Blythe Energy Project Phase II

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January 9, 2003

Mr. John Bunyak
Chief, Policy, Planning and Permit Review Branch
National Park Service
Air Resources Division
P.O. Box 25287
Denver CO 80225

DOCKET
02-AFC-1
DATE JAN 09 2003
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Subject: **Blythe Energy Project – Phase 2**
Air Quality Impact Analysis

Reference: Letter, N3615 (2350), John Bunyak (NPS) to Bill Pfanner (CEC)
Dated September 24, 2002

Dear Mr. Bunyak:

In response to the reference letter, Caithness Blythe 2, LLC (CB 2) retained an independent consultant, Earth Tech to assist with addressing issues presented by National Park Service regarding the air quality analysis performed by Greystone Environmental Consultants. Earth Tech required several weeks to familiarize themselves with the project and the associated documentation. Additionally, Mr. Scire has been traveling frequently on business over the last two months.

Earth Tech has prepared the attached Class I Air Quality Modeling Protocol. We believe the approach outlined in this attachment will form the basis for addressing your staff's specific concerns. We would like to discuss this protocol with Mr. Codding of your staff and will contact him to set up a time convenient to conference with Greystone, Earth Tech and CB 2 personnel.

We believe we are on the right path to address National Park Service issues and expect that we can complete any additional modeling which would be required within 30 –45 days after we obtain concurrence with your staff on the modeling protocol.

If you have any questions, please do not hesitate to call me at (262) 560-0524 or (262) 853-3777 (cell).

Very truly yours,

Thomas Cameron

Thomas Cameron
Project Manager
Caithness Blythe 2

Attachment: Class I Air Quality Modeling Protocol for the Proposed Blythe Energy Project – Phase II, January 2003

cc: Mr. Don Codding (National Park Service)
Mr. Gordon Frisbie (Greystone Environmental Consultants)
Mr. Joseph Scire (Earth Tech)

Class I Air Quality Modeling Protocol for the Proposed Blythe Energy Project – Phase II

January 2003

Prepared For:

Caithness Blythe II, LLC
Blythe, California

Submitted By:
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1. INTRODUCTION

Earth Tech, Inc., on behalf of Caithness Blythe II, LLC, is conducting an air quality analysis for the proposed Blythe Energy Project II, in Blythe California. This proposed facility will have an electrical generating capacity 520 megawatts (MW) and will be located adjacent to the existing Blythe Energy Project.

The modeling analysis will evaluate air quality and visibility impacts at the Joshua Tree National Park Class I Area. The purpose of the modeling is to assess the ambient air quality impacts of sulfur dioxide (SO_2), particular matter with an equivalent diameter less than or equal to 10 microns (PM_{10}), and nitrogen oxides (NO_x) emissions. Predicted concentrations due to the proposed emissions will be compared to Significant Impact Levels (SILs) at the Joshua Tree Class I area. In addition, the impacts of the facility on visibility, acid deposition, and other air quality related values in the Class I areas will be evaluated. The Joshua Tree National Park is located approximately 65 km to the northwest of the proposed facility.

If the predicted concentration due to the proposed net emissions increase is less than the SIL, then a cumulative impact analysis to demonstrate compliance with the Ambient Air Quality Standards (AAQS) and the PSD increments is not needed. If the predicted concentrations exceed the SIL for any pollutant, then a cumulative impact analysis will be performed using appropriate background source emissions inventory data. Predicted total concentrations will be compared to State and Federal AAQS and Class I PSD increments.

A non-steady-state modeling approach which evaluates the effects of spatial changes in the meteorological and surface characteristics is necessary to properly evaluate the air quality impacts of the emissions sources. The "No Observations" (NOOBS) version of the CALMET and CALPUFF non-steady-state models (Scire et al., 2000a,b) are proposed for the modeling analysis. The U.S. Environmental Protection Agency (EPA) has proposed the CALPUFF modeling system as a Guideline Model for Class I impact assessments and other long range transport applications or, on a case-by-case basis, for use in near-field applications involving complex flows (USEPA, 2000). CALPUFF is recommended by both the Federal Land Managers Air Quality Workgroup (FLAG, 2000) and the Interagency Workgroup on Air Quality Modeling (IWAQM, 1998).

CALMET is a diagnostic meteorological model that produces three-dimensional wind fields based on parameterized treatments of terrain effects such as slope flows, terrain blocking effects, and kinematic effects. The NOOBS version of CALMET is proposed here for an advanced screening level analysis and together with CALPUFF will determine if there is the potential for significant air quality impacts within the Joshua Tree National Park. This version of CALMET only requires gridded hourly three-dimensional meteorological data from a prognostic numerical model and does not require observations. The gridded data produced by the Penn State/NCAR Fourth/Fifth Generation Mesoscale Model (MM4/MM5) will be used by CALMET to help define the initial estimate of the wind fields. Fine scale terrain effects will be determined by the diagnostic wind module in CALMET. It is proposed that CALMET and CALPUFF simulations be conducted for three years for which gridded prognostic meteorological data are available. These data are available for 1990 (MM4), 1992 (MM5), and 1996 (MM5). If this advanced screening analysis shows the potential for large air quality impacts then a more refined analysis using the prognostic data as well as all available surface observations and upper air soundings will be performed.

CALPUFF is a non-steady-state puff dispersion model. It accounts for spatial changes in the CALMET-produced meteorological fields, variability in surface conditions (elevation, surface roughness, vegetation type, etc.), chemical transformation, wet removal due to rain and snow, dry deposition, and terrain influences on plume interaction with the surface. CALPUFF contains a module to compute visibility effects, based on a humidity-dependent relationship between particulate matter concentrations and light extinction, as well as wet and dry deposition fluxes. Meteorological and dispersion modeling simulations will be conducted for the three separate years (1990, 1992, and 1996) corresponding to the CALMET simulation periods. These years have been selected based on the availability of the MM4 or MM5 data sets from the U.S. Environmental Protection Agency (USEPA) and the National Park Service. Short-term and long-term average concentrations of SO_2, PM_{10}, NO_x, and their secondary products resulting from emissions from the proposed sources will be predicted by the model at receptors in the Joshua Tree National Park Class I area. In addition, the impacts on visibility, acid deposition, and other air quality related values in the Class I area will be determined.

This protocol outlines the techniques and data sources to be used in the Class I impact analyses. In Section 2, a general description of the source configuration and emissions are provided. Descriptions of the proposed modeling domain and the data bases (meteorological, geophysical, and aerometric) to be used in the analysis are provided in Section 3. Section 4 includes an overview of the CALMET and CALPUFF models. The products of the modeling analysis are described in Section 4.8.

2. SOURCE DESCRIPTION

2.1 Source Data

Caithness Blythe II, LLC is proposing the Blythe II Energy Project, an electrical generating facility, to be located in Blythe California directly adjacent to the existing Blythe Energy Project facility. This new facility will be located about 100 meters south of the existing Blythe Energy project and will have an electrical generating capacity of 520 MW. It will consist of two combustion turbine generator (CTG) units firing natural gas, two heat recovery steam generator (HRSG) units with supplemental firing, one steam turbine generator (STG) unit and eight mechanical draft wet cooling towers. The CTG units will be equipped with selective catalytic reduction (SCR) to control NO_x emissions.

Table 2-1 shows the stack parameters and emission rates to be used in the modeling analysis. The facility will vent emissions through two stacks and eight cooling towers will be treated as a single stack. Stacks 1 and 2 will vent emissions from the CTG/HRSG units. For modeling purposes the cooling towers will be treated as a single stack with emissions equal to the total emissions from all eight cooling towers.

The NO_x emission rates were computed by Greystone Environmental Consultants, Inc. based on the assumption of one cold start and five hot starts during a 24-hour period with no downtime between startups. This will result in maximum NO_x emissions from the CTG/HRSG units. For SO_2 and PM_{10}, the emissions are based on continuous full-load operation because this results in the maximum emission rates of these pollutants.

2.2 Background Source Data

If the predicted concentrations due to emissions from the Blythe Energy Project II exceed the significant impact level (SIL) concentrations, then a cumulative impact analysis would be required. In the event that a cumulative impact analysis is necessary, appropriate background emissions inventory data will be developed in coordination with the state of California, and other areas as required.

Table 2-1. Point Source Parameters and Emissions[1]

Source Description	UTM[2] Coordinate East	UTM[2] Coordinate North	Stack Height	Base Elevation	Stack Diameter	Exit Velocity	Exit Temperature	SO_2 Emission Rate	SO_4 Emission Rate	NO_x Emission Rate	PM_{10} Emission Rate
	(km)	(km)	(m)	(m)	(m)	(m/s)	(K)	(g/s)	(g/s)	(g/s)	(g/s)
1	714.315	3721.351	39.62	100.0	5.64	16.99	366.3	0.30	0.37	15.27	0.75
2	714.284	3721.351	39.62	100.0	5.64	16.99	366.3	0.30	0.37	15.27	0.75
3	714.184	3721.358	12.19	100.0	10.07	8.06	309.4	0.00	0.00	0.00	0.0785

[1] Stack parameters and emissions data provided to J. Scire by Caithness Blythe II, LLC.

[2] Coordinates in UTM Zone 11 and based on WGS84 datum.

3. GEOPHYSICAL AND METEOROLOGICAL DATA

3.1 Modeling Domain and Terrain

Gridded terrain elevations for the proposed modeling domain are derived from 3 arc-second digital elevation models (DEMs) produced by the United States Geological Survey (USGS). Data are provided in files covering 1 degree by 1 degree blocks of latitude and longitude. The 1-degree DEMs are produced by the Defense Mapping Agency using cartographic and photographic sources. USGS 1:250,000 scale topographic maps are the primary source of 1-degree DEMs.

One degree DEM data consists of an array of 1201 by 1201 elevations referenced on the geographic (latitude/longitude) coordinate system of the World Geodetic System 1984 Datum. Elevations are in meters relative to mean sea level, and the spacing of the elevations along each profile is 3 arc-seconds, which corresponds to a spacing of approximately 90 meters.

The proposed CALMET computational domain shown in Figure 3-1 is located in the southern portion of California. The entire domain covers an area of 300 km by 250 km. A resolution of 2 km in the horizontal is proposed to resolve the variations of the terrain elevations in the area. The USGS elevation records located within each grid cell in the computational domain are averaged to produce a mean elevation at each grid point. A 2 km resolution produces a workable number of grid cells (151 x 126) and allows adequate representation of the important terrain features.

Figure 3-1 shows contours of the terrain averaged to 2 km grid cells. There are significant topographical features in the western part of the domain, reaching peaks of near 3000 meters while the terrain elevations within Joshua Tree National Park range from approximately 400 meters to as high as 1300 meters. The base elevation of the proposed facility is 100 m.

The proposed CALPUFF computational domain is the same as the CALMET domain. The domain extends at least 50 km beyond the boundary of Joshua Tree National Park and 50 km from the facility in order to provide an adequate buffer zone at the boundaries, and to allow the effects of flow curvature and possible small-scale re-circulation to be evaluated.

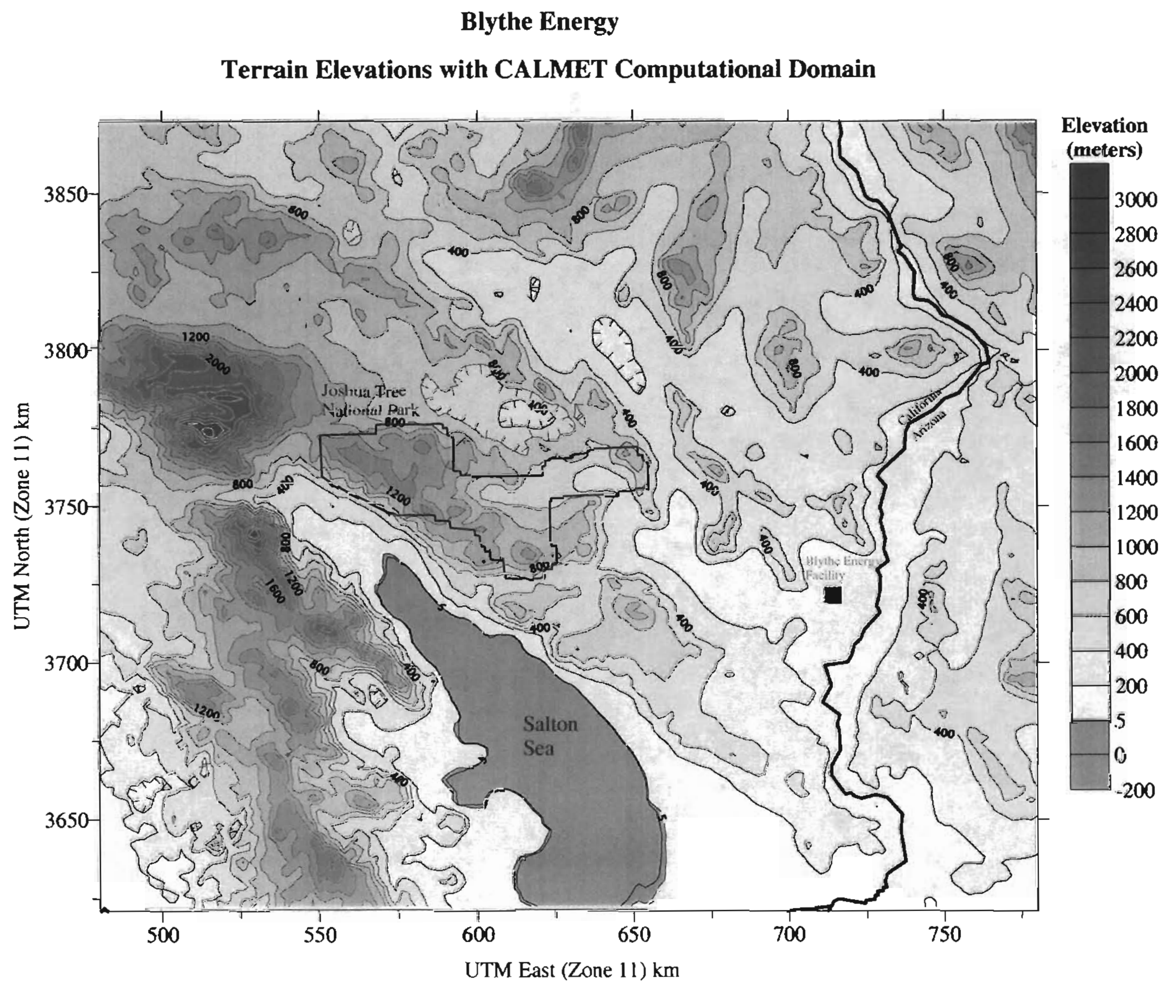

Figure 3-1. Terrain elevations for the proposed CALMET/CALPUFF computational domain. The Joshua Tree National Park Class I area and the facility site are also shown.

3.2 Land Use

The USGS Land Use data within the CALMET/CALPUFF domain have been used to produce a gridded field of dominant land use categories. The land use data were obtained in Composite Theme Grid format (CTG) from the USGS, with a resolution of 200 m.

Land use data were processed to produce a 2 km resolution gridded field of fractional land use categories. The 37 USGS land use categories were then mapped into 14 CALMET land use categories. Surface properties such as albedo, Bowen ratio, roughness length, and leaf area index were computed proportionally to the fractional land use. The USGS land use categories are described in Table 3-1. Table 3-2 displays the 14 CALMET land use categories and their associated geophysical parameters. Figure 3-2 shows the dominant land use categories for each CALMET grid cell in the modeling domain.

3.3 Meteorological Data Base

A special version of CALMET called "No Observations" (NOOBS) version of CALMET is proposed for use in this analysis. This version of CALMET uses three dimensional gridded data sets from a prognostic numerical weather prediction model only and does not require meteorological observations. This approach is proposed as an advanced screening technique, to assess the potential for significant air quality impacts at the Joshua Tree National Park Class I Area. More refined CALMET simulations would be performed using both three-dimensional gridded prognostic model data as well as all available surface observations and upper air soundings if this screening analysis shows the potential for large air quality or visibility impacts.

It is proposed that the three dimensional gridded prognostic meteorological data produced by the USEPA and the National Park Service for the years 1990, 1992, and 1996 be used in the analysis. The prognostic MM4 and MM5 data sets consist of hourly values of wind speed, wind direction, temperature and pressure on a three-dimensional grid. For 1990 (MM4) and 1992 (MM5) the horizontal resolution is 80 km while for 1996 (MM5) the horizontal resolution is 36 km. These data sets cover the entire continental United States, Southern Canada and Northern Mexico.

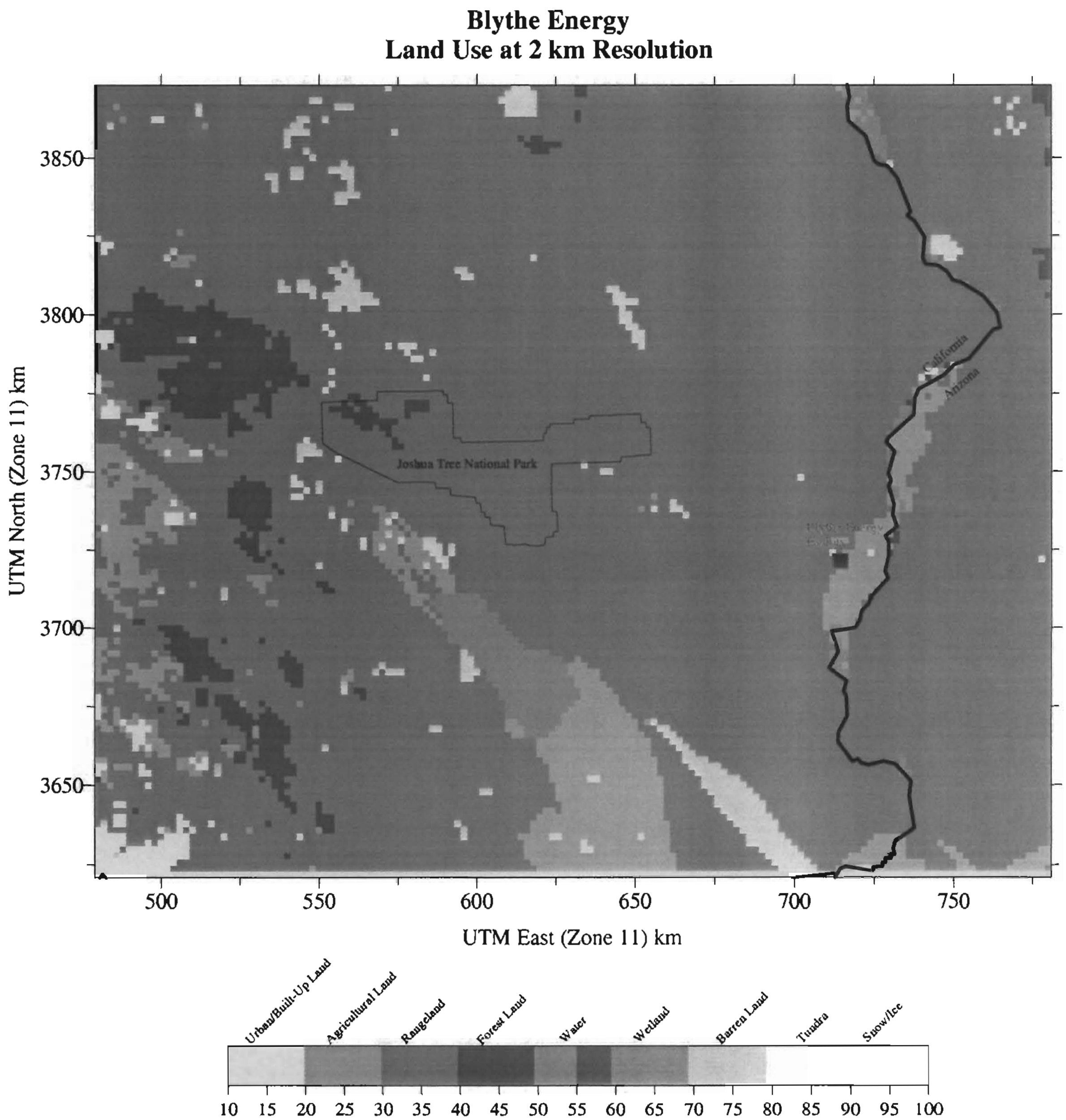

Figure 3-2. Land use for the CALMET/CALPUFF computational domain. The Joshua Tree National Park Class I Area and the facility site are also shown.

Table 3-1. U.S. Geological Survey Land Use and Land Cover Classification System

Level I		Level II	
10	Urban or Built-up Land	11	Residential
		12	Commercial and Services
		13	Industrial
		14	Transportation, Communications and Utilities
		15	Industrial and Commercial Complexes
		16	Mixed Urban or Built-up Land
		17	Other Urban or Built-up Land
20	Agricultural Land	21	Cropland and Pasture
		22	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas
		23	Confined Feeding Operations
		24	Other Agricultural Land
30	Rangeland	31	Herbaceous Rangeland
		32	Shrub and Brush Rangeland
		33	Mixed Rangeland
40	Forest Land	41	Deciduous Forest Land
		42	Evergreen Forest Land
		43	Mixed Forest Land
50	Water	51	Streams and Canals
		52	Lakes
		53	Reservoirs
		54	Bays and Estuaries
		55	Oceans and Seas
60	Wetland	61	Forested Wetland
		62	Nonforested Wetland
70	Barren Land	71	Dry Salt Flats
		72	Beaches
		73	Sandy Areas Other than Beaches
		74	Bare Exposed Rock
		75	Strip Mines, Quarries, and Gravel Pits
		76	Transitional Areas
		77	Mixed Barren Land
80	Tundra	81	Shrub and Brush Tundra
		82	Herbaceous Tundra
		83	Bare Ground
		84	Wet Tundra
		85	Mixed Tundra
90	Perennial Snow or Ice	91	Perennial Snowfields
		92	Glaciers

Table 3-2. Default CALMET Land Use Categories and Associated Geophysical Parameters Based on the U.S. Geological Survey Land Use Classification System (14-Category System)

Land Use Type	Description	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux Parameter	Anthropogenic Heat Flux (W/m^2)	Leaf Area Index
10	Urban or Built-up Land	1.0	0.18	1.5	.25	0.0	0.2
20	Agricultural Land - Unirrigated	0.25	0.15	1.0	.15	0.0	3.0
-20*	Agricultural Land - Irrigated	0.25	0.15	0.5	.15	0.0	3.0
30	Rangeland	0.05	0.25	1.0	.15	0.0	0.5
40	Forest Land	1.0	0.10	1.0	.15	0.0	7.0
50	Water	0.001	0.10	0.0	1.0	0.0	0.0
54	Small Water Body	0.001	0.10	0.0	1.0	0.0	0.0
55	Large Water Body	0.001	0.10	0.0	1.0	0.0	0.0
60	Wetland	1.0	0.10	0.5	.25	0.0	2.0
61	Forested Wetland	1.0	0.1	0.5	0.25	0.0	2.0
62	Nonforested Wetland	0.2	0.1	0.1	0.25	0.0	1.0
70	Barren Land	0.05	0.30	1.0	.15	0.0	0.05
80	Tundra	.20	0.30	0.5	.15	0.0	0.0
90	Perennial Snow or Ice	.05	0.70	0.5	.15	0.0	0.0

* Negative values indicate "irrigated" land use

Figure 3-3 and 3-4 shows the MM4 and MM5 grid points for 1990 (MM4) and 1992 (MM5) relative to the proposed CALMET modeling domain. Figure 3-4 shows the MM5 grid points for the 1996 data set.

3.4 Air Quality Monitoring Data

CALPUFF uses ozone concentration measurements in the chemical transformation rates (SO_2 to SO_4, NO_x to HNO_3/NO_3). The ambient ozone measurements will be used in determining SO_2 loss rates due to chemical transformation to sulfate and in determining NO_x loss rates to nitrate. Use of ambient ozone monitoring data from the Joshua Tree CASTNET station is proposed. This CASTNET monitoring station is located within Joshua Tree National Park and this is depicted in Figure 3-5. Data from this station will be used to develop the monthly average ozone values used in the CALPUFF simulations. These monthly average ozone values are computed using five years of hourly ozone concentrations (1996-2001) during daylight hours only. For this analysis it will be assumed that daylight hours occur between 6:00 AM and 6:00 PM.

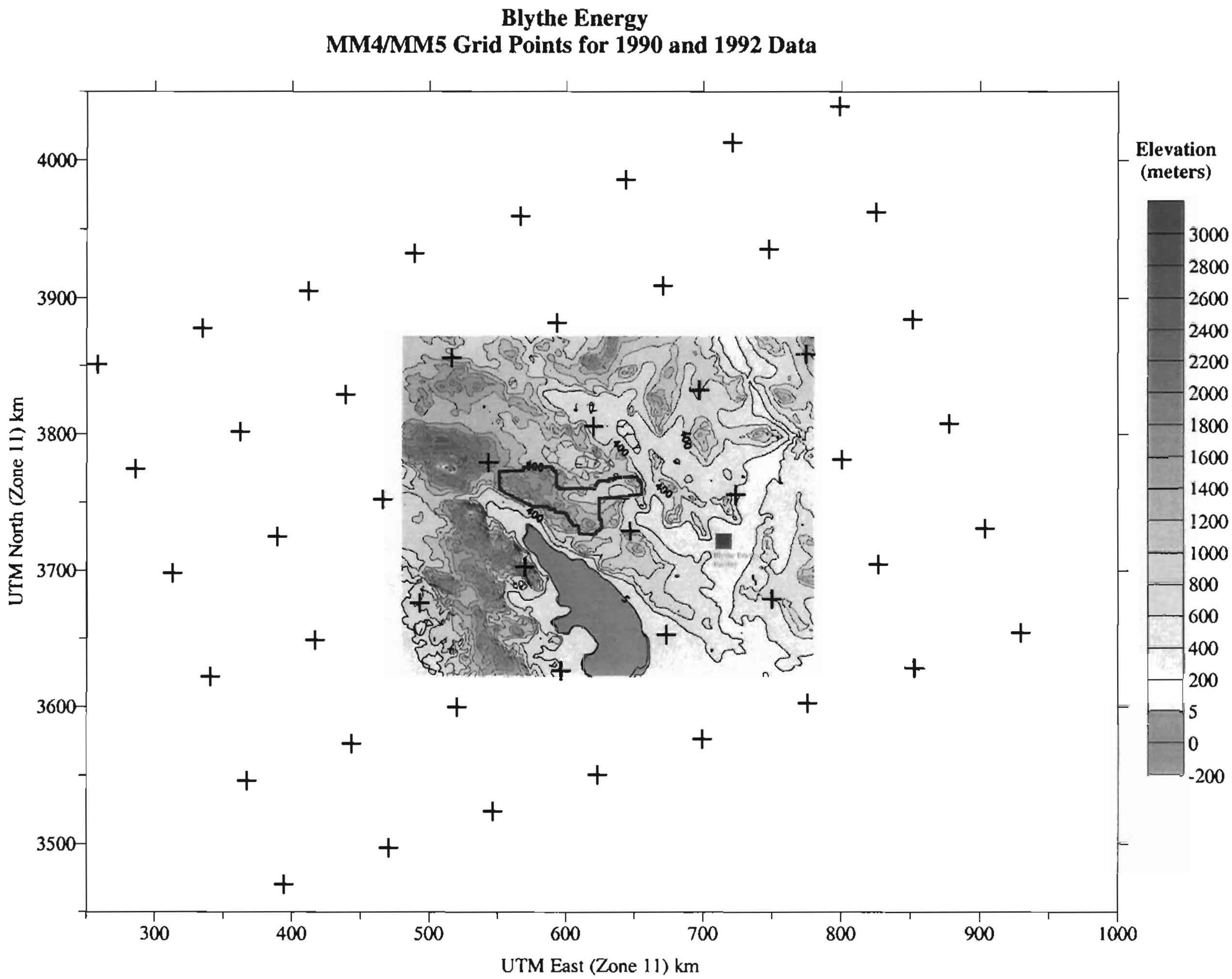

Figure 3-3. Location of the CALMET/CALPUFF computational domain and grid points for the 1990 (MM4) and 1992 (MM5) data sets. The horizontal resolution of both data sets is 80 km.

Blythe Energy
MM5 Grid Points for 1996 Data

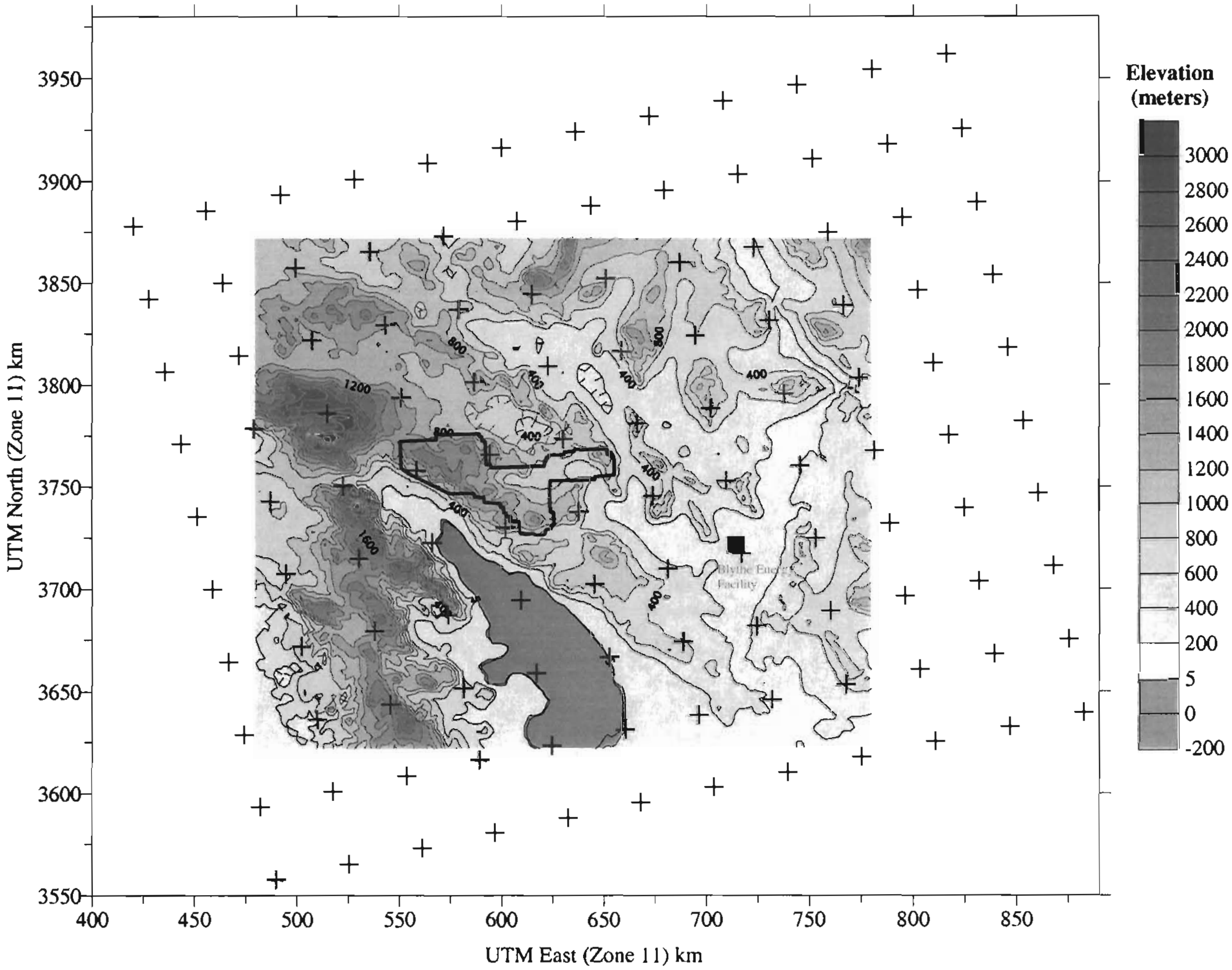

Figure 3-4. Location of the CALMET/CALPUFF computational domain and grid points for the 1996 MM5 data set. The horizontal resolution of the 1996 data is 36 km.

Blythe Energy

Terrain Elevations and Location of CASTNET Ozone Monitor

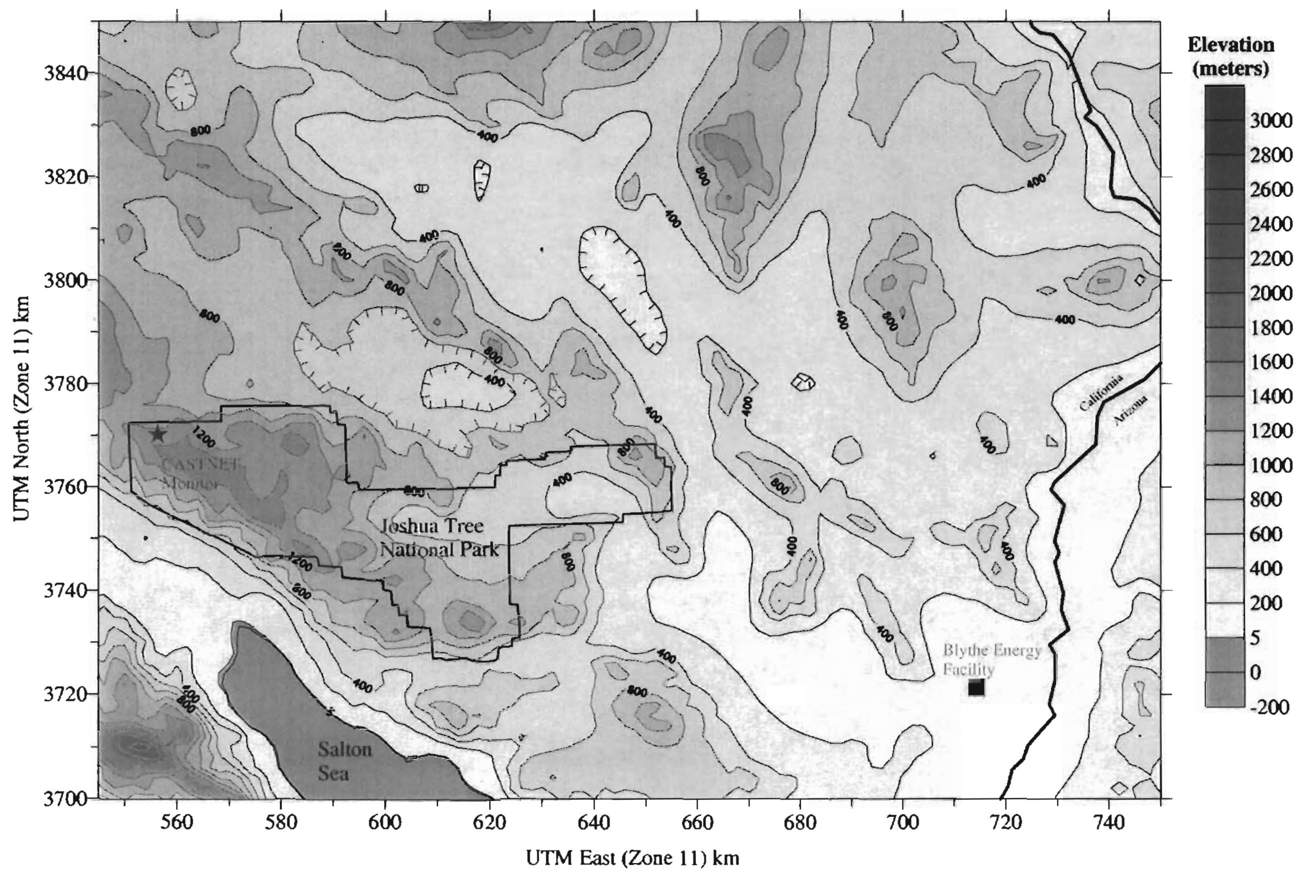

Figure 3-5. Location of the CASTNET ozone monitoring station. The CASTNET station is depicted by a green star.

4. AIR QUALITY MODELING METHODOLOGY

4.1 Model Selection

The NOOBS version of the CALMET/CALPUFF modeling system (Scire et al., 2000a,b) is proposed for an initial advanced screening analysis. If the results of this screening analysis indicate that large air quality impacts are occurring then a refined level CALMET/CALPUFF modeling analysis would be performed in which all available observations would be included in the CALMET simulations. CALPUFF and its meteorological model CALMET, are designed to handle the complexities posed by the complex terrain, the long source receptor distances, chemical transformation and deposition, and other issues related to Class I impacts. The CALPUFF modeling system has been proposed by the U.S. EPA as a Guideline Model for source-receptor distances greater than 50 km, and for use on a case-by-case basis in complex flow situations for shorter distances (Federal Register, April 21, 2000). CALPUFF is recommended for Class I impact assessments by the Federal Land Managers Workgroup (FLAG, 2000) and the Interagency Workgroup on Air Quality Modeling (IWAQM, 1998).

CALMET is a diagnostic meteorological model that is used to drive the CALPUFF dispersion model. It produces three-dimensional wind and temperature fields and two-dimensional fields of mixing heights and other meteorological fields. It contains slope flow effects, terrain channeling, and kinematic effects of terrain. CALPUFF is a non-steady-state Gaussian puff model that includes algorithms for building downwash effects as well as chemical transformation, wet deposition, and dry deposition. One capability of CALPUFF not found in many specialized models such as CTDMPLUS is the ability to treat the combined effects of multiple processes (e.g., building downwash effects in complex terrain; dry deposition and overwater dispersion, etc.). A complete summary of the capabilities and features of CALMET and CALPUFF is provided in Sections 4.1.1 and 4.1.2.

4.1.1 Major Features of CALMET

The CALMET meteorological model consists of a diagnostic wind field module and micrometeorological modules for overwater and overland boundary layers. When using large domains, the user has the option to adjust input winds to a Lambert Conformal Projection coordinate system to account for Earth's curvature. The diagnostic wind field module uses a two step approach to the computation of the wind fields (Douglas and Kessler, 1988). In the first step, an initial-guess wind field is adjusted for kinematic effects of terrain, slope flows, and terrain blocking effects to produce a Step 1 wind field. The available MM4/MM5 gridded data for the years 1990, 1992, and 1996 are proposed for the initial guess field. The second step consists of an objective analysis procedure to introduce observational data into the

Step 1 wind field to produce a final wind field. However, this step is not performed for the NOOBS version of CALMET.

The major features and options of the meteorological model are summarized in Table 4-1. The techniques used in the CALMET model are briefly described below.

Step 1 Wind Field

Kinematic Effects of Terrain: The approach of Liu and Yocke (1980) is used to evaluate kinematic terrain effects. The domain-scale winds are used to compute a terrain-forced vertical velocity, subject to an exponential, stability-dependent decay function. The kinematic effects of terrain on the horizontal wind components are evaluated by applying a divergence-minimization scheme to the initial guess wind field. The divergence minimization scheme is applied iteratively until the three-dimensional divergence is less than a threshold value.

Slope Flows: The slope flow algorithm in CALMET has recently been upgraded (Scire and Robe, 1997). It is based on the shooting flow algorithm of Mahrt (1982). This scheme includes both advective-gravity and equilibrium flow regimes. At night, the slope flow model parameterizes the flow down the sides of the valley walls into the floor of the valley, and during the day, upslope flows are parameterized. The magnitude of the slope flow depends on the local surface sensible heat flux and local terrain gradients. The slope flow wind components are added to the wind field adjusted for kinematic effects.

Blocking Effects: The thermodynamic blocking effects of terrain on the wind flow are parameterized in terms of the local Froude number (Allwine and Whiteman, 1985). If the Froude number at a particular grid point is less than a critical value and the wind has an uphill component, the wind direction is adjusted to be tangent to the terrain.

Step 2 Wind Field

The wind field resulting from the adjustments described above of the initial-guess wind is the Step 1 wind field. The second step of the procedure involves the introduction of observational data into the Step 1 wind field through an objective analysis procedure. An inverse-distance squared interpolation scheme is used which weighs observational data heavily in the vicinity of the observational station, while the Step 1 wind field dominates the interpolated wind field in regions with no observational data. The resulting wind field is subject to smoothing, an optional adjustment of vertical velocities based on the O'Brien (1970) method, and divergence minimization to produce a final Step 2 wind field.

CALMET Boundary Layer Models

The CALMET model contains two boundary layer models for application to overland and overwater grid cells.

Overland Boundary Layer Model: Over land surfaces, the energy balance method of Holtslag and van Ulden (1983) is used to compute hourly gridded fields of the sensible heat flux, surface friction velocity, Monin-Obukhov length, and convective velocity scale.. Mixing heights are determined from the computed hourly surface heat fluxes and observed temperature soundings using a modified Carson (1973) method based on Maul (1980). Gridded fields of PGT stability class and optional hourly precipitation rates are also determined by the model.

Overwater Boundary Layer Model: The aerodynamic and thermal properties of water surfaces suggest that a different method is best suited for calculating the boundary layer parameters in the marine environment. A profile technique, using air-sea temperature differences, is used in CALMET to compute the micro-meteorological parameters in the marine boundary layer.

An upwind-looking spatial averaging scheme is optionally applied to the mixing heights and 3-dimensional temperature fields in order to account for important advective effects.

Table 4-1. Major Features of the CALMET Meteorological Model

- **Boundary Layer Modules of CALMET**
  - X Overland Boundary Layer - Energy Balance Method
  - X Overwater Boundary Layer - Profile Method
  - X Produces Gridded Fields of:
    - Surface Friction Velocity
    - Convective Velocity Scale
    - Monin-Obukhov Length
    - Mixing Height
    - PGT Stability Class
    - Air Temperature (3-D)
    - Precipitation Rate

- **Diagnostic Wind Field Module of CALMET**
  - X Slope Flows
  - X Kinematic Terrain Effects
  - X Terrain Blocking Effects
  - X Divergence Minimization
  - X Produces Gridded Fields of U, V, W Wind Components
  - X Inputs Include Domain-Scale Winds, Observations, and (optionally) Coarse-Grid Prognostic Model Winds
  - X Lambert Conformal Projection Capability

4.1.2 Major Features of CALPUFF

By its puff-based formulation and through the use of three-dimensional meteorological data developed by the CALMET meteorological model, CALPUFF can simulate the effects of time- and space-varying meteorological conditions on pollutant transport from sources in complex terrain. The major features and options of the CALPUFF model are summarized in Table 4-2. Some of the technical algorithms are briefly described below.

Complex Terrain: The effects of complex terrain on puff transport are derived from the CALMET winds. In addition, puff-terrain interactions at gridded and discrete receptor locations are simulated using one of two algorithms that modify the puff-height (either that of ISCST3 or a general "plume path coefficient" adjustment), or an algorithm that simulates enhanced vertical dispersion derived from the weakly-stratified flow and dispersion module of the Complex Terrain Dispersion Model (CTDMPLUS) (Perry et al., 1989). The puff-height adjustment algorithms rely on the receptor elevation (relative to the elevation at the source) and the height of the puff above the surface. The enhanced dispersion adjustment relies on the slope of the gridded terrain in the direction of transport during the time step.

Subgrid Scale Complex Terrain (CTSG): An optional module in CALPUFF, CTSG treats terrain features that are not resolved by the gridded terrain field, and is based on the Complex Terrain Dispersion Model (CTDMPLUS) (Perry et al., 1989). Plume impingement on subgrid-scale hills is evaluated at the CTSG subgroup of receptors using a dividing streamline height (H_d) to determine which pollutant material is deflected around the sides of a hill (below H_d) and which material is advected over the hill (above H_d). The local flow (near the feature) used to define H_d is taken from the gridded CALMET fields. As in CTDMPLUS, each feature is modeled in isolation with its own set of receptors.

Puff Sampling Functions: A set of accurate and computationally efficient puff sampling routines are included in CALPUFF which solve many of the computational difficulties encountered when applying a puff model to near-field releases. For near-field applications during rapidly-varying meteorological conditions, an elongated puff (slug) sampling function may be used. An integrated puff approach may be used during less demanding conditions. Both techniques reproduce continuous plume results under the appropriate steady state conditions.

Building Downwash: The Huber-Snyder and Schulman-Scire downwash models are both incorporated into CALPUFF. An option is provided to use either model for all stacks, or make the choice on a stack-by-stack and wind sector-by-wind sector basis. Both algorithms have been implemented in such a way as to allow the use of wind direction specific building dimensions.

Dispersion Coefficients: Several options are provided in CALPUFF for the computation of dispersion coefficients, including the use of turbulence measurements (Φ_v and Φ_w), the use of similarity theory to estimate Φ_v and Φ_w from modeled surface heat and momentum fluxes, or the use of Pasquill-Gifford (PG) or McElroy-Pooler (MP) dispersion coefficients, or dispersion equations based on the Complex Terrain Dispersion Model (CTDM). Options are provided to apply an averaging time correction or surface roughness length adjustments to the PG coefficients.

Overwater and Coastal Interaction Effects: Because the CALMET meteorological model contains both overwater and overland boundary layer algorithms, the effects of water bodies on plume transport, dispersion, and deposition can be simulated with CALPUFF. The puff formulation of CALPUFF is designed to handle spatial changes in meteorological and dispersion conditions, including the abrupt changes which occur at the coastline of a major body of water.

Dry Deposition: A full resistance model is provided in CALPUFF for the computation of dry deposition rates of gases and particulate matter as a function of geophysical parameters, meteorological conditions, and pollutant species. Options are provided to allow user-specified, diurnally varying deposition velocities to be used for one or more pollutants instead of the resistance model (e.g., for sensitivity testing) or to by-pass the dry deposition model completely. For particles, source-specific mass distributions may be provided for use in the resistance model.

Wind Shear Effects: CALPUFF contains an optional puff splitting algorithm that allows vertical wind shear effects across individual puffs to be simulated. Differential rates of dispersion and transport among the "new" puffs generated from the original, well-mixed puff can substantially increase the effective rate of horizontal spread of the material.

Wet Deposition: An empirical scavenging coefficient approach is used in CALPUFF to compute the depletion and wet deposition fluxes due to precipitation scavenging. The scavenging coefficients are specified as a function of the pollutant and precipitation type (i.e., frozen vs. liquid precipitation).

Chemical Transformation: CALPUFF includes options for parameterizing chemical transformation effects using the five species scheme (SO_2, $SO_4^=$, NO_x, HNO_3, and NO_3^-) employed in the MESOPUFF II model or a set of user-specified, diurnally-varying transformation rates.

Table 4-2. Major Features of the CALPUFF Model

- **Source types**
  - ≅ Point sources (constant or variable emissions)
  - ≅ Line sources (constant or variable emissions)
  - ≅ Volume sources (constant or variable emissions)
  - ≅ Area sources (constant or variable emissions)

- **Non-steady-state emissions and meteorological conditions**
  - ≅ Gridded 3-D fields of meteorological variables (winds, temperature)
  - ≅ Spatially-variable fields of mixing height, friction velocity, convective velocity scale, Monin-Obukhov length, precipitation rate
  - ≅ Vertically and horizontally-varying turbulence and dispersion rates
  - ≅ Time-dependent source and emissions data for point, area, and volume sources
  - ≅ Temporal or wind-dependent scaling factors for emission rates, for all source types

- **Interface to the Emissions Production Model (EPM)**
  - ≅ Time-varying heat flux and emissions from controlled burns and wildfires

- **Efficient sampling functions**
  - ≅ Integrated puff formulation
  - ≅ Elongated puff (slug) formulation

- **Dispersion coefficient (Φ_y, Φ_z) options**
  - ≅ Direct measurements of Φ_v and Φ_w
  - ≅ Estimated values of Φ_v and Φ_w based on similarity theory
  - ≅ Pasquill-Gifford (PG) dispersion coefficients (rural areas)
  - ≅ McElroy-Pooler (MP) dispersion coefficients (urban areas)
  - ≅ CTDM dispersion coefficients (neutral/stable)

- **Vertical wind shear**
  - ≅ Puff splitting
  - ≅ Differential advection and dispersion

- **Plume rise**
  - ≅ Buoyant and momentum rise
  - ≅ Stack tip effects
  - ≅ Building downwash effects
  - ≅ Partial penetration
  - ≅ Vertical wind shear

- **Building downwash**
  - ≅ Huber-Snyder method
  - ≅ Schulman-Scire method

- **Complex terrain**
  - ≅ Steering effects in CALMET wind field
  - ≅ Optional puff height adjustment: ISC3 or "plume path coefficient"
  - ≅ Optional enhanced vertical dispersion (neutral/weakly stable flow in CTDMPLUS)

Table 4-2. Major Features of the CALPUFF Model (Cont'd)

- **Subgrid scale complex terrain (CTSG option)**
  - ≅ Dividing streamline, H_d, as in CTDMPLUS:
    - Above H_d, material flows over the hill and experiences altered diffusion rates
    - Below H_d, material deflects around the hill, splits, and wraps around the hill

- **Dry Deposition**
  - ≅ Gases and particulate matter
  - ≅ Three options:
    - Full treatment of space and time variations of deposition with a resistance model
    - User-specified diurnal cycles for each pollutant
    - No dry deposition

- **Overwater and coastal interaction effects**
  - ≅ Overwater boundary layer parameters
  - ≅ Abrupt change in meteorological conditions, plume dispersion at coastal boundary
  - ≅ Plume fumigation

- **Chemical transformation options**
  - ≅ Pseudo-first-order chemical mechanism for SO_2, $SO_4^=$, NO_x, HNO_3, and NO_3^- (MESOPUFF II method)
  - ≅ Pseudo-first-order chemical mechanism for SO_2, $SO_4^=$, NO, NO_2 HNO_3, and NO_3^- (RIVAD/ARM3 method)
  - ≅ User-specified diurnal cycles of transformation rates
  - ≅ No chemical conversion

- **Wet Removal**
  - ≅ Scavenging coefficient approach
  - ≅ Removal rate a function of precipitation intensity and precipitation type

- **Graphical User Interface**
  - ≅ Point-and-click model setup and data input
  - ≅ Enhanced error checking of model inputs
  - ≅ On-line Help files

- **Interface Utilities**
  - ≅ Scan ISCST3 and AUSPLUME meteorological data files for problems
  - ≅ Translate ISCST3 and AUSPLUME input files to CALPUFF input format

4.2 Modeling Domain Configuration

The proposed CALMET/CALPUFF computational domain will consist of a uniform horizontal grid with a grid cell size of 2 kilometers in order to properly resolve spatial changes in flow fields and surface characteristics. In the vertical, a stretched grid will be used with a fine resolution in the lower layers in order to resolve the mixed layer and a somewhat coarser resolution aloft. The ten vertical levels are centered at: 10, 30, 60, 120, 240, 460, 800, 1250, 1850, and 2600 meters.

4.3 Meteorological Modeling

The NOOBS version of CALMET is proposed for this advanced screening modeling analysis. This will allow the meteorological fields to be driven by the use of prognostic meteorological fields only adjusted by CALMET for local (fine-scale) terrain effects. The diagnostic wind module in CALMET will produce winds at a grid spacing of 2 km with 151 × 126 grid cells.

Initial Guess Field

It is proposed that MM4/MM5 gridded meteorological data be used to define the initial guess field for the CALMET simulations. The MM4/MM5 data are available for the years 1990, 1992, and 1996 at a horizontal resolution of 80 km (1990 and 1992) and 36 km (1996). The MM4/MM5 data set contains 23 vertical levels.

Step 1 Field: Terrain Effects

In developing the Step 1 wind field, CALMET adjusts the initial guess field to reflect kinematic effects of the terrain, slope flows and blocking effects. Slope flows are a function of the local slope and altitude of the nearest crest. The crest is defined as the highest peak within a radius TERRAD around each grid point. The value of TERRAD will be determined based on an analysis of the scale of the terrain. The Step 1 field produces a flow field consistent with the fine-scale CALMET terrain resolution (2 km).

Step 2 Field: Objective Analysis

In Step 2, observations are incorporated into the Step 1 wind field to produce a final wind field. This step would only be performed if a refined level CALMET/CALPUFF analysis is required. Each observation site influences the final wind field within a radius of influence (parameters RMAX1 at the surface and RMAX2 aloft). Observations and Step 1 field are weighted by means of parameters R1 at the surface and R2 aloft: at a distance R1 from an observation site, the Step 1 wind field and the surface observations are weighted equally.

4.4 CALPUFF Computational Domain and Receptors

The CALPUFF computational grid will be the same as the meteorological grid (i.e., 151 x 126 grid cells with a 2 km resolution). The modeling domain includes a buffer zone of at least 50 km from the facility and the border of the Class I area. This will minimize edge effects and allow pollutants involved in flow reversals to be brought back into the Class I area.

The proposed receptor grid will consist of a grid of discrete receptors within the Joshua Tree National Park Class I area and receptors along the boundary of this area. The receptors within the park boundary will have a spacing of 2 km. The discrete receptors to be placed along the boundaries will have a spacing of approximately 1 km. Figures 4-1 shows the distribution of the receptors within the Joshua Tree National Park. There are a total of 952 receptors.

4.5 Dispersion Modeling Options

The CALPUFF simulations will be conducted using the following model options:

- Gaussian near-field distribution

- Transitional plume rise

- Stack tip downwash

- PG dispersion coefficients (rural areas), McElroy-Pooler coefficients (urban areas)

- Transition of Φ_y to time-dependent (Heffter) growth rates

- Partial plume path adjustment for terrain

- Wet deposition, dry deposition, and chemical transformation using the MESOPUFF scheme

Two important computational parameters in CALPUFF are XMXLEN (maximum length of an emitted puff, in grid units) and XSAMLEN (maximum travel distance of a puff, in grid units, during one time step). Both of these variables will be set to 1.0 in the CALPUFF simulations in order to allow the strong wind channeling effects to be accounted for in the puff trajectory calculations. The first parameter ensures that the length of an emitted puff does not become so large so that it cannot respond to changes in the wind field on the scale of the meteorological grid (2 km resolution). The model will automatically increase the frequency of puff releases to ensure the length of a single puff is not larger than the grid size. The second parameter will decrease the internal time step to ensure the travel distance during one time step does not exceed the grid size.

The partial plume path adjustment option will be used in CALPUFF for this analysis (MCTADJ=3). The CALMET wind field incorporates the effect of the terrain on the plume trajectories. The plume path coefficient is used to characterize the local effect on ground-level concentrations. The default plume path coefficients (PPC) are listed below:

Stability Class	A	B	C	D	E	F
PPC	0.5	0.5	0.5	0.5	0.35	0.35

Deposition and chemical transformation effects will be modeled using the default dry deposition model, the scavenging coefficient wet removal module, and the default chemical transformation mechanism. Six species will be modeled with CALPUFF for this analysis: SO_2, SO_4, NO_x, NO_3, HNO_3, and PM_{10}. Of these six species, four are emitted by the project sources: SO_2, SO_4, NO_x and PM_{10}. The chemical mechanism computes transformation rates of SO_2 to SO_4 and NO_x to NO_3/HNO_3. Monthly average ozone concentrations measured at a CASTNET monitor within the Joshua Tree National Park are proposed for use with the chemical transformation module. These ozone concentrations, along with radiation intensity, are used as surrogates for the OH concentration during the day when the gas phase free radical chemistry is active. For the advanced screening simulations, a constant background NH3 concentration of 1 ppb will be used in CALPUFF. If refined modeling is necessary, modifications of the ammonia concentration to reflect potential ammonia limiting affects will be performed.

4.6 Visibility Calculations

The Interagency Workgroup on Air Quality Modeling (IWAQM) developed a set of procedures for use in evaluating visibility impacts (EPA, 1998) which are referenced in the Federal Land Managers workgroup guidance document on assessing air quality related values in Class I areas (FLAG, 2000). The procedures focus on the contribution of anthropogenically-generated fine particles such as sulfate and nitrate to visibility degradation. The procedures involve the use of an air quality model to obtain concentrations of particulate matter. The CALPUFF model is recommended for this type of application because of its ability to treat chemical conversion of SO_2 and NO_x, its treatment of wet and dry deposition and its ability to represent non-steady-state transport over longer range distances where the assumptions of steady-state models break down. A relative humidity correction is applied to the concentrations of hygroscopic particles which accounts for aerosol growth during

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Terrain Elevations and Joshua Tree National Park Receptors

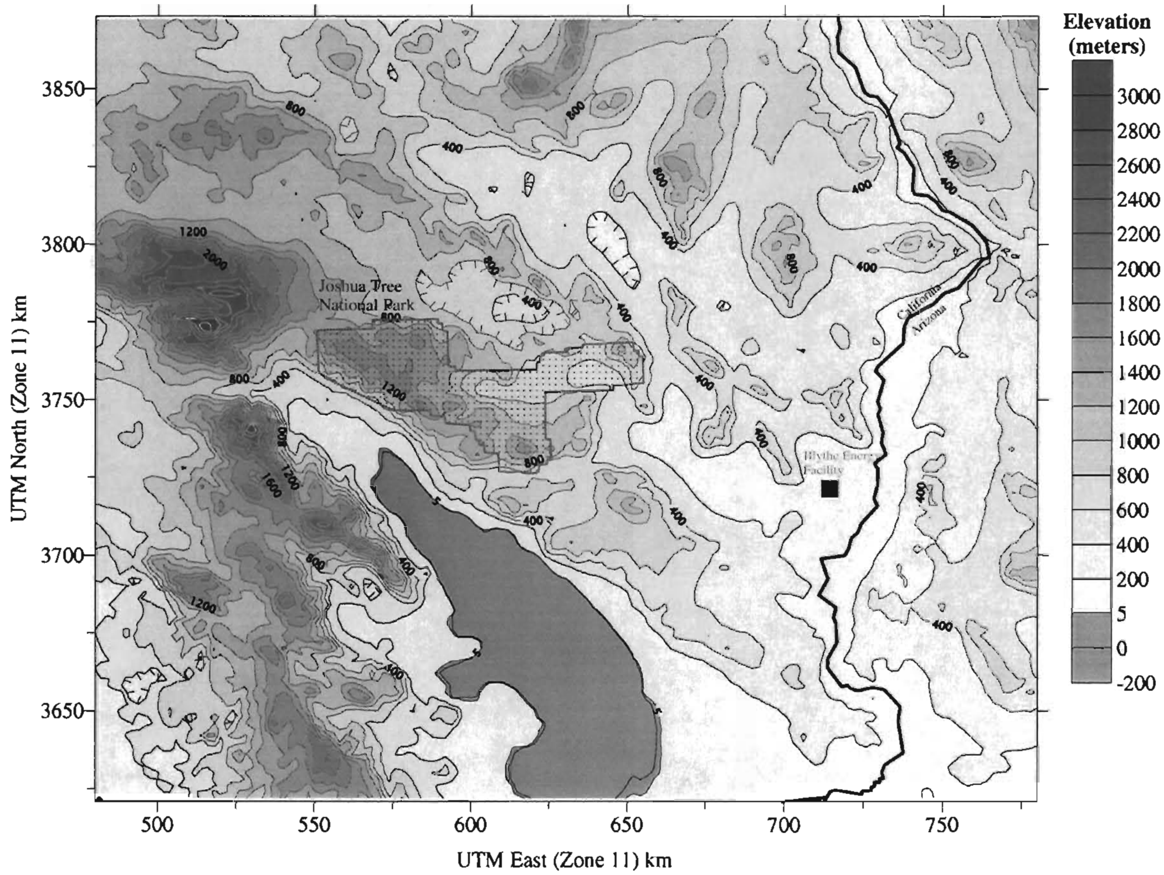

Figure 4-1. Plot of receptors within the Joshua Tree National Park proposed for the CALPUFF modeling. Receptor spacing is 2 km within the Class I area (blue) and 1 km along the boundary (orange).

high humidity conditions. The extinction coefficient (b_{ext}) due to scattering by sulfate and nitrate is computed as:

b_{SO4} $= 1.375\ E_{dry}\ f(RH)\ [SO_4]$ (sulfate)

b_{NO3} $= 1.29\ E_{dry}\ f(RH)\ [NO_3]$ (nitrate)

where, E_{dry} is the dry extinction efficiency of 3.0 m^2/g,

f(RH) is a relative humidity adjustment factor, and

1.375 and 1.29 are molecular weight adjustments converting SO_4 and NO_3 to $(NH_4)_2SO_4$ and NH_4NO_3, respectively, and

$[SO_4]$, $[NO_3]$ are the concentrations of sulfate and nitrate, respectively expressed in $\Phi g/m^3$.

The contribution of non-hygroscopic particulate matter (PM_{10}) to visibility degradation must also be taken into account. The most important types of particle matter for visibility calculations are organics, elemental carbon, soil, and coarse mass. Each of these components has their own dry extinction efficiency. Therefore, the extinction coefficient (b_{ext}) due to scattering by various types of PM_{10} is computed for each component as:

b_{OC} $=$ 4 [OC] (organics)

b_{soil} $=$ 1 [Soil] (soil)

b_{coarse} $=$ 0.6 [Coarse mass] (coarse mass)

b_{EC} $=$ 10 [EC] (elemental carbon)

where, [OC], [Soil], [Coarse mass], and [EC] are the concentrations of organics, soil, coarse mass, and elemental carbon, respectively, expressed in $\Phi g/m^3$.

In addition, Rayleigh scattering of air molecules contributes to total extinction. The typical value for Rayleigh scattering recommended by FLAG (2000) is 10 Mm^{-1} (where Mm^{-1} stands for inverse megameters). Therefore,

b_{ray} $=$ 10 Mm^{-1} (Rayleigh)

The total extinction is expressed as:

$$b_{ext} = b_{SO4} + b_{NO3} + b_{OC} + b_{soil} + b_{coarse} + b_{EC} + b_{ray}$$

The purpose of the visibility analysis is to calculate the change in extinction at each receptor for each day (24-hour period) of the year due to the proposed project sources. The visibility test looks for a change in extinction of 5 percent or greater for any day of the year. The fractional change in b_{ext} is calculated as follows:

$$\in b_{ext} = b_{source} / b_{back}$$

Processing of visibility impairment will be carried out with the CALPUFF post-processing program CALPOST (Scire et al., 2000) using CALPOST Method 6. Method 6 uses monthly relative humidity adjustment factors in the calculation of extinction. The monthly relative humidity adjustment factors proposed for this analysis are provided in *Draft Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule* (USEPA, 2001). The values of background concentrations of pollutants detailed in Table 4-3 for the Joshua Tree National Park are from the FLAG (2000) report. Table 4-4 provides the monthly relative humidity adjustment factors for the Joshua Tree National Park.

As an example of the visibility calculations to be performed in the screening analysis, consider the reference visibility conditions for the Joshua Tree National Park as detailed in Table 4-3. The reference 24-hour average visibility has a hygroscopic component (combined sulfate and nitrate) dry extinction coefficient $b_{SN} = 0.6\ Mm^{-1}$ (neglecting the effects of relative humidity), and a non-hygroscopic component (extinction coefficient due to scattering from the other components plus Rayleigh scattering), $b_{dry} = 14.5\ Mm^{-1}$. The extinction coefficient is expressed in the form of

$$b_{back} = b_{SN}\ f(RH) + b_{dry}$$

where

$$b_{SN} = 3\ [\ (NH_4)_2SO_4 + NH_4NO_3\ ]$$

expresses the sulfate and nitrate contribution, and

$$b_{dry} = b_{OC} + b_{soil} + b_{coarse} + b_{EC} + b_{ray}$$

expresses the non-hygroscopic components. Therefore, the reference background extinction coefficient is

$$b_{back} = 0.6\ f(RH) + 14.5\ Mm^{-1}$$

If the f(RH) term for a particular day is 2.24, this yields an extinction coefficient of $15.84\ Mm^{-1}$. The modeling results for the project facility will be compared with the reference condition each 24 hour averaging period. For this example, assume the project sources contribute 0.058 $\Phi g/m^3$ of sulfate (SO_4) and 0.1 $\Phi g/m^3$ of fine primary particulate matter (assumed to have optical properties similar to "soil"). The contribution of sulfate to the total extinction (b_{SO4}) is calculated using the equation above. For a source impact of 0.058 g/m^3 of sulfate, the values of E_{dry} of 3.0 m^2/g, the value of f(RH) of 3.8, and the molecular weight conversion factor of 1.375, the resulting value of b_{SO4} is calculated to be:

$$b_{SO4} = (1.375)\,(3.0\ m^2/g)\,(2.24)\,(0.058\ g/m^3)$$

$$b_{SO4} = 0.54\ Mm^{-1}$$

In this example, a conversion of the mass of fine particulate matter (FPM) is not required, so we just multiply the FPM concentration (0.1 Φg/m^3) by the extinction coefficient of soil (which is 1.0). This yields an extinction coefficient of 0.1 Mm^{-1}. Therefore following the form of the above equation, the source contribution will be:

$$b_{source} = 0.54\ Mm^{-1} + 0.1\ Mm^{-1}$$

$$b_{source} = 0.64\ Mm^{-1}$$

The same f(RH) adjustment term that was applied to the extinction must be applied to the source contribution. For instance, if it is assumed that the 24-hour average f(RH) is 3.8, then b_{back} = 15.84 Mm^{-1} and b_{source} = 0.64 Mm^{-1}, and the resulting change in extinction is)b_{ext} =4.0%. In this example,)b_{ext} is below the screening level value (SLV) of 5%. This calculation is repeated for all days and receptors in the modeling domain.

Table 4-3. Reference Visibility Conditions at the Joshua Tree National Park Class I Area

Location	Components of Dry Extinction (Mm^{-1})		
	Non-Hygroscopic	Hygroscopic	Rayleigh
Joshua Tree National Park	4.5	0.6	10

Source: FLAG (2000)

Table 4-4. Monthly Values of Relative Humidity Adjustment Factors at Joshua Tree National Park

Month	Relative Humidity Adjustment Factor f(RH)
January	2.35
February	2.30
March	2.24
April	2.02
May	1.99
June	1.91
July	1.97
August	2.00
September	2.03
October	2.02
November	1.91
December	2.04

Source: Draft Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule (USEPA, 2001).

4.7 Deposition Calculations

Under the calculation procedure recommended by the National Park Service, sulfur and nitrogen deposition will include contributions from other species besides SO_4 and NO_3. Sulfur deposition is the sum of the wet and dry sulfur deposition from SO_2 and SO_4 (with their appropriate molecular weight adjustments). Nitrogen deposition is due to HNO_3, NO_3, NO_x and SO_4 (note: sulfate represents $((NH_4)_2SO_4)$ and nitrate represents NH_4NO_3).

In CALPUFF, NO_x is weighed as NO_2, ammonium nitrate (NH_4NO_3) is weighed as NO_3, and ammonium sulfate ($(NH_4)_2SO_4$) is weighed as SO_4. Sulfate is assumed to contribute to N deposition as well as S deposition. The end result is:

total deposition = wet deposition + dry deposition.

total S deposition = 0.5 x (total SO_2 deposition) + 0.3333 x (total SO_4 deposition)

total N deposition = 0.291667 x (total SO_4 deposition) + 0.2222 x (total HNO_3 deposition) + 0.451613 x (total NO_3 deposition) + 0.3043 x (total NO_x deposition)

4.7.1 Calculation of Nitrogen Deposition

In CALPUFF nitrate is weighed as NO_3, but deposition is assumed to be in the form of (NH_4NO_3). Converting NO_3 to NH_4NO_3 results in:

$$D_{NH4NO3} = D_{NO3} \times (80/62)$$

$$D_N = D_{NO3} \times (28/62)$$

$$= 0.4516 \times D_{NO3}$$

where, D_{NO3} is the deposition flux of NO_3 (g $NO_3/m^2/s$)

D_{NH4NO3} is the deposition flux of NH_4NO_3 (g $NH_4NO_3/m^2/s$)

D_N is the deposition flux of N (g $N/m^2/s$)

(62, 80 and 14 are the molecular weights of NO_3, NH_4NO_3 and N respectively).

Nitrogen deposition from sulfate is as follows:

$$D_N = D_{SO4} \times (28/96)$$

$$= D_{SO4} \times 0.2917$$

where, D_{SO4} is the deposition flux of SO_4 (g $SO_4/m^2/s$)

Nitrogen deposition from nitric acid is as follows:

$$D_N = D_{HNO3} \times (14/63)$$

$$= D_{HNO3} \times 0.2222$$

where D_{HNO3} is the deposition flux of HNO_3 (g $HNO_3/m^2/s$)

Nitrogen deposition from NO_x is as follows:

$$D_N = D_{NOx} \times (14/46)$$

$$= D_{NOx} \times 0.3043$$

where, D_{NOx} is the deposition flux of D_{NOx} (g $NO_x/m^2/s$)

Thus the total nitrogen deposition (g $N/m^2/s$) is assumed to be:

$$D_N = 0.451613\, D_{NO3} + 0.291667\, D_{SO4} + 0.2222\, D_{HNO3} + 0.3043\, D_{NOx}$$

The deposition fluxes (D_{NO3}, D_{SO4}, D_{HNO3}, D_{NOx}) are derived from the total (wet + dry) deposition fluxes of these species produced by the CALPUFF model.

The SLV is 0.005 kg N/hectare/year, which applies to total nitrogen deposition (D_N).

4.7.2 Calculation of Sulfur Deposition

Sulfur deposition is calculated from the of SO_2 and SO_4 deposition fluxes as:

$$D_s = 0.3333\, D_{SO4} + 0.5000\, D_{SO2}$$

The sulfur deposition SLV is 0.005 kg S/hectare/year.

4.8 Modeling Products

The CALPUFF modeling will produce short term and annual average SO_2, NO_2 and PM_{10} concentrations in the Class I area due to the proposed sources. The predicted concentrations of PM_{10} and NO_2 will be compared to the Class I Significant Impact Levels (SILs). The SO_2 SILs are 1.0 $\mu g/m^3$ for 3-hour averages, 0.2 $\mu g/m^3$ for 24-hour averages, and 0.1 $\mu g/m^3$ for annual averages. The NO_2 SIL is 0.1 $\mu g/m^3$ for annual averages. The PM_{10} SILs are 0.3 $\mu g/m^3$ for 24-hour averages, and 0.2 $\mu g/m^3$ for annual averages.

If the predicted concentration due to the proposed emissions is less than the SIL, then a cumulative impact analysis to demonstrate compliance with the Ambient Air

Quality Standards (AAQS) and the PSD increments is not needed. If the predicted concentrations exceed the SIL for any pollutant, then a cumulative impact analysis will be performed for that pollutant using appropriate background source emissions inventory data. Predicted total increment consuming concentrations will be compared to the Class I PSD increments.

The results will be presented in the tables in the format shown in sample Table 4-5.

In addition, the change in light extinction due to primary and secondary particulate matter due to emissions from the proposed sources will be computed. CALPOST Method 6 with U.S. EPA-recommended monthly humidity factors (USEPA, 2001) will be used to determine light extinction. The light extinction impacts will be presented as percent change in extinction from the reference values for the Joshua Tree National Park listed in the FLAG (2000) report. The results of the visibility calculation will be presented in the form of the sample Table 4-6.

Total sulfur and nitrogen deposition fluxes will be computed for use in evaluating potential acid deposition impacts from the facility. Those results will be presented as in the sample Table 4-7. The sulfur and nitrogen deposition values will be compared to screening levels of 0.005 kg S/ha/yr and 0.005 kg N/ha/yr.

Table 4-5. Sample Format of the Ambient Concentration Summary Table

Class I Area	Averaging Period	Maximum SO_2 Concentration ($\mu g/m^3$)	Receptor Location (UTM) X (km)	Receptor Location (UTM) Y (km)	Class I Significant Impact Level ($\mu g/m^3$)	Exceedance of SIL Yes/No
Joshua Tree NP	3 hours	0.059	752.000	4096.000	1.0	No
	24 hours	0.012	752.250	4096.000	0.2	No
	Annual	0.001	752.500	4098.000	0.1	No

Table 4-6. Sample Format of the Visibility Summary Table

Class I Area	Averaging Period	Maximum Change in B_{ext} (%)	Receptor Location (UTM) X (km)	Receptor Location (UTM) Y (km)	Exceedance of 5% SLV Yes/No	Number of days with)B_{ext} above 5%	Number of days with)B_{ext} above 10%
Joshua Tree NP	24 Hours	1.6	752.000	4098.000	No	0	0

Table 4-7. Sample Format of the Deposition Flux Summary Table

Class I Area	Maximum Annual N Deposition (kg S/ha/yr)	NPS Class I Screening Level Value (kg S/ha/yr)	Exceedence of SLV Yes / No
Joshua Tree NP	0.004	0.005	No

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