.4.2 Deposition

Deposition at the Class I and Class II areas of concern will be assessed through an analysis of total sulfur (S) and total nitrogen (N) deposition. First, annual deposition rates (wet and dry) are calculated by CALPUFF for all relevant species. The equivalent sulfur and nitrogen deposition are then determined from these data using POSTUTIL. The CALPUFF deposition fluxes for each species will be adjusted to account for the difference in molecular weights between the species (i.e. ammonium sulfate or ammonium nitrate) and the element (sulfur or nitrogen). These ratios are shown in Table 3-3. For nitrogen deposition, the analysis also considers the contribution of the ammonium ion from ammonium sulfate.

TABLE 3-3. MOLECULAR WEIGHT RATIOS FOR POSTUTIL DEPOSITION CALCULATIONS

Element	Ratio of Molecular Weights
N from SO_4	0.292 (28/96)
N from HNO_3	0.222 (14/63)
N from NO_3	0.452 (28/62)
N from NO	0.304 (14/46)
S from SO_2	0.50 (32/64)
S from SO_4	0.333 (32/96)

The POSTUTIL output is processed in CALPOST to calculate the total deposition for each modeling year. The CALPOST deposition output is in grams per square meter per second and will be converted to the unit of interest (kg/ha-yr). Impacts from the proposed alternatives will be compared to the FLM deposition threshold of 0.005 kg/ha/yr. An appropriate threshold for cumulative impacts has not been determined.

3.4.3 Concentration

CALPOST determines the ambient concentration for pollutants of interest (NO_X, SO_2, and PM_{10}) by performing the appropriate averaging for the air quality standard of interest (3-hour, 24-hour, or annual). An appropriate background will be determined by SJPL, and added to the cumulative impacts, which in turn will be compared to the NAAQS. The IMPROVE visibility monitoring sites within the domain (listed in Table 3-2) also monitor NO_X, SO_2, and PM_{10}. These data would be available either as possible candidates on which to base a representative background concentration, or to compare to modeled results.

Although this study will not constitute a formal PSD increment analysis, impacts from the proposed sources will be compared to PSD increment levels for Class I and Class II areas. Because such comparisons might not include a complete analysis of all sources that contribute to, as well as expand, increment, and therefore would be for disclosure purposes, and as a planning tool for SJPL as it manages development on the land for which it is responsible.

4.0 TECHNICAL REPORT/DOCUMENTATION

The results of the CALPUFF modeling analyses will be presented in a technical report and submitted to the SJPL. The report will describe the modeling methods, input data, and present modeling results for each Class I area, sensitive Class II area, and any other receptors of interest (such as deposition in designated high mountain lakes) that were modeled.

The report will also include the input and output files for CALMET, CALPUFF, POSTUTIL, and CALPOST in electronic format on CD or DVD.