San Juan Basin Action Plan

AIR QUALITY TECHNICAL REPORT

for the
**Environmental Impact Statement
on Public Service Company of New Mexico's
Proposed New Mexico Generating Station
and Possible New Town**

United States
Department
of the Interior

Bureau of Land Management
New Mexico State Office
Santa Fe, New Mexico

October 1982

Report 6 of 22

March 3, 1849

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
NEW MEXICO STATE OFFICE
P.O. BOX 1449
SANTA FE, NEW MEXICO 87501

IN REPLY REFER TO
NM30840EIS
1792.73(934A)

October 1982

Dear Interested Citizen:

Attached is one of twenty-two technical reports developed as a basis for writing the Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town (NMGS EIS). (A list of the technical reports is attached.)

These technical reports provide detailed information on the existing environment, methods used for the impact analysis, and related data supportive of the analysis and conclusions presented in the EIS. These reports should be retained for use with the Draft and Final EIS and other documents related to BLM's San Juan Basin Action Plan (SJBAP).

The Draft NMGS EIS will be filed with the Environmental Protection Agency and released for public review on November 30, 1982. Comments on the Draft EIS will be due by close of business February 7, 1983, at the BLM New Mexico State Office. Because of the large volume of material presented in the technical reports, the BLM is distributing these reports in advance of the Draft EIS to provide sufficient time for public review. The technical reports will be available for public review at the places indicated on the attached list. Copies will also be available from the BLM New Mexico State Office, U.S. Post Office and Federal Building, Santa Fe, for a copy fee.

Informational public meetings are scheduled for December 1982 to provide a public forum to clarify questions and concerns about the SJBAP proposals and the related environmental documents, which will all have been issued by that time. The meetings are scheduled as follows:

- December 14, Civic Center, Farmington, 3 to 9 PM
- December 14, Convention Center, Albuquerque, 3 to 9 PM
- December 15, Chapter House, Crownpoint, 3 to 9 PM
- December 16, Holiday Inn, Gallup, 3 to 9 PM
- December 16, Kachina Lodge, Taos, 3 to 9 PM

In addition, formal public hearings will be held in January 1983 to solicit public comments on the SJBAP Proposals. These meetings are scheduled as follows:

- January 10, Chapter House, Crownpoint, beginning at 1:00 PM
- January 12, Civic Center, Farmington, beginning at 9:00 AM
- January 14 (and 15th if necessary because of the number of registrants), Four Seasons Motor Lodge, Albuquerque, I-40 and Carlisle Blvd., beginning at 9:00 AM (each day)

Questions on the public meetings, hearings, and the technical reports themselves should be directed to:

Leslie M. Cone
NMGS Project Manager
BLM, New Mexico State Office
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

Sincerely yours,

Charles W. Luscher

Charles W. Luscher
State Director, New Mexico

List of Technical Reports

1. Purpose and Need
2. Project Description
3. Alternatives to the Project
4. Site Alternatives
5. Permit Reconnaissance
6. Air Quality
7. Geologic Setting
8. Mineral Resources
9. Paleontology
10. Soils, Prime and Unique Farmlands
11. Hydrology
12. Water Quality
13. Vegetation
14. Wildlife and Aquatic Biology
15. Threatened and Endangered Species
16. Cultural Resources
17. Visual Resources
18. Recreation Resources
19. Wilderness Values
20. Transportation
21. Social and Economic Conditions
22. Land Use Controls and Constraints

Availability of Technical Reports for Public Review

Individual copies of the technical reports can be obtained for a copy fee. Inquiries should be directed to:

Bureau of Land Management, New Mexico State Office
Title Records and Public Assistance Section (943B)
U.S. Post Office and Federal Building
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6107 FTS 476-6107

Copies of the reports are available for public review at the locations listed below. [Formal and informal cooperating agencies are denoted by an asterisk (*).]

BUREAU OF LAND MANAGEMENT OFFICES

New Mexico State Office

NMGS Project Staff (934A)
Room 122, Federal Building
Cathedral Place
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

San Juan Energy Projects Staff (911)
Room 129, Federal Building
Cathedral Place
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6226 FTS 476-6226

Public Affairs Staff (912)
Room 2016
U.S. Post Office and Federal Building
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6316 FTS 476-6316

Division of Resources (930)
509 Camino de los Marquez, Suite 3
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6212 FTS 476-6212

Albuquerque District Office
3550 Pan American Freeway NE
P.O. Box 6770
Albuquerque, NM 87107
(505) 766-2455 FTS 474-2455

Farmington Resource Area Headquarters
900 La Plata Road
P.O. Box 568
Farmington, NM 87401
(505) 325-3581

Taos Resource Area Office
Montevideo Plaza
P.O. Box 1045
Taos, NM 87571
(505) 758-8851

Socorro District Office
198 Neel Avenue
P.O. Box 1219
Socorro, NM 87801
(505) 835-0412 FTS 476-6280

Las Cruces District Office
1705 N. Valley Drive
P.O. Box 1420
Las Cruces, NM 88001
(505) 524-8551 FTS 571-8312

Roswell District Office
1717 W. Second Street
P.O. Box 1397
Roswell, NM 88201
(505) 622-7670 FTS 476-9251

Carlsbad Resource Area Headquarters
114 S. Halagueno Street
P.O. Box 506
Carlsbad, NM 88220
(505) 887-6544

USDI, Bureau of Land Management
Division of Rights-of-Way (330)
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Washington, D.C. 20240
(202) 343-5441 FTS 343-5441

USDI, Bureau of Land Management
Denver Service Center (D-460)
Technical Publications Library
Denver Federal Center, Bldg. 50
Denver, CO 80225
(303) 234-2368 FTS 234-2368

NEW MEXICO STATE AGENCIES

New Mexico State Environmental Improvement Division*
725 St. Michaels Drive
P.O. Box 968
Santa Fe, NM 87503
(505) 827-5217, ext. 2416

New Mexico Energy and Minerals Department*
525 Camino de los Marquez
P.O. Box 2770
Santa Fe, NM 87503
(505) 827-3326

New Mexico Historic Preservation Bureau*
State Historic Preservation Officer
505 Don Gasper Avenue
Santa Fe, NM 87503
(505) 827-2108

New Mexico Natural Resource Department*
Villagra Building
Santa Fe, NM 87503
(505) 827-5531

New Mexico Public Service Commission*
Bataan Memorial Building
Santa Fe, NM 827-3361
(505) 827-3361

New Mexico State Engineer's Office*
Bataan Memorial Building
Santa Fe, NM 87503
(505) 827-2423

New Mexico State Planning Office*
505 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-5191

OTHER ORGANIZATIONS

Public Service Company of New Mexico
Alvarado Square
P.O. Box 2268
Albuquerque, NM 87158
(505) 848-2700

Woodward-Clyde Consultants, Inc.
3 Embarcadero Center, Suite 700
San Francisco, California 94111
(415) 956-7070

PUBLIC AND UNIVERSITY LIBRARIES

Reading copies of the NMGS EIS and associated technical reports will be available at the following public and university libraries:

State and Public Libraries

Albuquerque Public Library
501 Copper Avenue NW
Albuquerque, NM 87102

Aztec Public Library
201 W. Chaco
Aztec, NM 87401

Crownpoint Community Library
c/o Lioness Club, P.O. Box 731
Crownpoint, NM 87313

Cuba Public Library
Box 5, La Jara
Cuba, NM 87027

Farmington Public Library
302 N. Orchard
Farmington, NM 87401

Gallup Public Library
115 W. Hill Avenue
Gallup, NM 87301

Mother Whiteside Memorial Library (Public)
525 W. High Street
P.O. Box 96
Grants, NM 87020

New Mexico State Library
325 Don Gaspar Avenue
Santa Fe, NM 87503

OTHER DEPARTMENT OF THE INTERIOR AGENCIES

Bureau of Indian Affairs*
Albuquerque Area Office
123 4th Street
P.O. Box 2088
Albuquerque, NM 87198
(505) 766-3374 FTS 474-3374

Bureau of Indian Affairs*
Eastern Navajo Agency
P.O. Box 328
Crownpoint, NM 87313
(505) 786-5228

Bureau of Indian Affairs*
Navajo Area Office
Box M - Mail Code 305
Window Rock, AZ 86515
(602) 871-5151 FTS 479-5314

Bureau of Reclamation*
Upper Colorado Regional Office
125 S. State Street
P.O. Box 11568
Salt Lake City, UT 84147
(801) 524-5463 FTS 588-5463

Minerals Management Service*
South Central Region
505 Marquette Avenue NW, Suite 815
Albuquerque, NM 87102
(505) 766-1173 FTS 474-1173

Minerals Management Service*
Resource Evaluation Office
411 N. Auburn
Farmington, NM 87401
(505) 327-7397 FTS 572-6254

National Park Service*
Southwest Regional Office
1100 Old Santa Fe Trail
Santa Fe, NM 87501
(505) 988-6375 FTS 476-6375

National Park Service*
Environmental Coordination Office
Pinon Building, 1220 St. Francis Drive
P.O. Box 728
Santa Fe, NM 87501
(505) 988-6681 FTS 476-6681

U.S. Fish and Wildlife Service*
Field Supervisor, Ecological Services
3530 Pan American Highway, Suite C
Albuquerque, NM 87107
(505) 766-3966 FTS 479-3966

U.S. Geological Survey (WRD)*
505 Marquette Avenue, Room 720
Albuquerque, NM 87101
(505) 766-2810 FTS 474-2817

OTHER FEDERAL AGENCIES AND ORGANIZATIONS

Environmental Protection Agency*
Region VI
1201 Elm Street
Dallas, TX 75270
(214) 767-2716 FTS 729-2716

Navajo Tribe*
c/o Division of Resources
P.O. Box 308
Window Rock, AZ 86515
(602) 871-6592

Pueblo of Zia*
General Delivery
San Ysidro, NM 87053
(505) 867-3304

Soil Conservation Service*
424 N. Mesa Verde
Aztec, NM 87410
(505) 334-9437

U.S. Corps of Engineers*
P.O. Box 1580
Albuquerque, NM 87103
(505) 766-2657 FTS 474-2657

USDA, Forest Service*
717 Gold Avenue
Albuquerque, NM 87102
(505) 474-1676 FTS 474-1676

USDA, Forest Service*
District Ranger
Mt. Taylor Ranger District
201 Roosevelt Avenue
Grants, NM 87020
(505) 287-8833

Harwood Foundation Library
(Public)
25 LeDoux
P.O. Box 766
Taos, NM 87571

University/College Libraries

University of New Mexico
General Library
Albuquerque, NM 87131

Navajo Community College Library
Shiprock Branch
P.O. Box 580
Shiprock, AZ 87420

Northern New Mexico Community College
P.O. Box 250
Espanola, NM 87532

New Mexico State University
San Juan Campus
4601 College Blvd.
Farmington, NM 87401

University of New Mexico, Gallup Campus
Learning Resources Center
200 College Road
Gallup, NM 87301

New Mexico State University/Grants
1500 Third Street
Grants, NM 87020

New Mexico Highlands University
Donnelly Library
National Avenue
Las Vegas, NM 87701

College of Santa Fe
Fogelson Memorial Library
St. Michaels Drive
Santa Fe, NM 87501

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Prepared by

Woodward-Clyde Consultants

for the

U.S. Department of the Interior
Bureau of Land Management

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NEW MEXICO GENERATING STATION

1.0

INTRODUCTION

BACKGROUND

Included in the recent Council on Environmental Quality Regulations (1979) are several important objectives to reduce excessive paperwork in the preparation of environmental impact statements (EISs):

- Discuss only briefly issues other than significant ones.
- Emphasize the portions of the EIS that are useful to decision makers and the public and reduce emphasis on background material.
- Prepare analytic rather than encyclopedic EISs.

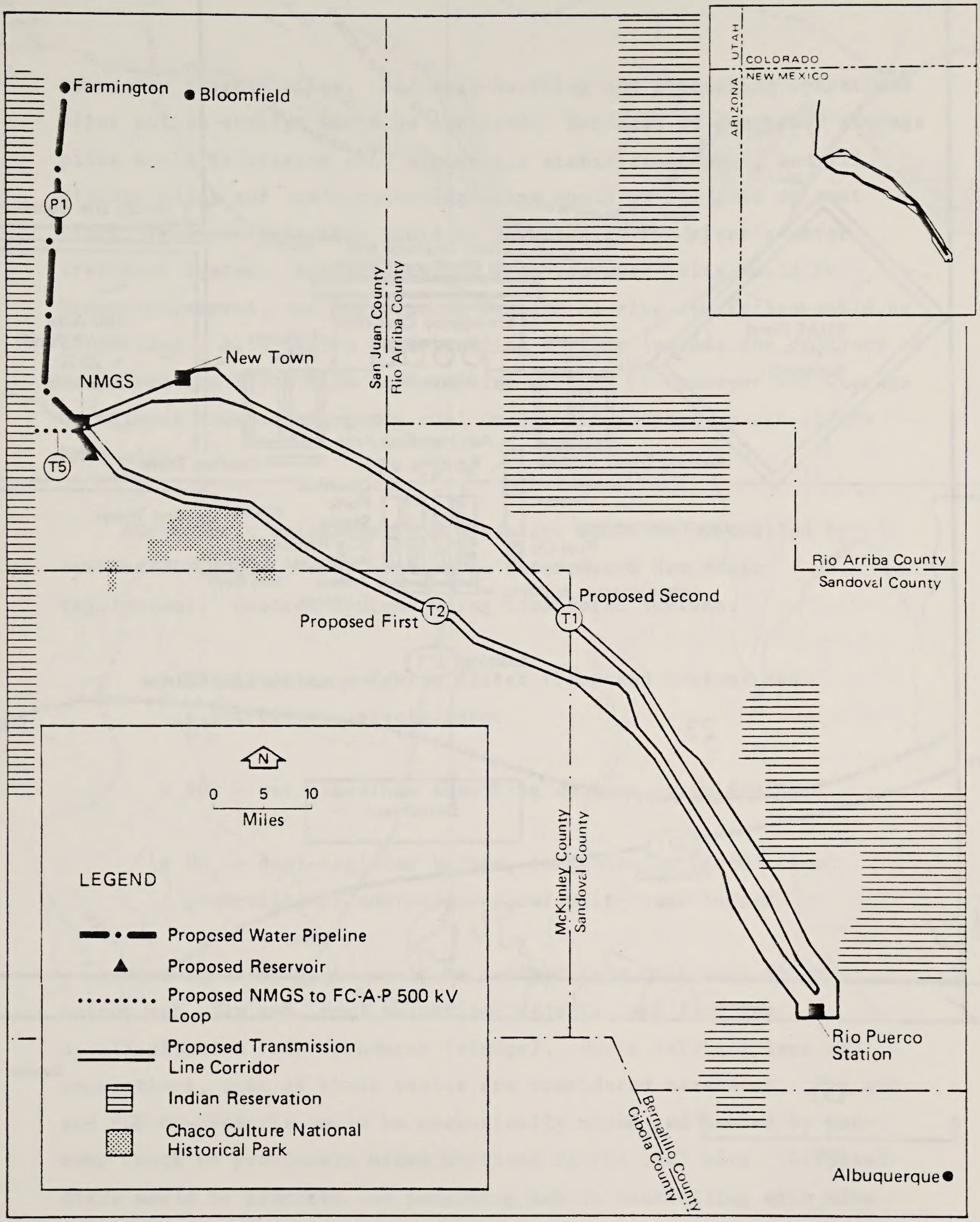
In order to accomplish these objectives and still provide the depth and background required for an analytic impact statement, this technical report has been prepared for the New Mexico Generating Station (NMGS) project. In this report, impacts that were not identified as significant but which are still considered important by the public or technical specialists are analyzed. Background material is provided for those issues and impacts that were considered necessary for the comparison of alternatives. Impacts that were not identified as significant or important by the public and by technical preparers are summarized, and reasons for their elimination from detailed analysis are discussed.

SUMMARY DESCRIPTION OF PROJECT COMPONENTS

Public Service Company of New Mexico (PNM) proposes to construct a 2000-megawatt (MW) coal-fired electric generation plant approximately 35 miles south of Farmington, New Mexico, in San Juan County (Map 1-1). The proposed NMGS, at ultimate development, would have four 500-MW generating units. Each generating unit would include a turbine generator area, coal pulverizer area, boiler area, particulate removal system, SO_2 removal system, and chimney stack. The proposed arrangement of these and other power plant components is shown in Figure 1-1. For the environmental analysis, it was assumed that commercial operation of the first 500-MW unit would begin in 1990 and that other units would start operating during the 1990s.

Coal for NMGS would be acquired through long-term contracts with Sunbelt Mining and Arch Minerals (Proposed Action) or other producers in the San Juan Basin (alternative coal supply). Coal acquired from a joint venture of Sunbelt and Arch Minerals would be supplied from surface mines (referred to as the Bisti mine in this analysis) in the immediate vicinity of the proposed plant site. Coal acquired from other producers in the San Juan Basin would be hauled from mines located as much as 30 miles from the proposed plant site. Coal required for NMGS would average 7.5 million tons per year, or a total of 300 million tons over the 40-year project life.

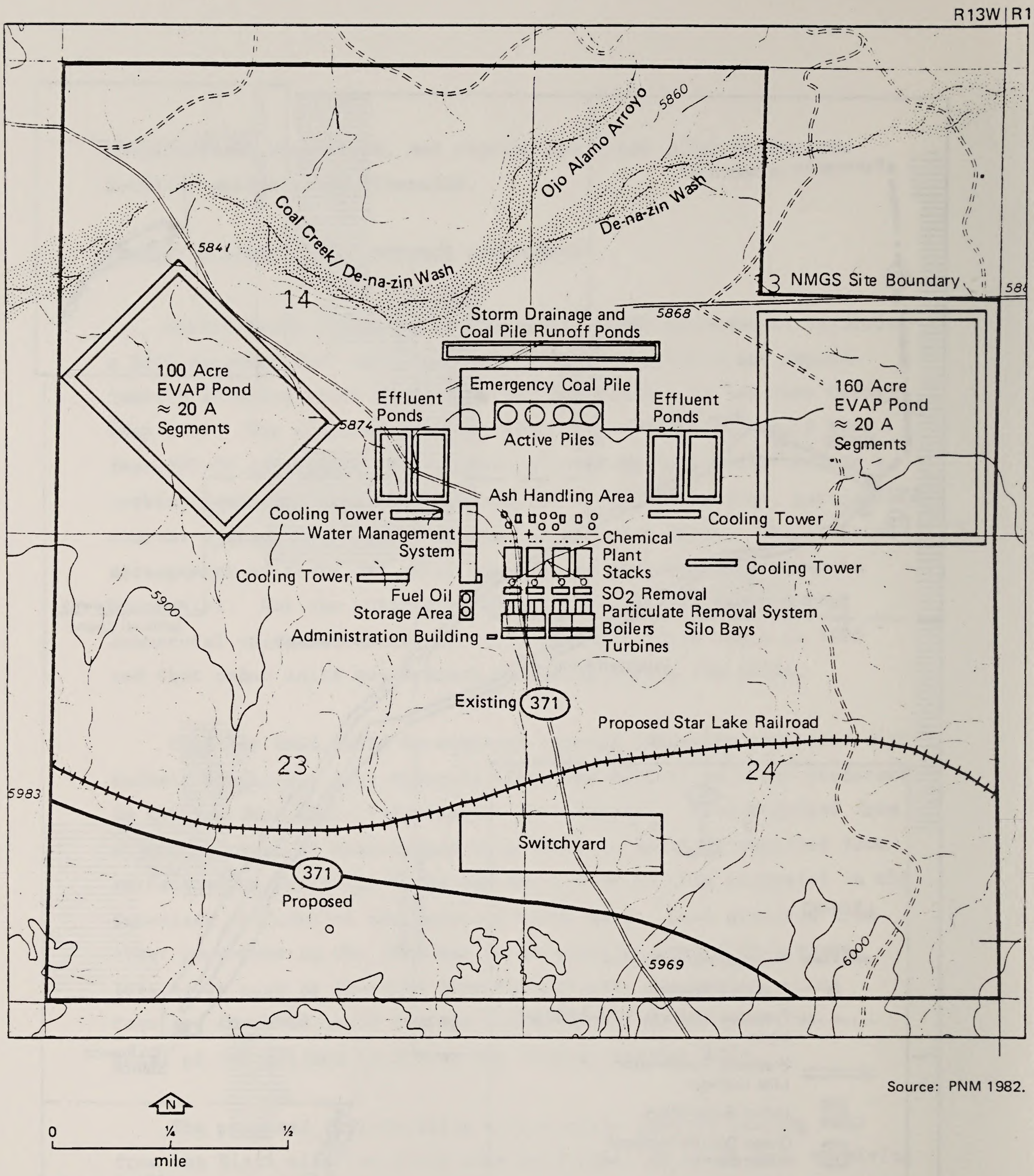
The proposed fuel-handling system would involve hauling coal from the Bisti mine (or other mine locations) by truck to a receiving facility located adjacent to the NMGS site. Coal would then be transferred via conveyor belt from the receiving station to active or



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-1. GENERAL LOCATION OF PROPOSED ACTION



Source: PNM 1982.

Figure 1-1. STATION LAYOUT

emergency storage piles. All coal-handling and processing operations after active storage would be enclosed. Surfaces of emergency storage piles would be treated with a nontoxic stabilizing agent, and all storage piles and coal-processing areas would be designed so that runoff from precipitation would be diverted to the plant's water treatment system. Any coal spills from conveyor belts would be promptly removed, and percolation beneath on-site stockpiles would be controlled. Alternative fuel-handling systems include the delivery of coal from the Bisti mine to receiving station by conveyor and storage of primary crushed emergency coal on Sunbelt property north of the NMGS site.

Atmospheric emissions from the plant would be controlled by systems designed to meet applicable federal and New Mexico regulations. Control systems being considered include:

- Particulates - fabric filter (Proposed Action) and electrostatic precipitator
- SO_2 - wet limestone scrubbing or lime spray drying
- NO_x - dual-register burner, tangentially fired steam generator, or controlled-flow/split-flame burner

Four types of waste would be derived from coal used in NMGS: bottom ash, fly ash, coal pulverizer rejects, and flue gas desulfurization (FGD) products (sludge). Under existing laws and regulations, none of these wastes are considered hazardous. Fly ash and FGD by-products would be mechanically mixed and hauled by end-dump truck to previously mined portions of the coal mine. Disposal areas would be prepared for receiving ash by backfilling with mine overburden. Ash would then be dumped and spread in layers over the mine overburden. After the ash was placed and spread, it would be covered with layers of overburden and surface soil or topsoil and then a vegetative cover would be established. Bottom ash and pulverizer rejects would be collected for disposal in dewatering bins and then hauled by end-dump trucks for disposal into previously mined portions of the coal mine. Procedures for disposal would be the same as for fly ash.

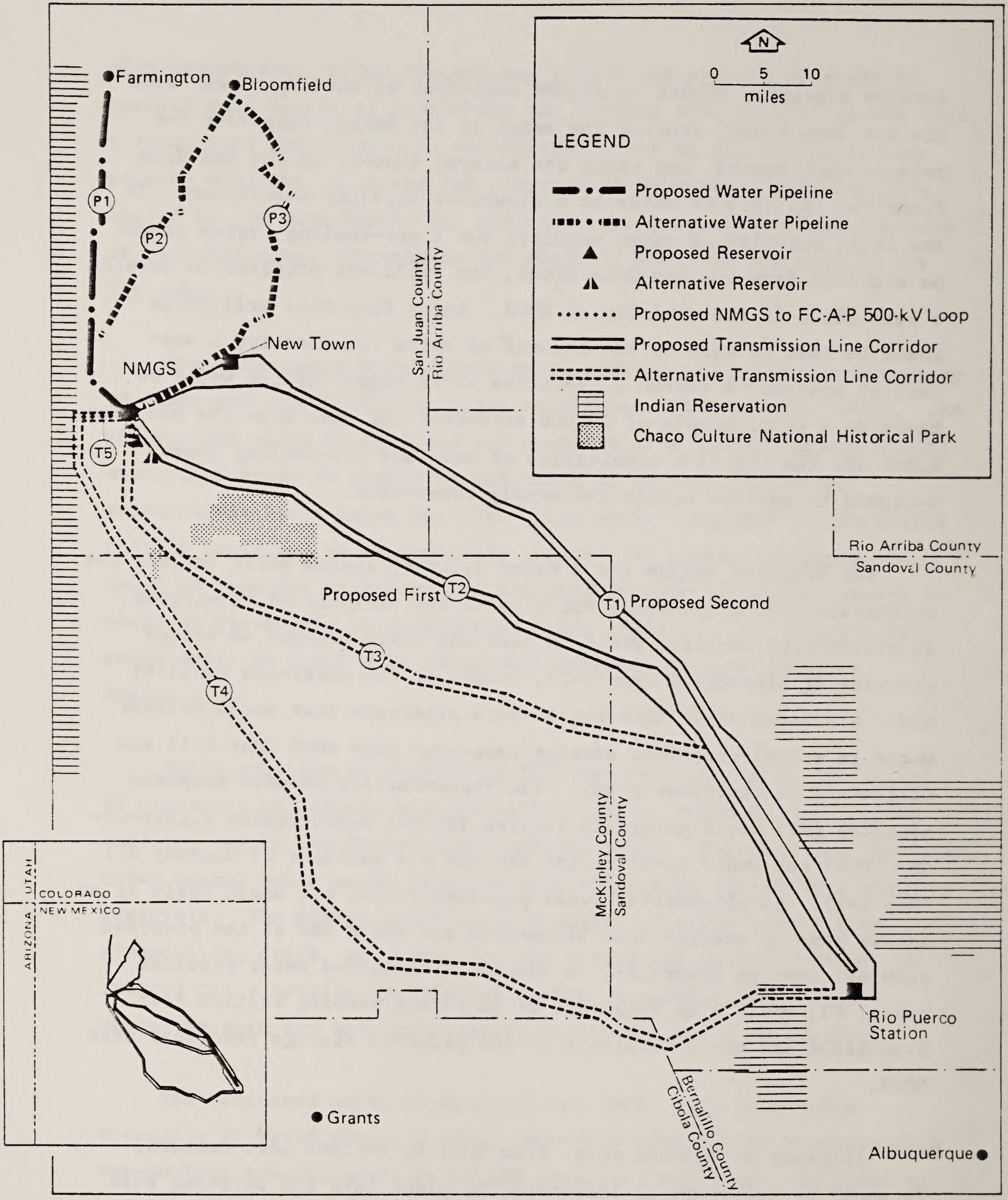
The water management system would contain all equipment necessary to treat and supply all the plant makeup water and potable water. The power plant would be designed and operated as a zero-discharge plant; wastewater would be reused by cascading it to uses requiring successively lower water quality. Used water, degraded to the extent that it could not be economically treated for further in-plant use, would be used for transport and disposal of plant-generated wastes or would be discharged to evaporation ponds (Figure 1-1). Evaporation ponds would be lined with impervious material to limit seepage losses.

Water supplies available for NMGS are believed to be sufficient to construct an all-wet heat-rejection system, based on evaporative cooling, and to use forced-draft cooling towers (Figure 1-1). Cooling-tower makeup water would be drawn from the nearby raw-water storage reservoir. The makeup water would replace the tower losses from evaporation, drift, and blowdown. If sufficient water could not be secured for a totally evaporative system, a water-cooling system employing both dry and conventional wet towers might be required.

The estimated water requirement for NMGS, with four units operating at rated capacity and a heat-rejection system equipped with wet-cooling towers, would be 35,000 acre-feet per year. In order to supply this quantity of water to NMGS, the Proposed Action would involve acquiring rights to 35,000 acre-feet of water per year from the San Juan River, storing the water in the Navajo Reservoir for release upon demand, and using the natural channel of the San Juan River for delivery of water to a diversion facility downstream. If the total quantity of water required for a wet-cooling system cannot be acquired from the San Juan River, the applicant proposes to develop a well field in the vicinity of NMGS. Water from this well field would be used to make up the balance of water required for a wet-cooling system. A second alternative water supply system would be based on a total supply of 20,000 acre-feet per year from the San Juan River and the use of a combination of wet- and dry-cooling towers designed to perform within the supply constraint.

The Proposed Action for a water delivery system would include the construction of a diversion facility in the vicinity of Farmington; an alternative location would be near the State Highway 44 bridge crossing at Bloomfield (Map 1-2). Pumps at the diversion facility would discharge water into two 36-inch pipelines that would deliver water to a 4000-acre-foot storage reservoir near NMGS (Map 1-1) and ultimately to the power plant. The approximately 40-mile proposed pipeline (P1) would generally require 90-foot construction rights-of-way (ROW) and would parallel the new and old portions of Highway 371 (Map 1-1). An alternative water pipeline route, P2, would begin at an intake pumping station near Bloomfield and would end at the proposed terminal storage reservoir. A 49-mile alternative water pipeline route, P3, would also originate at an intake pumping station near Bloomfield and would terminate at the proposed storage reservoir near NMGS.

In order to deliver power from NMGS to various load centers, it would be necessary to integrate the plant into the existing bulk



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-2. GENERAL LOCATION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION transmission systems of PNM and neighboring utilities. Thus the proposed transmission system would consist of a 500-kilovolt (kV) loop linking NMGS with PNM's approved 500-kV Four Corners-Ambrosia-Pajarito (FC-A-P) line, located approximately 5 miles west of NMGS, and two 500-kV lines linking NMGS with the Albuquerque distribution and load center at the proposed Rio Puerco Station (Map 1-1). The NMGS-Albuquerque system would be installed in phases: the 500-kV loop in 1990 with commencement of commercial operation of Unit 1, the first 500-kV line with Unit 2 in 1993, and the second 500-kV line with Unit 4 in 1998.

Four routes are considered technically and economically feasible for construction of the 500-kV transmission system. Route T2 is proposed for the first 500-kV line and route T1 is proposed for the second 500-kV line; routes T3 and T4 are alternatives to the Proposed Action. The total distance traversed would be similar for the two proposed and two alternative corridors: 101 miles (T2), 107 miles (T1), 105 miles (T3), and 126 miles (T4). With the exception of tower sites, the proposed 200-foot ROW could support other compatible land uses, such as grazing. PNM would keep the transmission line ROW closed and would patrol the line by helicopter each month. Lands disturbed by heavy equipment and temporary access roads would be restored to their original condition.

Table 1-1 displays construction work force estimates over time. Construction employment for station facilities would reach peaks of 1515 employees in 1987 and 1530 employees in 1992. Operations employment at station facilities would increase steadily, from 30 employees in 1989 to 900 employees in 1999 when all four units are expected to be on-line.

Table 1-1. NMGS CONSTRUCTION AND OPERATION EMPLOYMENT

			NMGS											
	Intake Pipeline and	500-kV Trans-mission	Construction					Operation					Total	Annual
Year	Reservoir	Line	Unit 1	Unit 2	Unit 3	Unit 4	Total	Unit 1	Unit 2	Unit 3	Unit 4	Total	Employment	Change
1985	—	—	85	—	—	—	85	—	—	—	—	—	85	+85
1986	—	—	800	—	—	—	800	—	—	—	—	—	800	+715
1987	115	—	1515	—	—	—	1630	—	—	—	—	—	1630	+830
1988	295	104	1180	30	—	—	1505	—	—	—	—	—	1505	-125
1989	—	—	360	450	—	—	914	30	—	—	—	30	944	-560
1990	—	—	100	940	40	—	1080	200	—	—	—	200	1280	+336
1991	—	—	—	750	570	—	1320	250	—	—	—	250	1570	+290
1992	—	—	—	270	1260	—	1530	250	24	—	—	274	1804	+234
1993	—	—	—	105	955	30	1090	250	160	—	—	410	1500	-304
1994	—	78	—	—	325	435	838	250	200	30	—	480	1318	-182
1995	—	—	—	—	90	940	1030	250	200	200	—	650	1680	+362
1996	—	—	—	—	—	775	775	250	200	250	—	700	1475	-205
1997	—	—	—	—	—	255	255	250	200	250	24	724	979	-496
1998	—	—	—	—	—	95	95	250	200	250	160	860	955	-24
1999	—	—	—	—	—	—	0	250	200	250	200	900	900	-55

Source: PNM 1980, unpublished data.

According to PNM (unpublished data, 1980), estimated construction employment skill requirements would be as follows:

Skill	Percent of Total Construction Work Force
Boilermakers	9.4
Pipefitters	14.2
Electricians	14.4
Carpenters	5.6
Ironworkers	10.0
Operators	10.0
Laborers	9.0
Teamsters	4.1
Cement masons	0.8
Millwrights	3.3
Insulators	4.0
Sheetmetal workers	1.1
Painters	1.2
Others	0.5
Supervision	12.4

The above estimates are averaged for construction of all four units.

SAN JUAN BASIN ACTION PLAN OVERVIEW AND RELATIONSHIP OF THE NMGS EIS TO ACTIONS INCLUDED IN THE PLAN

The proposed site for the NMGS is located in the San Juan Basin of northwestern New Mexico. The Bureau of Land Management (BLM) is responsible for the management of much of the land and mineral resources in this area, and currently has six separate but interrelated proposals under consideration within the basin. In order to respond to these, the BLM has developed a San Juan Basin Action Plan (SJBAP). This plan provides for the organizational arrangements whereby the environmental analyses and decision making can be implemented in a timely and efficient manner. The plan describes the process for preparation of three site-specific EISs (including the NMGS EIS) and three Environmental Assessments (EAs):

- Coal Preference Right Lease Applications (EA)
- San Juan River Regional Coal Leasing (EIS)
- Wilderness Study Areas (WSAs) (EIS)
- New Mexico Generating Station (EIS)
- Ute Mountain Land Exchange (EA)
- Bisti Coal Lease Exchange (EA)

In addition to these documents, the action plan provides for the preparation of a Cumulative Overview (CO). The CO is intended to focus on the cumulative impacts that would result from the proposed actions analyzed in the EISs and EAs listed above and therefore to facilitate public review and decision making. As a result of this organization, the impact analysis in the NMGS EIS and technical background reports concentrates on the impacts expected to result from the specific NMGS components proposed. The cumulative impacts expected to result from the proposed NMGS, in addition to the cumulative impacts of other proposals to be developed in the same time period, are described in the CO.

BASELINE CONDITIONS ASSUMED FOR THE NMGS TECHNICAL REPORT IMPACT ANALYSES

The site-specific impact analysis for this technical report was based on the affected environment and available resources that would be existing at the time of construction and operation of the NMGS facility. Since construction at the NMGS facility would not begin until 1985, certain assumptions regarding project development in the San Juan Basin were necessary. Two levels of project development were considered, along with criteria for each, in developing a status for the various non-SJBAP actions proposed for the San Juan Basin area.

- Baseline 1 - The projects considered in this level of development are those that have approval and are to be built or under construction in 1985. This level represents the projected existing environment without the proposals included in the SJBAP.
- Baseline 2 - The projects considered in this level are in some phase of the application stage. In this level, Baseline 1 projects are added to any projects in Baseline 2 along with any revision in resource production or uses (e.g., coal).

Where differences in Baselines 1 and 2 affect the results of impact analyses, discussion is provided. If no differences are identified, it should be assumed that consideration of the two different baselines did not alter the impact analyses.

A complete list of projects and comprehensive location maps for Baselines 1 and 2 are provided in Appendix C of the NMGS EIS.

ORGANIZATION OF THE REPORT

Section 2.0 of this technical report describes the assumptions and methodological approach used in the assessment of potential impacts of the Proposed Action on the affected environment. In addition, Section 2.0 contains a definition of the study area and identification of data sources.

Section 3.0, Affected Environment, contains baseline data on existing conditions in the study area, as well as projections of future conditions without the Proposed Action. Information on historical trends is presented where it is useful in providing a basis for predicting most likely future trends. The description of projected future trends takes into consideration the changes in the environment that are expected to occur as a result of the projects identified in Baseline 1. This provides a reasonable estimate of the future existing environment against which the potential impacts of the Proposed Action and alternatives can be assessed.

Section 4.0 describes the potential effects of implementing the Proposed Action and alternatives. Impacts identified are measured against indicators of significance in order to estimate the importance of the impact to the affected human environment. (Potential impacts associated with alternatives to the Proposed Action are compared in Section 9.0.)

In Section 5.0, mitigation measures are suggested. These measures would help to alleviate the potentially significant adverse impacts or enhance the beneficial impacts identified in the Section 4.0 analysis. Those potentially adverse impacts for which no appropriate mitigation measures have been suggested are discussed in Section 6.0 as "unavoidable adverse impacts."

2.0

FRAMEWORK FOR ANALYSIS

This section provides a brief description of the methodology and approaches used in conducting the air quality and noise analysis for the EIS. The issues raised in public scoping meetings are described, and discussion is included with respect to the relationship of these issues to (1) national and state ambient air quality standards and (2) federal and state air permit requirements.

Also described in this section are the techniques that were used to critically review and verify information and analyses obtained from PNM and other sources. In addition, there is a discussion of issues identified during the verification process and how the issues were resolved.

Definitions for indicators of significance of impacts are provided for air quality, visibility, and noise criteria that were used in the analysis.

2.1 RELATIONSHIP OF THE CLEAN AIR ACT TO THE ANALYSIS

Congress over the last decade has enacted several major laws in response to public concern over potential adverse effects on public health from pollutants in the environment. One of the earliest of these laws was the Clean Air Act. The Act requires the EPA to set national ambient air quality standards, which are the cornerstone of the Clean Air Act program for the control of pollution from existing stationary sources.

The ambient standards are established by the EPA through a detailed procedure stipulated in the Clean Air Act. The procedure requires an independent review to be conducted by a committee composed of at least one member of the National Academy of Sciences, one physician, and one person representing state air pollution control agencies. Their review includes assessments of epidemiological, toxicological, and plant and material damage studies. These studies are then used by the EPA as a basis for selecting standards that minimize the risk of adverse effects on public health and welfare. The EPA is thus required to set national primary air quality standards to protect against pollution levels that endanger public health, "allowing an adequate margin of safety."

In addition to the primary standards, the Act requires EPA to establish secondary standards. These standards must reflect levels of air quality that are judged necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Ambient air quality standards have been established by both the U.S. Environmental Protection Agency (EPA) and the New Mexico Environmental Improvement Division (NMEID) (Table 2-1). State standards are not to be exceeded at any time, while federal short-term standards are not to be exceeded more than once per year.

In addition to the requirement for national ambient air quality standards, the Clean Air Act also contains provisions for implementation of a program for the prevention of significant deterioration of air quality. This program arose because of a court

Table 2-1. APPLICABLE NEW MEXICO AND NATIONAL AMBIENT AIR QUALITY STANDARDS AND CLASS I AND II PREVENTION OF SIGNIFICANT DETERIORATION INCREMENTS

Pollutant	Averaging Time	New Mexico Standards[a]	National Standards[b]	PSD Increments[b]	
				Class I	Class II
Sulfur dioxide	Annual average	0.02 ppm	80 $\mu g/m^3$	2 $\mu g/m^3$	20 $\mu g/m^3$
	24 hours	0.10 ppm	365 $\mu g/m^3$	5 $\mu g/m^3$	91 $\mu g/m^3$
	3 hours	-	1300 $\mu g/m^3$	25 $\mu g/m^3$	512 $\mu g/m^3$
Suspended particulate matter	Annual geometric mean	60 $\mu g/m^3$	75 $\mu g/m^3$	5 $\mu g/m^3$	19 $\mu g/m^3$
	24 hours	150 $\mu g/m^3$	150 $\mu g/m^3$	10 $\mu g/m^3$	37 $\mu g/m^3$
Nitrogen dioxide	Annual average	0.05 ppm	100 $\mu g/m^3$	-	-
	24 hours	0.10 ppm	-	-	-
Carbon monoxide	8 hours	8.7 ppm	10 mg/m^3	-	-
	1 hour	13.1 ppm	40 mg/m^3	-	-

[a] Except for particulate matter, the New Mexico standards are defined in units of volume (parts per million, or ppm).

[b] Federal Standards and PSD increments are defined in units of micrograms per cubic meter ($\mu g/m^3$).

suit in which the Sierra Club sued the U.S. EPA (Sierra Club et al. versus Ruckelshaus (344 F. Supp. 253 D.D.C.)). The court found that the Act requires the EPA to establish an air quality program that aims at not only improving air quality in places where the air is relatively "dirty" (judged against the national ambient air quality standards), but also in preventing serious degradation of air quality where the air is relatively clean. As a result of the suit, the EPA promulgated its Prevention of Significant Deterioration (PSD) regulations.

While the national ambient air quality standards are uniform minimum national standards for air quality, the PSD regulations provide for additional protection in areas where existing air quality is better than the minimum standards require. In short, the aim of the PSD regulations is to keep "clean air clean." It does this by placing cumulative increment limits for SO_2 and total suspended particulate matter above a baseline concentration. These limits apply to new or modified sources of air pollution. (These sources are required to obtain permits under the PSD regulations.) As new sources of air pollution propose to locate within a certain area, each source "consumes" portions of the increment. Each company applying for a permit under the PSD regulations must demonstrate 1) that their source will not cause a violation of any national ambient standard, and 2) that this source in combination with other "increment-consuming" sources will not exceed the increment limit at any point.

Increment limits vary, depending on the classification of the areas involved. The regulations establish three "classes" of clean air areas. Each class has been assigned numerical increments for total suspended particulate (TSP) and SO_2 concentrations. Class I increments permit only minor air quality deteriorations and Class II increments permit a moderate amount of deterioration. There are currently no areas in the U.S. designated Class III. Table 2-1 presents the Class I and II increment limits.

Areas in the United States are designated Class I depending on (1) their classification as wilderness area, national or international park, or national memorial park; and (2) the acreage of each such area. In response to concerns raised at public scoping meetings, Class I areas that are examined in this analysis are the San Pedro Parks Wilderness Area and Mesa Verde National Park.

The relationship of the PSD permit process to this EIS is discussed in further detail below.

2.2 RELATIONSHIP OF ANALYSES TO STATE AND FEDERAL AIR PERMITS

The granting of state and EPA permits is predicated, in part, upon the demonstration that a new project, in combination with existing sources of air pollution, will not violate the applicable state and federal ambient air quality standards. The intent of the analyses for the EIS was to provide an assessment of the effect of the proposed project on human health and general welfare and degradation of air quality. This evaluation was made by comparing results with the ambient standards.

The analyses were not designed to determine whether EPA's or NMEID's permit requirements have been fulfilled. That analysis is specific to the requirements of PSD review.

Since compliance with PSD regulations must be made in order for the project to be permitted and built, it is evident that at some future date, in response to a permit application which has not yet been filed, a demonstration of compliance will be made. If such demonstration cannot be made, EPA has the right to deny the permit regardless of whether BLM has granted rights-of-way for the project. The PSD increment limits for Class I and II areas are included in Table 2-1. However, a PSD increment analysis was not performed for this study. The increment limits are presented in this report as a benchmark only, with which to compare the concentration increases due to NMGS in both Class I and Class II areas.

Under PNM's current schedule, a PSD permit application would be submitted in October 1983. This date may change, however, if other components in the project schedule are altered.

2.3 ISSUES RAISED IN SCOPING MEETINGS THAT ARE ADDRESSED IN THE EIS

The air quality and noise analyses were conducted to address the issues raised during public scoping meetings. The analyses addressed the following concerns:

- People and population centers
- Overall effect of the project on air quality
- Fugitive dust impacts
- Visibility
- Acid rain
- Compliance with all applicable federal and state regulations
- Weather modification
- Radionuclides

The remainder of this section describes, in part, the relationships of the above issues to the types of analyses that were conducted.

2.4 GEOGRAPHIC AREA OF INFLUENCE

Direct Impacts

Air Quality. The geographic area of influence is defined for this analysis as a circle with the radius equal to the distance from the source beyond which the calculated concentration increase for each pollutant and averaging time is below a predetermined value. These predetermined values are defined in EPA's Interpretative Ruling (40 CFR 51.18, Appendix S) and are presented below:

Pollutant	Averaging Time Annual	24 hours	8 hours	3 hours	1 hour
SO_2 ($\mu g/m^3$)	1.0	5.0	--	25.0	--
TSP ($\mu g/m^3$)	1.0	5.0	--	--	--
NO_2 ($\mu g/m^3$)	1.0	--	--	--	--
CO ($\mu g/m^3$)	--	--	500	--	2000

Based on the concentration increases of the pollutants that would be emitted by NMGS, the geographic area of influence extends as far as approximately 47 miles in the southwest and westerly directions. In the other directions, concentration increases due to NMGS fall below the EPA-specified levels within 30 to 38 miles. In addition, since there is a specific interest in the San Juan River valley, concentration estimates have been made in that area. It was found that concentration increases due to NMGS in the San Juan River valley (including the Farmington area) have been predicted to be below these EPA-specified levels.

The calculated geographic area of influence does not necessarily suggest a severe or adverse impact to the area. This area represents the region where NMGS's emissions may contribute to ambient ground-level concentrations.

In addition to the above area, Mesa Verde National Park and the San Pedro Parks Wilderness Area (both designated Class I) have been examined as areas of special interest brought up in public scoping meetings.

Public scoping meetings also indicated a concern regarding the effect of NMGS on Taos. The analysis showed concentration measures of pollutants to be below the above-mentioned EPA-specified levels at receptors in the San Pedro Parks Wilderness Area. Concentration increases at locations further beyond this area would be much lower. For this reason, concentration increases at Taos were not included in this study.

Noise. Noise impact analyses are generally conducted to assess the possible effects on residential and community areas. The proposed NMGS would be located in an isolated area, and the majority of people exposed to noise from the plant would be employees. Of particular interest with respect to this project is the effect of noise on the Wilderness Study Areas (WSAs) and Chaco Culture National Historical Park, since they are areas of special interest with respect to other concerns identified in public scoping meetings. As such, the geographic area of influence with respect to noise includes the Bisti, De-na-zin, and Ah-shi-sle-pah WSAs, and the Chaco Culture National Historical Park.

Indirect Impacts

Indirect impacts associated with air quality are mainly associated with the concern for acid rain. The geographic area of influence for indirect impacts includes the San Juan Basin, as well as high mountain lake areas of Colorado and northern New Mexico. This represents the area immediately surrounding NMGS. The high mountain lakes are the closest sensitive receptors to acid precipitation (based on bedrock geology) to NMGS.

2.5 INDICATORS OF IMPACT SIGNIFICANCE

Air Quality

As discussed above, concentration increases due to NMGS are added to the appropriate background concentration level to predict total ambient concentrations. These predicted levels are then compared with the applicable state and federal ambient air quality standards. The standards provide levels that are considered by the U.S. EPA to represent concentrations below which human health and general welfare are not endangered. As such, they are used in this analysis as indicators of impact significance. If the concentration increase due to NMGS, added to the background concentration, would result in a total concentration that exceeds an applicable standard, this would provide an indication of a significant impact.

Currently there are no quantitative cause-effect relationships between pollutant emissions and the measured acidity of precipitation. Because theories regarding the phenomenon of acid precipitation and long-range transport are largely speculative, there is no indicator that can presently be used for significant effects. This discussion of acid precipitation impacts is limited to potential effects based on current research.

Visibility

At this time, there are no visibility standards with which to compare the impacts due to NMGS. However, EPA's visibility regulations (published in the December 2, 1980, Federal Register) provide guidelines for the characterization of visibility "impairments" and the criteria by which they are judged. In these regulations, visibility impairment is defined as "any humanly perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions." For this EIS, visibility impairment was assessed by considering the intensity, frequency, and time of occurrence of predicted visibility impacts.

Analytical techniques for accurate and more broad-based visibility modeling are currently in the developmental stage; consequently, the current regulations provide only general guidelines for the assessment of visibility. Because visibility models currently assess only specific plume impacts and since impacts are perceived as discoloration, the intensity of impairments was based on the coloration of the plume (termed ΔE values) from NMGS. Pictures providing an indication of the plume coloration are included in the visibility modeling report prepared by Systems Applications, Inc. (1981) for PNM.

The Workbook for Estimating Visibility Impairment (EPA 1980a) states that if a ΔE level is greater than 4, then the possibility that the visual impact would be judged adverse or significant cannot be ruled out. Thus, levels of ΔE that are greater than 4 are considered to be an indicator of significant impact. Such levels are tabluated with respect to frequency and time of occurrence. Following the example of the Workbook, ΔE levels of 5 and 10 are also tabulated. A ΔE level of 5 represents a plume that is slightly more perceptible than one with an associated ΔE level of 4. A ΔE level of 10 is judged to represent a highly perceptible plume.

The EPA regulations state that assessments of significant or adverse visibility impacts should be based on the anticipated frequency of occurrence of an impairment. Also considered in this evaluation are the time that such impairments are expected to occur.

Frequency of occurrence and the time of such occurrence were assessed using the number of mornings and number of afternoons within a year of projected visibility impairments. These frequency tabulations were broken down by season. The frequency of occurrence of impacts was estimated in the analysis on the basis of a 3-year period of meteorological data collected at the proposed project site. The model used for assessing visibility impacts was the PLUVUE model. This model has been evaluated using field measurements collected from the EPA-sponsored VISTTA program, and has been found to overestimate the visual effect of the plume (Bergstrom et al. 1981). The model is therefore considered conservative; model results have been interpreted with care.

Noise

Noise impacts were evaluated with respect to health, activity interference, and perceptivity effects. Health impacts are assessed with regard to the effect of noise upon human hearing. Activity interference is assessed with respect to impairment to conversation. The EPA recommends an outdoor noise level of 55 dB(A) or less as requisite to protect human hearing and to prevent impairment to conversation (EPA 1974). This level was used as a guideline with which to compare total noise levels resulting from the operation of NMGS.

In assessing the perceptual impacts of noise, the effect of the noise sources depends on the characteristics of the aggregate noise impinging on various locations, as well as on the personal characteristics and the activities of the individuals hearing the noise at those locations. The proposed NMGS would be located in an isolated area, and the majority of people exposed to noise from the plant would be employees. However, for purposes of the analysis, receptors were also assumed to be located in the Wilderness Study Areas. WCC's recreation and wilderness values specialists advised that these areas should be included, since the perceptual impacts of noise in these areas are considered by them to be an important aspect of the analysis.

Perceptivity effects are related to how noise levels are likely to be judged (loud, soft, no difference) by the perceiver. Observations that have been made reveal that a change in noise levels (i.e., an increase) of about 9 dB(A) represents a doubling of perceived loudness, or the "noisiness" of a sound (Stevens 1972). Because of the isolated nature of the Wilderness Study Areas and the low baseline noise levels there, it was assumed that a noise increase above 9 dB(A) would be considered an indicator of significance. These assumptions were based on consultation with recreation and wilderness values specialists.

Radionuclides

The concentration increase of radionuclides due to NMGS was compared with ambient standards in unrestricted areas around those sources that are legally obligated to register with the Radiation Protection Bureau of the NMEID (i.e., uranium mills). Although NMGS is not required to register, these standards establish levels for protection against radiation hazards. As such, they are used in this analysis as indicators of impact significance. Thus if levels due to NMGS were shown to exceed these standards, it would be considered a significant impact.

2.6 METHODS FOR DATA COLLECTION

Verification Methods for Meteorology and Air Quality Monitoring

WCC has reviewed PNM's meteorology and air quality monitoring program for the proposed NMGS site. This review involved an assessment of the type of equipment and quality assurance procedures. WCC was also provided information by PNM relating to quality assurance audits and procedures for the NMGS monitoring station, including the following documents:

- Meteorological Audits (Enviroplan, May 1981; Rockwell International, December 1980)

- Air Chemistry Audit (Rockwell International, September 1980, December 1980, April 1981, July 1981)

The methods used for collection and reduction of meteorological data were reviewed. An evaluation of such methods was made with respect to the following three items:

- Adequate representation of the project area
- Acceptable data collection methods
- Potential for biasing subsequent modeling analyses through the use of such data

Verification Methods for Air Quality Modeling

The modeling analyses conducted for PNM by its contractor, ERT, were assessed with respect to the rationale for model selection and the appropriateness of such models for the project area. Resulting predictions of concentration increases were examined in light of emissions data and area topography to verify that the results were reasonable. The emissions and meteorological data were also examined.

During the review of the modeling results, WCC requested the computer outputs for some of the modeling runs performed by ERT. Additional documentation on ERT's RTDM model was also reviewed to evaluate its appropriateness.

Identification of Issues Resulting from Verification and How Issues Were Resolved

Meteorological Issues.

Substitution of Alternate Level Meteorologies for Those Levels Deemed Invalid. In some instances, meteorological data collected at some levels of the three-level tower are invalid. (The meteorological tower is described in more detail in Section 3.0.) In these cases, meteorological data collected at alternate levels have been substituted after using the wind shear power law to adjust for different locations in the wind profile. When no data were available, "dummy" data (usually represented as "999") are substituted for the missing information.

Adjustment of wind data to different levels by use of the power law is a common method and is used in some EPA-approved models. All substituted and "dummy" data have been flagged for identification. The "dummy" meteorological data were not used in any modeling scenarios.

Use of Farmington Ceiling Height and Cloud Cover for Calculating Stability. The extrapolation of Farmington cloud cover data to the site is appropriate, since these data are currently the best available. A one-to-one relationship was assessed only for the annual frequency distribution. Hourly stabilities were based on the 60-meter sigma-phi values.

Use of Instantaneous Values for Representation of Hourly Average Conditions. Wind data measurements have been recorded at the project site every 15 minutes. Each 15-minute averaging interval is represented by at least two instantaneous readings at 5-minute intervals. Only one 15-minute average is required by ERT to create 1 hour of wind data. This means that two 5-minute instantaneous values may represent 1 hour. Instantaneous measurements made in such a manner are as representative of hourly average conditions as the National Weather Service (NWS) observations. The NWS observations consist of 1-minute values each hour. Since NWS observations are acceptable to the EPA for use in modeling, the instantaneous measurements made at the project site are judged by WCC to be adequate for subsequent modeling for the EIS.

Conformance with EPA's PSD Monitoring Requirements. The meteorology data collection methods have not necessarily been conducted according to PSD guidelines. However, these methods are acceptable for the EIS work. They adequately represent the project region and do not present problems in subsequent modeling analyses that used these data.

Air Quality Monitoring Issues. No significant issues were identified with respect to the air quality monitoring program conducted by PNM at the project site. The audit results for the air quality monitoring system were judged to be satisfactory. All audits fell within 19 percent difference, well within EPA quality assurance guidelines.

Air Quality Modeling. Concentration increases due to NMGS were predicted by using Gaussian dispersion models. These modeling analyses were performed by PNM's contractor, ERT. The EPA MPTER model was used to predict concentration increases due to NMGS in all low-terrain areas within 32 miles (50 km) of the plant site. The combined impacts of NMGS with the emissions from the Four Corners, San Juan, and Prewitt-Escalante power plants were predicted using both the EPA COMPLEX I model as a screening tool and more refined modeling using the RTDM model developed by ERT. These models were also used to predict concentrations in high terrain areas. A description of these models is included in Appendix E. The modeling approach is described in further detail in Section 4.5.

Use of Models That Are Not Approved by EPA. Neither the EPA COMPLEX I nor the RDTM models have received official approval for use in rough terrain. The view of EPA with respect to these models is that their use in permit application procedures would require review on a case-by-case basis. The National Park Service has reviewed the modeling conducted by ERT for this project. A January 6, 1982, memorandum from the NPS acknowledges that no model has received recommended status by EPA for use in rough terrain, and states further that "the models and meteorological data are considered appropriate for this analysis, although the models have not yet received official status by EPA in [its] modeling guidance."

Background Concentration and Combined Impacts with Respect to ERT's Modeling Analysis. As mentioned above, the MPTER model was used to predict concentration increases due to NMGS in all low-terrain areas within 30 miles (50 km) of the plant site. The maximum concentration increase due to NMGS was predicted to occur within 12 miles (20 km) of the plant site. The description and results of this modeling are included in the report entitled "EIS Impact Areas and Low Terrain Modeling of the Proposed New Mexico Generating Station" (ERT 1981). This report discusses the air quality impacts of NMGS alone; it does not address background concentrations. The concentration increases due to NMGS are compared with the national and state ambient air quality standards. However, these standards are used only as a "benchmark" in assessing the NMGS air quality impacts in ERT's report. In order to address the concerns raised in public scoping, it is necessary to predict the total concentrations, consisting of NMGS's concentration increases added to the concentrations associated with Baselines 1 and 2.

Since most of the SO_2 and NO_x emissions in the San Juan Basin come from the Four Corners and San Juan power plants, the results of a combined modeling analysis of these two sources with NMGS are appropriate to use as a first step in assessing future concentrations. Concentrations due to the combined impacts of NMGS and the San Juan, Four Corners, and Prewitt-Escalante power plants were also modeled by ERT, and the results published in a report entitled "EIS Combined Impacts Modeling of the Proposed New Mexico Generating Station" (ERT 1982a).

The above-referenced report discusses only the maximum concentrations due to the combination of the above sources. Thus the maximum concentrations reported in the document were representative of those locations in which the Four Corners and San Juan plants contributed the majority of the concentration values, with NMGS contributing zero, or negligible levels. Although such values were the highest predicted at any receptor, the report does not discuss the combined concentrations in the area in which NMGS alone would have the greatest concentration (i.e., within 12 miles or 20 km of the project site).

Additional data were obtained by examining the MPTER and COMPLEX I computer runs for both the modeling of NMGS alone and the combined modeling effort. The COMPLEX I results for the combined modeling were used as a first step in assessing the maximum concentration that would occur in the area of NMGS's expected maximum impact, inclusive of the other emission sources. These results could not be used by themselves, however, in representing future concentration values, since it cannot be assumed that without these sources, concentrations of SO_2 and NO_2 would be zero.

The second step in the assessment of future concentrations in these areas was to perform an evaluation of the background concentrations that represent what is termed "non-power plant" baseline. This is discussed further in Section 2.7 and 3.6. Essentially, the highest concentrations in the project area that have been measured and that cannot be attributed to either the Four Corners or San Juan power plant were selected as "non-power plant" baseline values. These concentrations were then "scaled up" to represent future levels, as is discussed in Section 2.7. The combined modeling results of COMPLEX I in the area of NMGS's area of expected maximum impact were then added to the future "non-power plant" baseline.

2.7 ISSUES RELATED TO DATA PRESENTATION

Characterization of Present and Future Background Air Quality Concentrations

Existing Concentrations. Background concentrations in the project area of influence were derived from monitor stations operated by NMEID in the San Juan River valley, the Joint Ambient Air Monitoring program (JAAM) operated by PNM and APS, and PNM's 602A monitoring program (see Figure 3-1). These programs are described in further detail in Section 3.

Future Concentrations.

NMGS Area of Expected Maximum Impact. Predictions of total maximum concentrations expected at the time that NMGS comes on line require an estimation of the future background concentration. As described in Section 2.6 above, the future concentration in NMGS's area of expected maximum impact was derived by modeling the emissions of the Four Corners, San Juan, and Prewitt-Escalante power plants, in combination with NMGS. The modeling used the maximum emission rates that would be allowed by law at the time that NMGS comes on line, and has taken into account the additional units to be added to Four Corners and San Juan. Prewitt-Escalante is currently in the process of construction and is anticipated to be operational when NMGS comes on-line. As such, modeling the concentrations from these three sources, without NMGS, is a first step in providing an estimation of future maximum concentrations in the project area.

As discussed in Section 2.8, an examination of Baselines 1 and 2 revealed that the above three sources would continue to be the largest air pollutant emission sources in the San Juan Basin. Other sources, due to the magnitude of their emissions and distance from the project, were judged not to contribute significantly to baseline values. As such, the following approach was followed in approximating future concentrations:

- The computer output of COMPLEX I modeling of Four Corners, San Juan, NMGS, and Prewitt-Escalante was examined to derive the highest combined concentration in the area of NMGS's expected maximum impact, as described in Section 2.7.

- The individual concentrations from Four Corners, San Juan, and Prewitt-Escalante at the point identified above were summed to determine the future concentration from these sources without NMGS. The individual concentrations from these sources were also obtained from COMPLEX I modeling.

- Background concentrations of SO_2 and NO_2 that were monitored at the NMGS plant site were examined. The highest concentrations of SO_2 and NO_2 measured at this station that could not be attributed to the emissions from Four Corners and San Juan were identified. This was done by examining the meteorology associated with each concentration that was measured. If the wind directions preceding the measured concentration originated from the area of these power plants, it was assumed that the concentration could be attributed to these sources. The highest concentrations identified in this manner are termed "non-power plant" baseline and are discussed in further detail in Section 4.4.

- The non-power plant baseline values identified in the manner described above were then adjusted to represent the future non-power plant values that could be expected in that area. This was done by "scaling up" the non-power plant values by multiplying such concentrations by the ratio of future emissions to present emissions in the San Juan Basin for the pollutants SO_2 and NO_2. Future emission rates for Baselines 1 and 2 (see Section 2.8) were obtained and compared with the present emission rates in the San Juan Basin to the extent available and verifiable.

- The concentrations from Four Corners, San Juan, and Prewitt-Escalante, derived in the manner described above, were then added to the non-power plant baseline. The total is representative of the future concentration in the area of NMGS's expected maximum impact, without the proposed project.

In the above approach, it should be noted that particulate matter concentrations were not scaled up, since it is recognized that the majority of such emissions in the project area are due to natural windblown dust.

San Juan River Valley. An examination of the computer modeling output has revealed that concentration increases due to NMGS in the San Juan River valley area are below the EPA-specified levels that were used to define the geographic area of influence. As such, the San Juan River valley is not considered part of the geographic area of influence. However, since the EIS must address the future baseline without NMGS, and public scoping has indicated that there is interest in population centers, it is necessary to address the future air quality in the Farmington area, which is part of the San Juan River valley.

Future concentrations in the Farmington area were derived by averaging the maximum concentrations recorded at monitors in the San Juan River valley, and scaling up the averaged concentrations by the ratio of future to present emissions in the San Juan Basin. The averaged concentrations were scaled up rather than using single maximum values recorded at any one monitor, since that monitor may have reflected emissions from only one particular source of air pollution. As such, that monitor would be representative of a rare or isolated occurrence rather than representative of the entire San Juan Basin, and therefore would not be amenable to scale up with area-wide emissions.

Approach Used in Scaling Up Concentration Levels

Use of Actual Emission Data Versus Allowable Emission Data. The scale-up of existing concentrations to future levels was accomplished by multiplying present levels by the ratio of future SO_2 or NO_2 emissions to existing emissions in the San Juan Basin. Existing emission levels were derived from PNM as well as the NMEID. Information supplied to WCC by PNM was checked by contacting appropriate personnel at NMEID. In order to obtain an accurate inventory of present emission levels, actual emission rates were used as much as possible to the extent that they were available and to the extent verifiable. In the instances when actual emission data were not verifiable, the maximum emission rate allowed by a permit condition, or by emission regulation, was used. This rate is termed the "allowable" emission rate.

For future emissions, worst-case assumptions dictated the use of the highest allowable rates that would be permitted.

Use of Annual Average Emission Rates Versus Short-Term Emission Rates. The largest sources of emissions (Four Corners and San Juan power plants) are regulated by an emission limitation that specifies an hourly maximum emission rate and a 30-day rolling average. The 30-day rolling average is used in calculating annual average emission rates.

Because of the distance of these sources from the project site, and the other isolated areas discussed above, the use of annual average emission rates is judged to be appropriate in calculating the future to present emission ratios for the San Juan Basin. As discussed previously, these ratios are used to scale-up existing non-power plant concentrations.

In calculating the future concentrations resulting from these sources themselves (in combination with NMGS), the short-term maximum emission rates have been used in all modeling analyses.

In the San Juan River valley, the annual average emission rates from these sources are used to calculate the ratios for scale-up. This is considered appropriate, since an estimation of future concentrations is based on a scale-up of averaged maximum concentrations measured by the monitors in this region. Using the maximum short-term emission rates would assume that these sources were operating at such capacity when the various maximum concentrations were measured. Such an assumption cannot be made.

2.8 INTERRELATIONSHIPS WITH BASELINES 1 AND 2

Projects which have been considered in the various levels of baseline regional impact are those presently in existence, those with approval for construction, and those under construction. These projects represent those classified under BLM's Baseline 1. Because of the large degree of uncertainty associated with prediction of the future existing environment, it is at best possible only to obtain estimates of future pollutant emissions assuming the maximum degree of development. Future emission estimates were obtained from PNM and NMEID. Baseline 2 emissions were judged to be the same as those in Baseline 1, with the exception of non-air quality developments such as irrigation projects. Projects that are principally sources of fugitive dust emissions were not included since (1) the impact was not judged to be regional because of the nature of these emissions, and (2) the projects were judged unlikely to interact with the emissions from NMGS. This is discussed further in Section 3.0.

2.9 DESCRIPTION OF MATHEMATIC TECHNIQUES AND DEFINITION OF TERMS USED IN THE ANALYSIS

Conversion of Concentration Values

Gaseous pollutant concentrations may be expressed in terms of micrograms per cubic meter ($\mu g/m^3$) or as a volume--parts per million (ppm) or parts per billion (ppb). Ambient air monitors generally report concentrations in ppb. The national ambient air quality standards are expressed in both $\mu g/m^3$ and ppm. The New Mexico ambient air quality standards are expressed in ppm; the federal standards, in $\mu g/m^3$. Modeled concentrations are computed in $\mu g/m^3$.

The following equation permits the conversion of concentration units between $\mu g/m^3$ and ppm and was used in converting modeled concentrations:

$$\text{ppm} = \frac{\mu g}{m^3} \cdot \frac{0.02447}{M} \left(\frac{P_o}{P}\right)\left(\frac{T}{T_o}\right)$$

where M is the molecular weight of the pollutant and the quantity in brackets is a correction factor which is identically 1 at the standard conditions of $P_o = 760$ mm mercury and $T_o = 298.15$ K (25°C). In all calculations that convert model values to ppm, P is assumed to be 633 mm pressure and T is assumed to be 25°C.

Comparison of monitored values (measured in ppm) with federal standards (expressed in $\mu g/m^3$), was accomplished by converting the concentration units of ppm to $\mu g/m^3$ using the following equation:

$$\frac{\mu g}{m^3} = (\text{ppm})\ 40.87\ M \left(\frac{P}{P_o}\right)\left(\frac{T_o}{T}\right)$$

where M, P_o, and T_o are defined as above. Federal regulations define monitored concentrations in terms of "reference conditions":

$T = 25°C$, and $P = 760$ mm mercury.

Thus, the above equation, when used for converting monitored values to reference conditions, becomes

$$\frac{\mu g}{m^3} = (\text{ppm})\ 40.87\ M$$

Calculations of all converted concentration values are shown in Appendix A.

<u>Definition and Use of the Term "Decibel"</u>

The unit of noise measurement most commonly used is the decibel (dB). It provides a means of converting the power associated with sound to a common scale. Sound is created by the vibration of molecules in the transmitting medium. In most cases the medium is air. The amount of power that causes such vibrations can be expressed in watts; it is termed "acoustic power."

The threshold of hearing is defined as the lowest acoustic power level that can be humanly detected without external aid. The acoustic power level associated with the threshold of hearing has been determined by experimentation to be about 10^{-12} watt. This level is used as the reference value in the defining equation of the decibel (N_{dB}) given below:

$$N_{dB} = 10 \log \frac{W_1}{W_2} \qquad (1)$$

where W_2 is the reference level of 10^{-12} watt and W_1 is the acoustic power level associated with the sound source in question.

A source that emits a sound at the threshold of hearing would equate to zero decibels, as shown below:

$$N_{dB} = 10 \log \frac{10^{-12}}{10^{-12}} = 10 \log 1 = 10 \times 0 = 0 \qquad (2)$$

Frequently, in analyses of noise impacts it is necessary to address the combined effect of different sources of noise. Since the noise levels are expressed in decibels (which as shown above are logarithmic functions of sound level or acoustic power), it is not possible to add the numbers directly. For example, if there are two sources of noise that each produce a level of 50 dB at a certain distance, the combined noise level at that distance is not 100 dB. The procedure for adding these levels is essentially to convert decibels to power equivalents, add these numbers directly to obtain a sum, and convert this sum back to the corresponding decibel level via equation 1 above.

The method for adding the 50-dB levels is shown below:

- By manipulating equation 1, the power equivalent of N_{dB} is obtained:

$$\frac{W}{10^{-12}} = 10^{(N_{dB}/10)} \qquad (3)$$

- Substituting 50 for the term "N_{dB}," the power equivalent of 50 dB is obtained:

$$\frac{W}{10^{-12}} = 10^{(50_{dB}/10)} = 10^{5} \qquad (4)$$

- The power equivalents of 50 dB are then summed:

$$\frac{W}{10^{-12}} + \frac{W}{10^{-12}} = 10^5 + 10^5 = 2 \times 10^5 \qquad (5)$$

- The sum of the values obtained from equation 5 is then substituted for the term "W_1/W_2" in equation 1 to obtain the equivalent decibel level:

$$N_{dB} = 10 \log (2 \times 10^5) = 53.01 \text{ dB} \qquad (6)$$

Thus the combination of two sources each producing 50 dB at an equal distance from the receptor results in a total noise level of 53 dB. This represents a change of 3 dB.

Definition and Use of the Term "pH"

The acidity of a solution such as rainwater is determined by its hydrogen ion concentration. Acidity is commonly denoted using the pH (power of hydrogen) scale, which is the negative logarithm of the hydrogen ion concentration expressed in terms of molarity, where

$$pH = -\log M_{H}+$$

and

$M_{H}+$ = molarity of the H+ ions in solution or the concentration in gram-equivalents per liter. A 1-molar concentration of H+ ion is equal to 1 gram of H+ per liter of solution.

A solution containing 1 x 10^{-1} grams of H+ per liter would have a pH of 1, while a solution containing 1 x 10^{-4} grams of H+ would have a pH of 4.

Since the pH scale is logarithmic, each whole number change represents a tenfold change in acidity. For example, a solution having a pH of 3 has 10 times as many hydrogen ions as a solution having a pH of 4 and 10,000 as many hydrogen ions as a solution having a pH of 7.

Water dissociates slightly to produce a small concentration of H+ ions. At 25°C one molecule of H_2O per billion is dissociated, producing a H+ ion concentration of 1 x 10^{-7} gram per liter, or a pH of 7.

An aqueous solution having a pH of 7 is neutral. Levels of pH that are greater than 7 represent increasing alkalinity. Levels of pH that are lower than 7 represent increasing acidity.

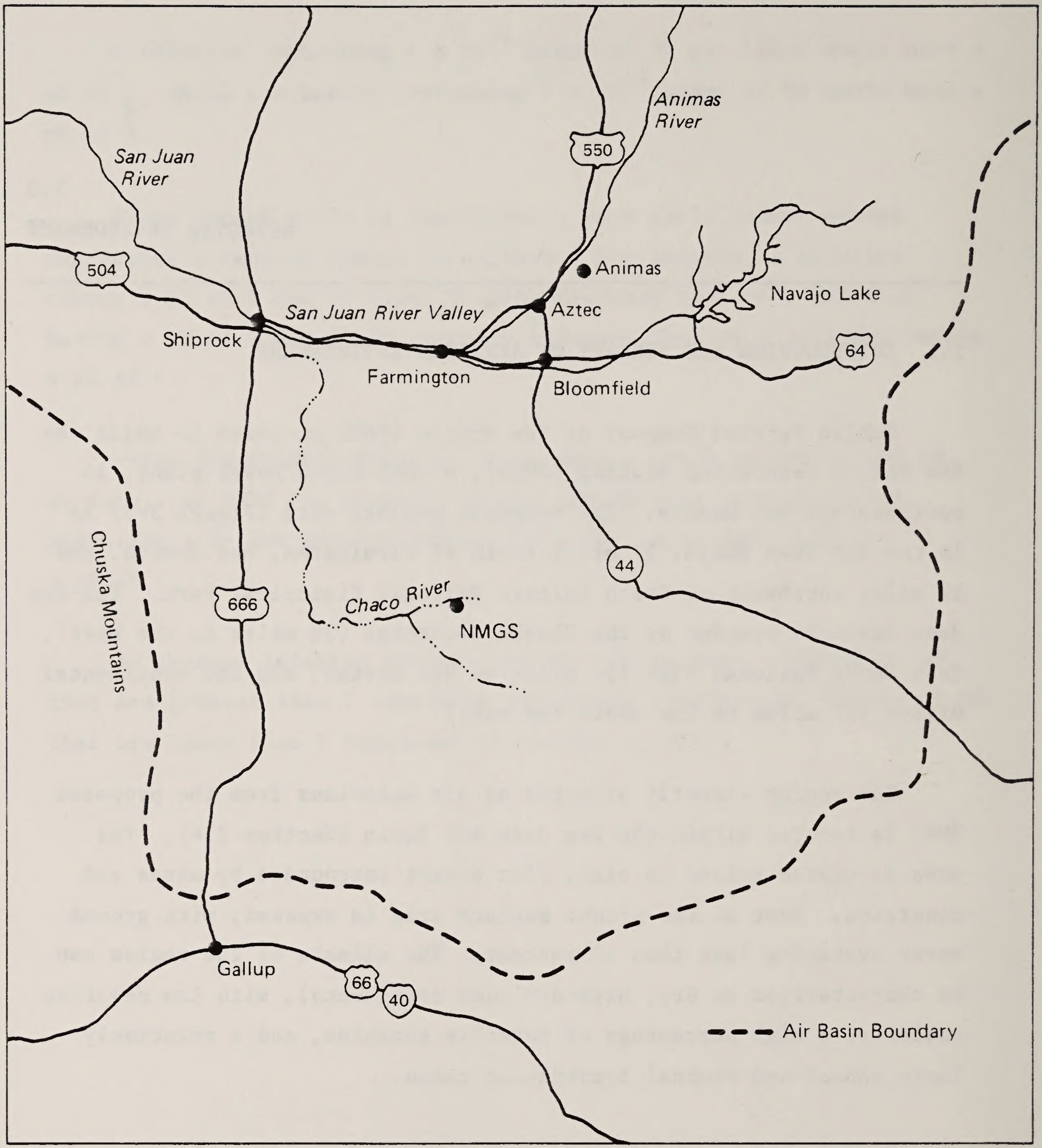
3.0
AFFECTED ENVIRONMENT

3.1 INTRODUCTION AND SUMMARY OF AFFECTED ENVIRONMENT

Public Service Company of New Mexico (PNM) proposes to build the New Mexico Generating Station (NMGS), a coal-fired power plant, in northwestern New Mexico. The proposed project site (Figure 3-1) is in the San Juan Basin, 37 miles south of Farmington, New Mexico, and 12 miles northwest of Chaco Culture National Historical Park. The San Juan Basin is bounded by the Chuska Mountains (30 miles to the west), Mesa Verde National Park (56 miles to the north), and the continental divide (37 miles to the south and east).

The region directly affected by air emissions from the proposed NMGS is located within the San Juan Air Basin (Section 2.4). The area is characterized as high, flat desert surrounded by mesas and mountains. Most of the ground surface area is exposed, with ground cover averaging less than 10 percent. The climate of the region can be characterized as dry, high-altitude continental, with low relative humidity, a high percentage of possible sunshine, and a relatively large annual and diurnal temperature range.

Emissions from the Four Corners and San Juan power plants contribute over 97 percent of the sulfur dioxide (SO_2) and 80 percent of the nitrogen oxides (NO_x) released by all sources in the San Juan



Source: BLM 1982.

Figure 3-1. SAN JUAN AIR BASIN

Basin. Area sources such as windblown dust contribute over 92 percent of the total suspended particulate (TSP) in the basin. Natural gas refineries and vehicles are also major contributors of NO_x. Vehicle exhaust is the major contributor of carbon monoxide and hydrocarbons.

Air monitoring conducted at the project site indicates that for SO_2 and nitrogen dioxide (NO_2), most concentrations recorded were at or below the threshold of detection of the monitoring instruments, and all levels were below the applicable New Mexico and federal ambient air quality standards. Total suspended particulate (TSP) matter concentrations monitored at the site were generally low and below the New Mexico and federal standards, although on approximately 4 percent of the days the state and national 24-hour standard of 150 μg/m was exceeded. There is no industrial development in the vicinity of the project site, and the land is semiarid. In light of this and the fact that the high TSP levels are most common during May, June, and July when dust storms are the most prevalent, these high particulate values were probably caused by windblown dust.

This rationale was accepted by the EPA in issuing its designation of "attainment" (i.e., in compliance with all applicable national ambient air quality standards) for TSP for the entire Four Corners Interstate Air Quality Control Region (AQCR). With the exception of SO_2, the Four Corners Interstate AQCR has been designated "attainment" for all criteria air pollutants. A small area outside Farmington and the northern portion of San Juan County have been designated "nonattainment" for SO_2, with the major contributing sources being coal-fired power plants. Because of the future requirement for increased pollution control for these plants, it is anticipated that the area will be designated "attainment" for SO_2 by the time NMGS would come on-line.

Concentrations of NO_2 in the San Juan River valley have been measured at levels below the state and federal annual standards. The 24-hour state NO_2 standard was exceeded at only one monitor location.

Noise

The proposed plant site is in a remote location in which the only major source of noise is vehicles traveling on roads. For the purposes of impact analysis, the Bisti, De-na-zin, and Ah-shi-sle-pah Wilderness Study Areas have been identified as potential sensitive receptors. Noise monitoring conducted at the first two sites indicates baseline levels of about 32 dB(A) at Bisti and 35 dB(A) at De-na-zin. These levels are typical of isolated areas.

Visibility

Visually significant points of interest in the project region include the Bisti, De-na-zin, and Ah-shi-sle-pah Wilderness Study Areas, Chaco Culture National Historical Park, Shiprock, and Mesa Verde. Other visual points of interest are the Chuska Mountains and the San Pedro Parks Wilderness Area. The National Park Service has conducted visibility monitoring for Mesa Verde National Park, Chaco Culture National Historical Park, and Bandolier National Monument. The annual average visual range in these areas is 80 miles (NCAQ 1981). However, data from Chaco Culture National Historical Park indicates geometric mean standard visual ranges from 108 to 141 miles.

Topography

Elevation of the project site is approximately 5900 feet above mean sea level. The terrain is high, flat desert surrounded by mesas and mountains. Rainfall has caused massive erosion resulting in both flat sandy washes and steep-walled gullies. Badlands in the area occasionally have steep slopes, but they are not generally high.

Topographic relief is not sharp, with only rock outcroppings providing a variance in topography. Existing grade conditions range from 2 to 10 percent, with the proposed power block area at 4 percent.

Most of the ground surface area is exposed, with ground cover averaging less than 10 percent. Soils are sandy, moderately deep to shallow on elevated mesas, and composed of loams and clay loams on drainageways. Soils on level areas tend to be moderately to strongly alkaline.

3.2 CLIMATE

The proposed site is located within the San Juan airshed (Figure 3-1). This major airshed has the continental divide as the upwind boundary, with drainage occurring toward the northwest along the San Juan River past Shiprock. Weak pressure gradients across the area allow local topographic influences to control wind flow. Nonsynoptic, downslope-upslope motion occurs more than 70 percent of all days (Crow 1973) in some areas of the basin, and synoptic-scale meteorological influences are relatively weak.

Climate in the airshed is strongly affected by local topography and thus has a large range of temperature, precipitation, and wind speed and direction. Mean average annual temperatures range from 43.8°F at Dulce, approximately 90 miles (145 km) north-northeast of the proposed site, to 50.5°F at Chaco Culture National Historical Park, 12 miles southwest of the proposed site. Annual average precipitation ranges from 17 inches at Dulce to less than 8 inches at Chaco Culture National Historical Park. Because of the strong topographic influences in the airshed, in addition to the associated mountain valley breezes, wind roses should be considered representative only of their immediate area (U.S. Dept. of Interior 1978a).

Representative meteorological data for the project site are available primarily from the PNM monitoring station at the proposed NMGS plant site and the U.S. National Park Service station at Chaco Culture National Historical Park. A 60-meter meteorological tower was installed 1 km southeast of the proposed project site by PNM. Meteorological instruments measuring wind speed, direction, and temperature are placed at three heights on the tower: 10, 30, and 58 meters. Precipitation and insolation are also measured. The nearest source of comprehensive climatological data is Albuquerque, New Mexico, about 90 miles southwest of the project area, although the Winslow, Arizona, weather station data are more representative of the project site.

Temperature

The annual average temperature for the project site and the Chaco Canyon area is 50°F, with the mean daily temperature ranging from about 29°F in December to 73°F in July. However, extremes can range from 100°F during the summer to below -10°F in the winter.

Precipitation

Annual average precipitation in the project area is less than 8 inches, with the mean monthly precipitation ranging from 0.14 to 1.52 inches. Precipitation amounts can vary greatly as a result of localized thunderstorm activity, with most precipitation occurring as rain during these storms. Snowfall can occur 8 months a year and average more than 16 inches, with the majority occurring during November, December, and January. As indicated by precipitation data, these snowfalls contain little moisture. Annual relative humidities range from 65 percent in the mornings to near 30 percent in midafternoon, and may average less than 20 percent on warmer days.

Dispersion Climatology

The ability of the atmosphere to disperse air pollutants depends on several factors, including atmospheric stability. Joint frequency distributions of wind speed, wind direction, and stability have been prepared from data collected at Farmington (U.S. Department of Commerce 1973) and the NMGS monitoring site (ERT 1981a). These data (Table 3-1) indicate that good dispersion conditions (Pasquill stability classes A through D) occur, on an average, 56 percent of the time at Farmington and 61 percent of the time at the project site (ERT 1981a). Poor dispersion conditions (Pasquill stability classes E and F) occur, on an average, 45 percent of the time at Farmington and 39 percent of the time at the project site.

The wind frequency distribution based on 60-meter data collected at Bisti is shown in Figure 3-2. Wind speeds are moderate, although strong winds often accompany frontal passages, generally during late winter and spring, and also precede thunderstorms. The low to medium wind speeds are usually associated with nocturnal drainage from the south-southeast and southeast (ERT 1981b).

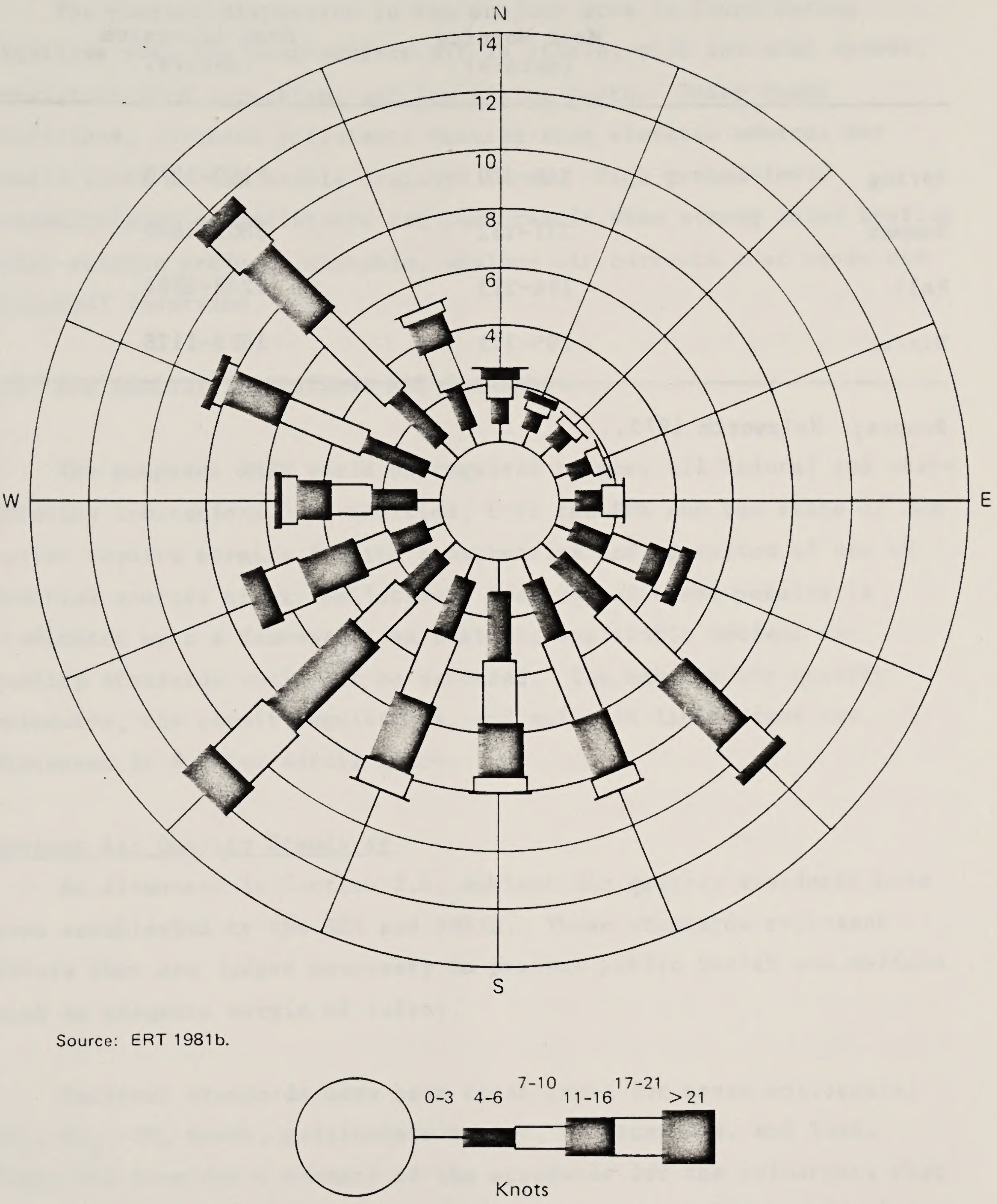
Mixing depth is a measure of the thickness of the layer of the lower atmosphere in which air pollutants can be mixed. Better dispersion results from greater mixing depth, since a greater volume of air is available for dilution of pollutants. Holzworth (1972) studied mixing depths as well as wind speeds for 62 National Weather Service (NWS) stations in the 48 contiguous states. Mixing height data were obtained for Winslow, Arizona, since this was the area most representative of the project region at which data are available. These data were also used in all modeling analyses, as discussed in Section 4.0 and Appendix F. Holzworth's data, based on a 5-year period, indicate that New Mexico has a relatively high mean annual mixing height (Table 3-2), with large annual and diurnal variations.

Table 3-1. FREQUENCIES OF STABILITY

Pasquill-Gifford Stability Class	Frequency	
	Project Site[a] %	Farmington[b] %
A - extremely unstable	3.2	4.8
B - unstable	10.1	10.6
C - slightly unstable	12.8	12.4
D - neutral	34.7	27.8
E - slightly stable	15.5	10.7
F - stable	23.8	34.5

[a] ERT 1981a.

[b] U.S. Department of Commerce 1973.



Source: ERT 1981b.

Figure 3-2. WIND FREQUENCY DISTRIBUTION (58 meter) -- PROJECT SITE METEOROLOGICAL TOWER, NOVEMBER 1977 THROUGH OCTOBER 1980

Table 3-2. MIXING HEIGHT FOR WINSLOW, ARIZONA

	Mean Morning (meters)	Mean Afternoon (meters)
Spring	241-270	3160-3178
Summer	221-232	3801-3840
Fall	198-213	2243-2303
Winter	205-223	1078-1128

Source: Holzworth 1972.

The poorest dispersion in the project area is found during nighttime when the near-surface air is stable, with low wind speeds, persistent wind direction, and low mixing depth. Under these conditions, airborne pollutants emitted from elevated sources may remain aloft in the stable drainage layer. High ground-level concentrations of pollutants can then result when strong solar heating after sunrise produces unstable, upslope air currents that erode the nocturnal inversion.

3.3 AIR QUALITY REGULATIONS AND STANDARDS

The proposed NMGS would be required to meet all federal and state emission limitations. In addition, both the EPA and the state of New Mexico require permits for the construction and operation of new or modified sources of air pollution. Granting of these permits is predicated upon a demonstration that the applicable ambient air quality standards would not be exceeded. The ambient air quality standards, the permit regulations, and emission limitations are discussed in further detail below.

Ambient Air Quality Standards

As discussed in Section 2.0, ambient air quality standards have been established by the EPA and NMEID. These standards represent levels that are judged necessary to protect public health and welfare with an adequate margin of safety.

National standards have been established for seven pollutants: SO_2, NO_2, CO, ozone, particulate matter, hydrocarbons, and lead. Table 2-1 provides a summary of the standards for the pollutants that would be emitted from NMGS in significant amounts. This table also presents the New Mexico standards.

Differences Between the Federal and New Mexico Standards. The national standards are defined in terms of micrograms per cubic meter ($\mu g/m^3$), at a reference condition of 25°C and 760 mm pressure. New Mexico's standards are defined in terms of parts per million (ppm), with the exception of particulate matter, which is expressed in $\mu g/m^3$. Unlike the federal standards, New Mexico's standards are defined at 25°C and 630 mm pressure. The federal short-term standards may be exceeded once per year without being considered a violation; however, the New Mexico standards are considered to be violated if they are exceeded at any time.

New Mexico's standards are equal to or more stringent than the federal standards. Specifically, the 24-hour and annual SO_2 standards for New Mexico are stricter than the federal SO_2 standards for the respective averaging periods. However, New Mexico does not have a 3-hour SO_2 standard. New Mexico's annual particulate standard is more stringent than the federal standard (60 versus 75 $\mu g/m^3$), as are New Mexico's 1-and 8-hour CO standards. New Mexico has an annual and a 24-hour NO_2 standard; the federal standard for NO_2 is on an annual basis only.

Issues Concerning the New Mexico NO_2 Standard. Although there is a standard defined for NO_2 under New Mexico Air Quality Control Regulation 201, the definition of NO_2 in Regulation 100 H states that "nitrogen dioxide includes other oxides of nitrogen, such as nitric oxide, which may test as nitrogen dioxide."

Thus the NO_2 standard may be inclusive of all oxides of nitrogen and could therefore be interpreted as an NO_x standard. The reference method used to measure NO_2, as stipulated in Regulation 100 H, is the Saltzman method, which is also referred to as the "bubbler" method. The NO_2 values measured by this method may reflect some NO as well.

In recent communications the NMEID (1982a,b) has indicated that the definition of the NO_2 standard will be changed to reflect that only NO_2 is to be considered. It is anticipated that the change in definition will occur in late 1982.

The NMEID has also indicated that at monitors that differentiate between NO_x and NO_2, it is reasonable to present both the NO_2 values measured at such monitors and the NO_x level for comparison with the New Mexico standard. NMEID has also advised that for purposes of impact analysis, it is appropriate to combine modeled NO_2 concentration increases with monitored NO_2 values, rather than with monitored NO_x values.

In this analysis, the above approach has been taken. Specifically, NO_2 values in addition to NO_x values recorded at monitoring stations are presented for comparison with the New Mexico standard, when such values are available. Only NO_2 values are used in comparisons with the federal NO_2 standard, since this value is defined to include only NO_2. However, in obtaining average baseline values for the San Juan River valley region, it was not possible to ascertain the NO_2 portion recorded at the monitors operated by NMEID. The computation of the average value of NO_2 in that region may include some values of NO. Therefore the actual NO_2 background may have been lower at some of the monitors than was recorded.

The approach of using NO_2 values when possible rather than total NO_x values is a reasonable one, in light of the fact that in this analysis comparison with ambient standards is done to provide an indication of possible health effects. The EPA's draft Air Quality Criteria for Oxides of Nitrogen (EPA 1979a) states that health studies indicate that "nitric oxide (NO) is not of direct concern for human health and welfare effects at typical ambient air concentration levels recorded over U.S. cities."

Federal and New Mexico Air Permit Requirements

The Clean Air Act, as amended in 1977, established a program designed to prevent significant deterioration of air quality in all areas of the country that do not exceed the National Ambient Air Quality Standards (NAAQS). These areas are referred to as attainment areas. The most recently revised PSD regulations were published by the EPA in the August 7, 1980, Federal Register (EPA 1980b). These regulations require permits to be obtained for sources emitting pollutants in amounts greater than specified levels.

On February 16, 1982, EPA Region VI delegated the authority for technical and administrative review of the PSD program to NMEID. But since NMEID did not request full delegation of authority, it has responsibility only for the technical review and processing of the PSD applications submitted to NMEID. The EPA Region VI will still retain the authority to issue or deny PSD permits. Thus, after NMEID conducts the technical review, it will make recommendation of its findings to EPA Region VI, which has final permitting authority. Permits issued by Region VI under the PSD program must be cosigned by the state and the EPA for final issuance. It is anticipated that at the time that PNM submits a formal PSD permit application, NMEID will have accepted full permitting authority.

The PSD regulations require the application of best available control technology (BACT) for each applicable pollutant. BACT denotes an emission limit or control technology that represents the maximum degree of reduction with respect to a particular source and pollutant, taking into account energy, environmental, and economic impacts, and other costs. BACT is required for each pollutant regulated under the Clean Air Act that exceeds applicability emission criteria. Included are pollutants commonly referred to as "noncriteria pollutants," for which no NAAQS exist but which are controlled under other sections of the Clean Air Act (such as National Emission Standards for Hazardous Air Pollutants, and New Source Performance Standards). The regulations require BACT for each pollutant (criteria and noncriteria) emitted in amounts greater than de minimis levels.

In addition to BACT analysis, an air quality impact analysis must be conducted to demonstrate compliance with all applicable federal ambient air quality standards. In areas where air quality levels are well below NAAQS (such as the proposed NMGS project area), the PSD regulations specify additional limitations on allowable deterioration increments for SO_2 and TSP above baseline conditions.

An increment and BACT analysis pursuant to PSD regulations would be prepared separately by PNM to be included in the PSD application submitted to NMEID.

In addition to the PSD permit requirements, the state of New Mexico has its own permit program. Under New Mexico Air Quality Control Regulation 702, an air quality permit is required for the construction or modification of any air contaminant source which, if it were uncontrolled, would result in an emission of the contaminant greater than 10 pounds per hour or 25 tons per year. The regulation is general and provides that no source that would violate any state or federal emission limitations or ambient air quality standard may be granted a permit. Permit applications made under Regulation 702 would be processed concurrently with the PSD permit application discussed above. It is anticipated that at the time NMEID obtains full PSD permitting authority, Regulation 702 will have been incorporated into the PSD program. Until that time, sources must undergo concurrent PSD and Regulation 702 review, and obtain two permits. In most cases, satisfying PSD requirements would also satisfy the requirements of Regulation 702.

Emission Standards. Both the EPA and the NMEID impose emission limitations for different categories of sources. Since December 21, 1971, the EPA has enforced emission standards for certain industrial source categories, including electric utility steam generation units, under the NSPS. Briefly, the NSPS regulations for these units limit SO_2, NO_2, and TSP from any fuel gas combustion device. However, the New Mexico Air Quality Control Regulations impose stricter emission limits than the federal NSPS regulations. Specifically, Regulations 602 and 603 limit sulfur oxides and nitrogen oxides from coal-burning equipment. These regulations as well as the federal emission limits are discussed in further detail in Section 4.0.

EPA's standards for hazardous pollutants (NESHAPS) do not apply to this project and are not considered in this study.

Visible-emission requirements are also imposed by New Mexico on the basis of opacity using the Ringleman indexing system for plumes. Air Quality Control Regulation 401 states that "no person owning or operating stationary combustion equipment shall permit, cause, suffer, or allow visible emissions from the stationary combustion equipment to equal or exceed an opacity of 20 percent." The definition of opacity used in these regulations is the degree to which emissions reduce the transmission of light and obscure the view of an object in the background. Opacity is to be determined consistent with the method set forth by the EPA in 40 CFR 50, Appendix A, Method 9.

3.4 BASELINE AIR QUALITY

The NMGS project site is located within the San Juan Air Basin. For air quality management purposes, EPA has divided the entire United States into Air Quality Control Regions (AQCRs). The San Juan Air Basin is located within the Four Corners Interstate AQCR (AQCR 014).

Each AQCR and its subdivisions have been given a designation by the EPA on the status of attainment with respect to the NAAQS. If a pollutant has been measured, or <u>predicted</u> to be, in excess of a short-term standard more than once per year (or once, for annual standards), the area may be designated "nonattainment" for that pollutant.

A small area of San Juan County is designated nonattainment for SO_2. Specifically, the area within a 2.5-mile radius of the Four Corners Power Plant along with two nearby high-altitude areas (Mesa Verde Plateau and the Hogback) have been designated nonattainment for SO_2. The major contributing source of this SO_2 is coal-fired power plant emissions (NMEID 1981a). For San Juan County, the state has demonstrated, using EPA-approved methods, that compliance with the ambient standards for SO_2 will be achieved through the emission limitations specified in New Mexico Air Quality Regulation 602, <u>Coal-Burning Equipment--Sulfur Dioxide</u>. The NMEID anticipates that when full compliance with the emission limits in this regulation is achieved, the present nonattainment areas for SO_2 in San Juan County should meet all state and federal SO_2 standards (NMEID 1981a).

In the city of Farmington, a corridor bounded one block north of Main and one block south of Broadway, and extending west from Butler Avenue to the intersection of Main and Broadway, has been designated nonattainment for CO.

These are the only nonattainment areas in the San Juan Basin. No nonattainment designations for any other areas or pollutants have been made in this region.

In the following discussion of baseline air quality, the term "ambient concentration" refers to the amount of a particular pollutant, expressed in terms of weight or volume, with respect to the volume of air in which it is contained. Pollutant concentrations are expressed either as parts per million (ppm) or $\mu g/m^3$. A discussion of the relationship and conversions between ppm and $\mu g/m^3$ units is contained in Section 2.9. (Also see the definition of "concentration" in the Glossary.)

Project Site

Baseline air quality for TSP, SO_2, NO_x, and NO_2 at the project site along with levels of CO and radionuclides in the San Juan Basin are discussed in this section.

Data obtained from the monitoring station at the project site are used in establishing the baseline ambient concentrations of TSP, SO_2, NO_x, and NO_2 in the region in which the proposed plant would be constructed as well as for other rural areas throughout the San Juan Basin.

Only maximum ambient concentrations of pollutants observed are reported in this subsection. This was done to determine the worst-case pollutant levels for the San Juan Basin. These values should not be interpreted as typical concentrations that would be measured on any given day. Maximum events are usually anomalous, occurring only once in a defined period. This is generally the case for the shorter-term averages such as the 3- or 24-hour values. Annual averages are representative of the concentrations that are typical over any given averaging period.

As will be discussed further in Section 4.0, emissions of volatile organic compounds (VOC) from NMGS would be minimal; specifically they would be below 40 tons per year. This level is termed a de minimis emission level by the EPA in its PSD regulations. As such, the EPA considers emissions of VOC below this level to be insignificant. These compounds are precursors to the formation of ozone in the atmosphere. Based on information received from NMEID (1981b), ozone is not considered to be a problem in the San Juan Basin. NMEID does not presently monitor ozone in the San Juan Basin, nor does it anticipate initiating such programs. For these reasons, ozone baseline values are not discussed in detail for this study.

Similarly, modeled concentrations of CO due to NMGS (as discussed in Chapter 4.0) were computed to be below the EPA-specified values used to define the geographic area of influence (see Section 2.4). As such, a detailed discussion of CO baseline values is not warranted. Thus only a brief discussion of CO is included.

Although no standards for radionuclide emissions or concentrations apply to this project, baseline levels are examined in response to concerns addressed during public scoping meetings (see Section 2.5).

PNM has been conducting air chemistry monitoring at the proposed project site since November 1977. Measurements were made of SO_2, NO_x, and NO_2 using EPA-approved continuous monitors. Data from TSP sampling of 24 hours duration were gathered approximately four times a week.

Concentrations of TSP, SO_2, NO_x, and NO_2 are discussed below. These concentrations are the maximum values monitored at that site for each averaging period.

Suspended Particulate Matter. The annual geometric means calculated at ambient conditions for the 2 full years for which data are available are 35 $\mu g/m^3$ and 44 $\mu g/m^3$ for 1978 and 1979 respectively. A maximum 24-hour concentration of 655 $\mu g/m^3$ was observed.

This is clearly a rural region with minimal human activity. There are no industrial sources of particulate matter in the vicinity of the project site (see Section 3.5). Observations of high TSP at the project site are the result of fugitive dust and not industrial emissions. This is because the land is semiarid, with less than 10 percent ground cover, and it is very susceptible to wind erosion. High TSP levels generally occur during May, June, and July, when dust storms are most prevalent.

The EPA's fugitive dust policy (EPA 1977a, 1977b) states that in rural areas particulates of fugitive origin are of much less concern than those of nonfugitive origin. The policy states: "New sources that wish to construct in rural areas should be allowed to do so without the need of an emission offset if they meet certain criteria. These include compliance with specific emissions limitations and the assurance that the source's emissions, plus nonurban background and the emissions from other stationary sources in the vicinity of the proposed location, would not cause violations of the national ambient air quality standards" (EPA 1977b).

The EPA (1977b) defines nonurban background as the lowest measured annual average particulate concentration in the broad area where the new source will be located. The EPA (1977b) recommends using this level as the background concentration for the 24-hour averaging period as well as for the annual average. Applying this policy, the lower 1978 annual concentration of 35 $\mu g/m^3$ will be used as the 24-hour and annual background levels. It should be noted that in an area with very little human activity, such as the project site, the annual concentration of 35 $\mu g/m^3$ is predominantly the result of windblown dust.

Sulfur Dioxide. Almost all SO_2 concentrations monitored at the project site were at or below the threshold of detection of the monitoring instruments. There have been no major emissions of SO_2 at or near the proposed site, although under certain meteorological conditions, as discussed below, it appears that emissions from the large generating stations operating in the region may account for any observed 3-hour and 24-hour levels. This is discussed further in Section 3.6.

The maximum concentrations observed were 0.066 ppm for the 3-hour, 0.021 ppm for the 24-hour, and 0.001 ppm for the annual measurements. These values are below the applicable state and federal standards (listed in Table 2-1). Specifically, the maximum 3-hour concentration observed is 12 percent of the federal standard. The maximum 24-hour concentration represents 21 percent of the state standard. The maximum annual concentration recorded at the site from November 1977 through October 1980 was 6 percent of the state and 4 percent of the federal annual standard.

Nitrogen Dioxide. Most levels of NO_x and NO_2 observed at the project site were at or below the threshold of detection of the monitoring instruments. The maximum 24-hour concentration of NO_x was 0.052 ppm. The maximum annual NO_x and NO_2 concentration observed was 0.002 ppm. The maximum 24-hour concentration of NO_2 was 0.030 ppm.

The maximum 24-hour average concentrations of NO_x and NO_2 were 52 percent and 30 percent, respectively, of the state standard of

0.100 ppm. The maximum annual NO_x and NO_2 concentrations observed were 4 percent of the New Mexico and federal standards.

Carbon Monoxide. Although no CO monitoring was conducted at the project site, continuous CO monitoring was conducted at a site in Farmington by NMEID and by PNM at a site near Highway 550 between the San Juan and Four Corners generating stations. Between 1978 and 1980 a 1-hour maximum of 15 ppm and an 8-hour maximum of 6.4 ppm were observed in Farmington. During the six months that the PNM station operated, almost all CO concentrations measured there were at or below the threshold of detection and only a maximum 1-hour level of 1 ppm (1 mg/m^3) was observed.

The Farmington area has major sources of CO, but the project site has no major sources. Therefore any levels of CO observed at the project site would be lower than the values reported for Farmington.

Radionuclides. There has been no radiological monitoring at the project site, although radiological monitoring has been performed at various locations within the San Juan Basin as part of a regional uranium study. The monitoring was conducted to characterize the San Juan Basin with respect to levels of various radionuclides that are considered harmful.

The San Juan Basin Regional Uranium Study (U.S. Dept. of Interior 1978b) states that the principal source of potentially harmful airborne radionuclides is radon 222 (Rn-222). Radon gas is dangerous because of the potential effects of deposition of its half-life products in the pulmonary region of the human body. Other radionuclides in the area are considered as "occurring, if at all, in an airborne form in only negligible amounts." Hence they are of negligible significance, particularly when compared with Rn-222.

Rn-222 is a gaseous radioactive isotope from the uranium 238 decay chain and is released as surface and near-surface uranium decays. The highest background concentrations of Rn-222 in the San Juan Basin were found near ground level under conditions of temperature inversion. Levels observed ranged from 0.008 to 0.9 picocurie per liter (pCi/l), based on 135 samples taken at various times of day during various months of the year. The arithmetic mean of all values observed was 0.19 pCi/l.

A second study of ambient natural concentrations of radon in the San Juan Basin (U.S. Dept. of Interior 1978c) resulted in levels ranging from 0.05 to 2.8 pCi/l, with a mean value of 0.65 pCi/l. The ambient concentrations were based on 490 samples taken during conditions of limited dispersion (i.e., nighttime stable conditions).

San Juan River Valley

The San Juan River valley is the region surrounding the Animas and San Juan rivers between Highways 44 and 666 (see Figure 3-1), including the towns of Aztec, Bloomfield, Farmington, and Shiprock. Some of the major industrial sources of emissions in this region include the Four Corners and San Juan generating stations and the El Paso Natural Gas-San Juan Refinery. This area also has the greatest vehicle density and the majority of vehicle traffic in the basin.

On the basis of the results of computer-simulated modeling of NMGS's emissions (discussed in Section 4.0) the San Juan River valley is not included in the geographic area of influence. This is because concentration increases of pollutants due to NMGS were predicted to be below the EPA-specified levels used in defining the geographic area (discussed in Section 2.4). The baseline air quality in this region is examined for purposes of responding to concerns raised during public scoping meetings regarding people and population areas;

specifically, they are used in projecting future baseline levels in this area (discussed in Section 3.6).

Baseline concentrations of NO_x, NO_2, SO_2, and TSP are presented in Tables 3-3 and 3-4. All data were obtained from the three monitoring networks that have been operating in and around the San Juan River valley. The San Juan-Four Corners Joint Ambient Air Monitoring Program (JAAM) operated 8 monitoring stations from 1973 through 1979, measuring SO_2, NO_x, NO_2, and TSP. Also, PNM began air chemistry monitoring of SO_2, NO_x, and NO_2 at 11 monitoring stations on July 30, 1980. These stations are designated "602A" monitors. NMEID has also been operating a series of monitoring stations since the early 1970s. The locations of all monitoring stations are shown in Figure 3-3.

The values in Tables 3-3 and 3-4 represent the average of the maximum concentrations observed at each monitoring site in the San Juan River valley for the various time periods, compared with state and federal standards. Averages of all the maximum values were used to represent this region rather than a single maximum value, since in many cases a maximum value is representative of a rare or isolated occurrence. Average values will be used to project future air quality in the San Juan River valley. For this purpose, it is considered appropriate to use values that are representative of emissions in the entire San Juan Basin rather than values that are attributed to one particular source of air pollution, as discussed in Section 2.7.

Similar to the project site, throughout the San Juan Basin particulate levels in excess of state and federal standards have been frequently recorded. Since the region is also considered rural, with fugitive dust as the primary source of the high TSP concentrations observed, the lowest annual concentrations observed are used as the

Table 3-3. COMPARISON OF SAN JUAN RIVER VALLEY BASELINE WITH NEW MEXICO AMBIENT STANDARDS

Constituent	Sampling Time	Average Concentration	New Mexico Standard	Percent of New Mexico Standard
SO_2	Annual[a]	0.008 (ppm)	0.020 (ppm)	40
	24-hour maximum[a]	0.043 (ppm)	0.100 (ppm)	43
NO_x	Annual[b]	0.011 (ppm)	0.050 (ppm)[f]	22
	24-hour maximum[c]	0.070 (ppm)	0.100 (ppm)[f]	70
NO_2	Annual[d]	0.007 (ppm)	0.050 (ppm)	14
	24-hour maximum[d]	0.036 (ppm)	0.100 (ppm)	36
Particulates[g]	Annual[e]	39 $\mu g/m^3$	60 $\mu g/m^3$	65
	24-hour maximum[e]	39 $\mu g/m^3$	150 $\mu g/m^3$	26

[a] Average of maximum values observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1978).
- NMEID: Stations 1-H, 1-O, 1-U over the period 1/77 through 12/80 (NMEID 1981a).
- 602A: Stations 103, 104, 105, 109, 110, 111 over the period 8/80 through 12/81 (PNM 1981a).

[b] Average of maximum values observed at all the JAAM Stations over the period 1/73 through 12/77 (PNM 1978).

[c] Average of maximum values observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1978).
- 602A: Stations 103, 104, 105, 109, 110, 111 over the period 8/80 through 12/81 (PNM 1981a).

[d] Average of maximum values observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1982r).
- NMEID: Stations 1-A, 1-B, 1-C, 1-H, 1-O, 1-Z over the period 1/77 through 12/80 (NMEID 1981a).
- 602A: Stations 103, 104, 105, 109, 110, 111 over the period 8/80 through 12/81 (PNM 1982a).

[e] Average of lowest annual geometric means observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1982a).
- NMEID: Stations 1-A, 1-B, 1-C, 1-G, 1-H, 1-O, 1-U over the period 1/77 through 12/80 (NMEID 1981a).

[f] New Mexico NO_2 standard (see text for discussion).

[g] Concentrations reported at ambient conditions.

Table 3-4. COMPARISON OF SAN JUAN RIVER VALLEY BASELINE WITH FEDERAL AMBIENT STANDARDS

Constituent	Sampling Time	Average[a] Concentration	Federal Standard	Percent of Federal Ambient Standard
SO_2	Annual[b]	21 $\mu g/m^3$	80 $\mu g/m^3$	26
	24-hour maximum[b]	112 $\mu g/m^3$	365 $\mu g/m^3$	31
	3-hour maximum[b]	356 $\mu g/m^3$	1300 $\mu g/m^3$ [e]	28
NO_2	Annual[c]	13 $\mu g/m^3$	100 $\mu g/m^3$	13
Particulates	Annual[d]	47 $\mu g/m^3$	75 $\mu g/m^3$	63
	24-hour maximum	47 $\mu g/m^3$	150 $\mu g/m^3$ [e]	31

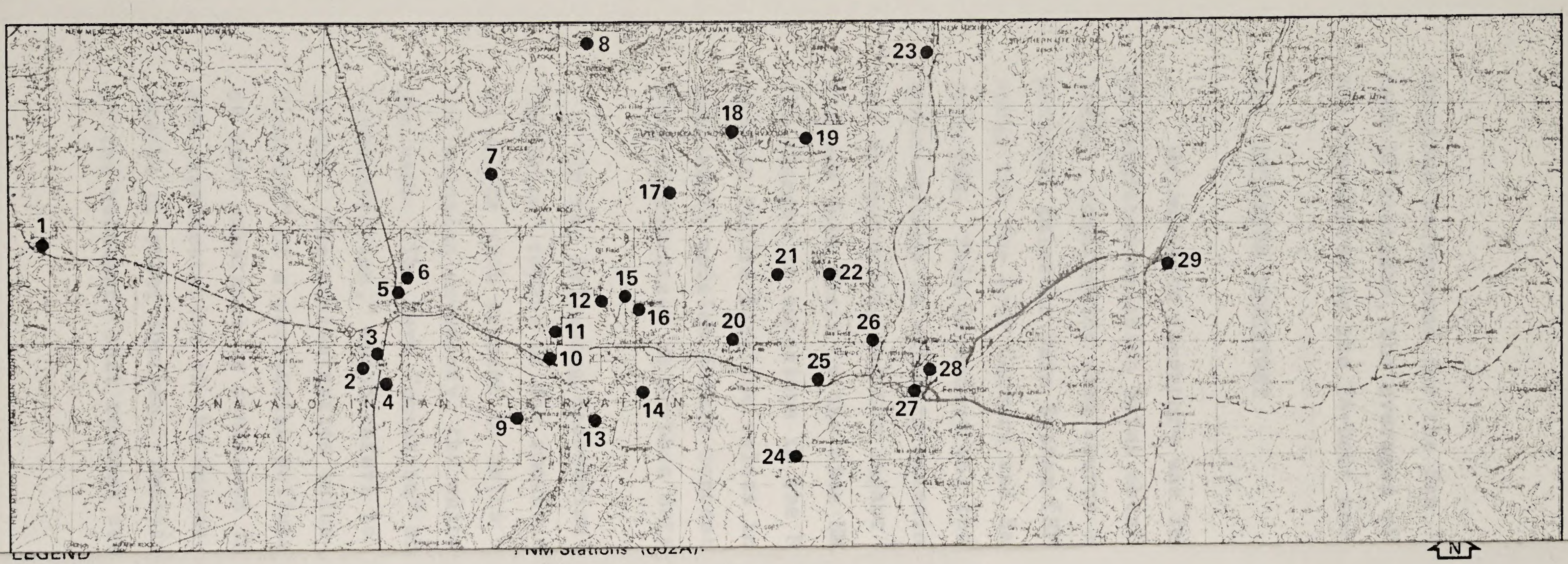
[a] All monitored concentrations of gaseous pollutants are reported in ppm and have been converted to $\mu g/m^3$ assuming 760 mm pressure. (See Appendix A)

[b] Average of maximum values observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1978).
- NMEID: Stations 1-H, 1-O, 1-U over the period 1/77 through 12/80 (NMEID 1981a).
- 602A: Stations 103, 104, 105, 109, 110, 111 over the period 8/80 through 12/81 (PNM 1981a).

[c] Average of maximum values observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1982a).
- NMEID: Stations 1-A, 1-B, 1-C, 1-H, 1-O, 1-Z over the period 1/77 through 12/80 (NMEID 1981a).
- 602A: Stations 103, 104, 105, 109, 110, 111 over the period 8/80 through 12/81 (PNM 1982a).

[d] Average of lowest annual geometric means observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1978).
- NMEID: Stations 1-A, 1-B, 1-C, 1-G, 1-H, 1-O, 1-U over the period 1/77 through 12/80 (NMEID 1981a).

[e] Federal Secondary Standard.



LEGEND

Key to Monitoring Stations
(pollutants measured and time period)

NMEID Stations

1	TSP, SO_2 (1974-75)
2	TSP (1973-80), SO_2, NO_2 (1977-78)
4	TSP, SO_2 (1973-80)
5	SO_2 (1974)
13	TSP (1974-80), SO_2 (1973-80), NO_2 (1977-80)
15	TSP, SO_2 (1973-80), NO_2 (1977-78)
20	TSP (1973-80)
23	TSP, SO_2 (1974-75)
27	3 Stations: TSP, SO_2. CO (1973-80), NO_2 (1977-80)
28	2 Stations: CO (1976-80)
29	TSP, SO_2 (1973-80), NO_2 (1977-80)
30	TSP (1973-80)

PNM Stations (062A):

From July 30, 1980, to present. At the following stations, SO_2, NO_2, wind speed, and wind direction are measured: **7, 8, 10, 11, 12, 17, 18, 19, 21, 22, 25.**
At station **10**, CO is also monitored.

San Juan Generating Station/APS Joint Monitoring Program (JAAM):

Operated from 1972 through 1980. At the following stations TSP, SO_2, NO_2, wind speed, wind direction, and temperature were measured: **3, 6, 9, 10**[a]**, 14, 16, 24, 26.**

PNM Project Site (**31**):

SO_2, NO_2, TSP, wind speed, wind direction, and temperature are measured. Monitors commenced operation in November 1977.

PNM McKinley Site:

Same parameters measured as at Bisti.
Monitoring period: December 1977 through March 1979.

Figure 3-3. AIR QUALITY AND METEOROLOGICAL MONITORING STATIONS IN PROJECT REGION

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[a] Turned over to PNM as owner/operator on July 13, 1980

Table 3-4. COMPARISON OF SAN JUAN RIVER VALLEY BASELINE WITH FEDERAL AMBIENT STANDARDS

Constituent	Sampling Time	Average Concentration[a]	Federal Standard	Percent of Federal Ambient Standard
SO_2	Annual[b]	21 μg/m^3	80 μg/m^3	26
	24-hour maximum[b]	112 μg/m^3	365 μg/m^3	31
	3-hour maximum[b]	356 μg/m^3	1300 μg/m^3 [e]	28
NO_2	Annual[c]	13 μg/m^3	100 μg/m^3	13
Particulates	Annual[d]	47 μg/m^3	75 μg/m^3	63
	24-hour maximum	47 μg/m^3	150 μg/m^3 [e]	31

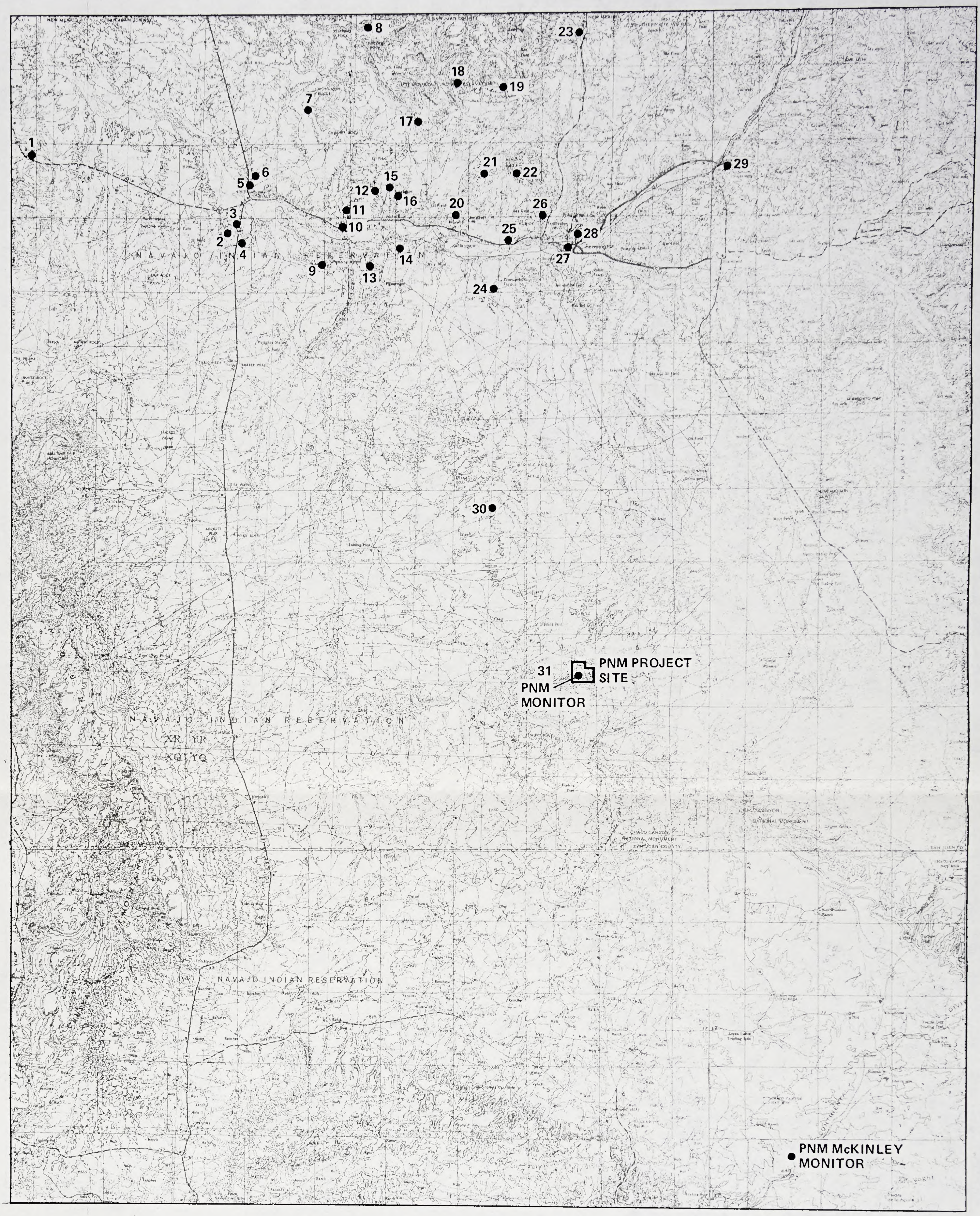
[a] All monitored concentrations of gaseous pollutants are reported in ppm and have been converted to μg/m^3 assuming 760 mm pressure. (See Appendix A)

[b] Average of maximum values observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1978).
- NMEID: Stations 1-H, 1-O, 1-U over the period 1/77 through 12/80 (NMEID 1981a).
- 602A: Stations 103, 104, 105, 109, 110, 111 over the period 8/80 through 12/81 (PNM 1981a).

[c] Average of maximum values observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1982a).
- NMEID: Stations 1-A, 1-B, 1-C, 1-H, 1-O, 1-Z over the period 1/77 through 12/80 (NMEID 1981a).
- 602A: Stations 103, 104, 105, 109, 110, 111 over the period 8/80 through 12/81 (PNM 1982a).

[d] Average of lowest annual geometric means observed at the following stations of the respective monitoring networks:
- JAAM: All stations over the period 1/73 through 12/77 (PNM 1978).
- NMEID: Stations 1-A, 1-B, 1-C, 1-G, 1-H, 1-O, 1-U over the period 1/77 through 12/80 (NMEID 1981a).

[e] Federal Secondary Standard.



LEGEND

Key to Monitoring Stations
(pollutants measured and time period)

NMEID Stations

1 TSP, SO_2 (1974-75)
2 TSP (1973-80), SO_2, NO_2 (1977-78)
4 TSP, SO_2 (1973-80)
5 SO_2 (1974)
13 TSP (1974-80), SO_2 (1973-80), NO_2 (1977-80)
15 TSP, SO_2 (1973-80), NO_2 (1977-78)
20 TSP (1973-80)
23 TSP, SO_2 (1974-75)
27 3 Stations: TSP, SO_2. CO (1973-80), NO_2 (1977-80)
28 2 Stations: CO (1976-80)
29 TSP, SO_2 (1973-80), NO_2 (1977-80)
30 TSP (1973-80)

PNM Stations (602A):

From July 30, 1980, to present. At the following stations, SO_2, NO_2, wind speed, and wind direction are measured: **7, 8, 10, 11, 12, 17, 18, 19, 21, 22, 25.**
At station **10**, CO is also monitored.

San Juan Generating Station/APS Joint Monitoring Program (JAAM):

Operated from 1972 through 1980. At the following stations TSP, SO_2, NO_2, wind speed, wind direction, and temperature were measured: **3, 6, 9, 10**[a]**, 14, 16, 24, 26.**

PNM Project Site (**31**):

SO_2, NO_2, TSP, wind speed, wind direction, and temperature are measured. Monitors commenced operation in November 1977.

PNM McKinley Site:

Same parameters measured as at Bisti.
Monitoring period: December 1977 through March 1979.

[a] Turned over to PNM as owner/operator on July 13, 1980

Figure 3-3. AIR QUALITY AND METEOROLOGICAL MONITORING STATIONS IN PROJECT REGION

nonurban background for the San Juan Basin. Since data were reviewed from 17 stations, the averages of all the lowest annual concentrations are considered as the 24-hour and annual baseline.

3.5 EMISSION INVENTORY

An emission inventory was developed for the San Juan Basin based on permitted emission rates obtained from NMEID files (NMEID 1981c, 1982c), county-wide area source emission estimates compiled in the National Emission Data System (EPA 1981a), and permitted emission rates for the Four Corners and San Juan generating stations obtained from PNM. This inventory was then adjusted to reflect changes and modifications in existing emission sources, permitted new sources not yet in operation, and the impact of increased population expected in the San Juan Basin by the time NMGS is projected to be in operation. The changes in emissions in the San Juan Basin were then used to project future baseline values in the San Juan River valley and to supplement modeled future concentrations in the project site area. This is discussed in further detail in Section 3.6.

In the following discussion of pollutant emissions, the term "emission" refers to the amount of a pollutant expressed in units of weight with respect to units of time. For purposes of discussing the emission inventory, the units used are tons of pollutant emitted per year. The term "emission" should not be confused with "concentration," which refers to the amount of a pollutant per volume of air. The concentration value is representative of the atmospheric "loading" of a particular pollutant; it answers the question "how much of this substance is contained in a given volume of air?" Emissions are representative of the amount of substance that is released from stacks or other sources. Emission values do not indicate the amount of the substance that remains suspended or mixed in the atmosphere.

Present Emission Inventory

Data on total emissions from all sources in the San Juan Basin are reported in Table 3-5. Emission information is compiled for all point and area sources. Area sources of emissions are those other than a stationary stack or vent (e.g., vehicle emissions). Since area source emissions are tabulated on a county basis, contributions from these sources within the San Juan Basin were calculated based on the percentage area of each county in the San Juan Basin, as follows: San Juan County, 100 percent; McKinley County, 41 percent; Rio Arriba County, 27 percent; and Sandoval County, 11 percent.

Emissions from point sources (i.e., emissions that originate from either a stack or vent) are divided into two categories: (1) minor point sources, which release less than 100 tons per year of any pollutant; and (2) major point sources, which release more than 100 tons per year of any pollutant.

Major point sources in the San Juan Basin and their annual emission rates are listed in Table 3-6. Major point source emissions are from four kinds of sources: natural gas refineries, oil refineries, tank farms, and electric generating stations. Emissions data represent the most recently tabulated (EPA 1980c) emission levels.

The breakdown of the total emissions in the San Juan Basin by industrial source types is presented in Figures 3-4 through 3-6. Area sources are the only significant sources of TSP, accounting for more than 92 percent of the emissions in the basin.

Emissions from the Four Corners and San Juan power plants contribute more than 97 percent of the total SO_2 and over 80 percent of the total NO_x in the basin. Natural gas refineries are another

Table 3-5. SAN JUAN BASIN EMISSIONS SUMMARY

Source Type	Pollutant (tons/year) TSP	SO_2	NO_x	HC	CO
● Area Emissions (tons/year)	694,000	1,500	9,000	11,600	72,000
Percent of Total	93	1	8	58	86
● All Point-Source Emissions (tons/year)	56,000	184,300	107,000	8,400	11,200
Percent of Total	7	99	92	42	14
● Total from All Sources (tons/year)	750,000	185,800	116,000	20,000	83,200

Sources: NMEID 1981c, 1982c
EPA 1980c
PNM 1982b

Table 3-6. MAJOR POINT SOURCES WITH EMISSIONS GREATER THAN 100 TONS PER YEAR IN SAN JUAN BASIN

		Emissions (tons/year)				
Plant Name	Location	TSP	SO_2	NO_x	HC	CO
Natural Gas Refineries						
El Paso	Angel Peak	0	0	140	59	18
	Ballard Station	0	0	546	225	69
	Blanco Station	0	1	3688	1506	540
	Chaco Station	8	0	3042	1095	459
	San Juan	6	1710	756	244	109
	Station No. 3B-1	0	0	243	100	31
	Kutz	0	0	342	141	44
	Lindrith	0	0	711	294	89
	Largo	0	0	742	305	94
	Station No. 115-1	1	0	134	47	1
Southern Union Gas	Dogie Canyon	5	0	127	27	5
	Star Lake	3	0	259	85	3
Southern Union Prod.	Kutz	2	0	360	132	58
Oil Refineries						
Plateau	Farmington	9	419	157	477	22
Southern Union Prod.	Kutz	4	0	468	179	50
Giant IND	Farmington	10	69	132	292	43
Tenneco		1	0	253	104	32
Caribou	Kirtland	2	0	19	215	2
Tank Farms						
Amoco Prod. Co.	Four Corners				363	
ARCO	Four Corners				140	
El Paso	Four Corners				733	
Generating Stations[a]						
APS	Four Corners	52,236	143,579	65,746	931	5100
PNM	San Juan	2,629	38,343	27,298	265	2795

Source: All data obtained from National Emissions Data System as compiled by the New Mexico Environmental Improvement Division (NMEID 1982c) unless otherwise indicated. Emissions from generating stations compiled by PNM for TSP, SO_2, and NO_x.

[a] From PNM (1982b)

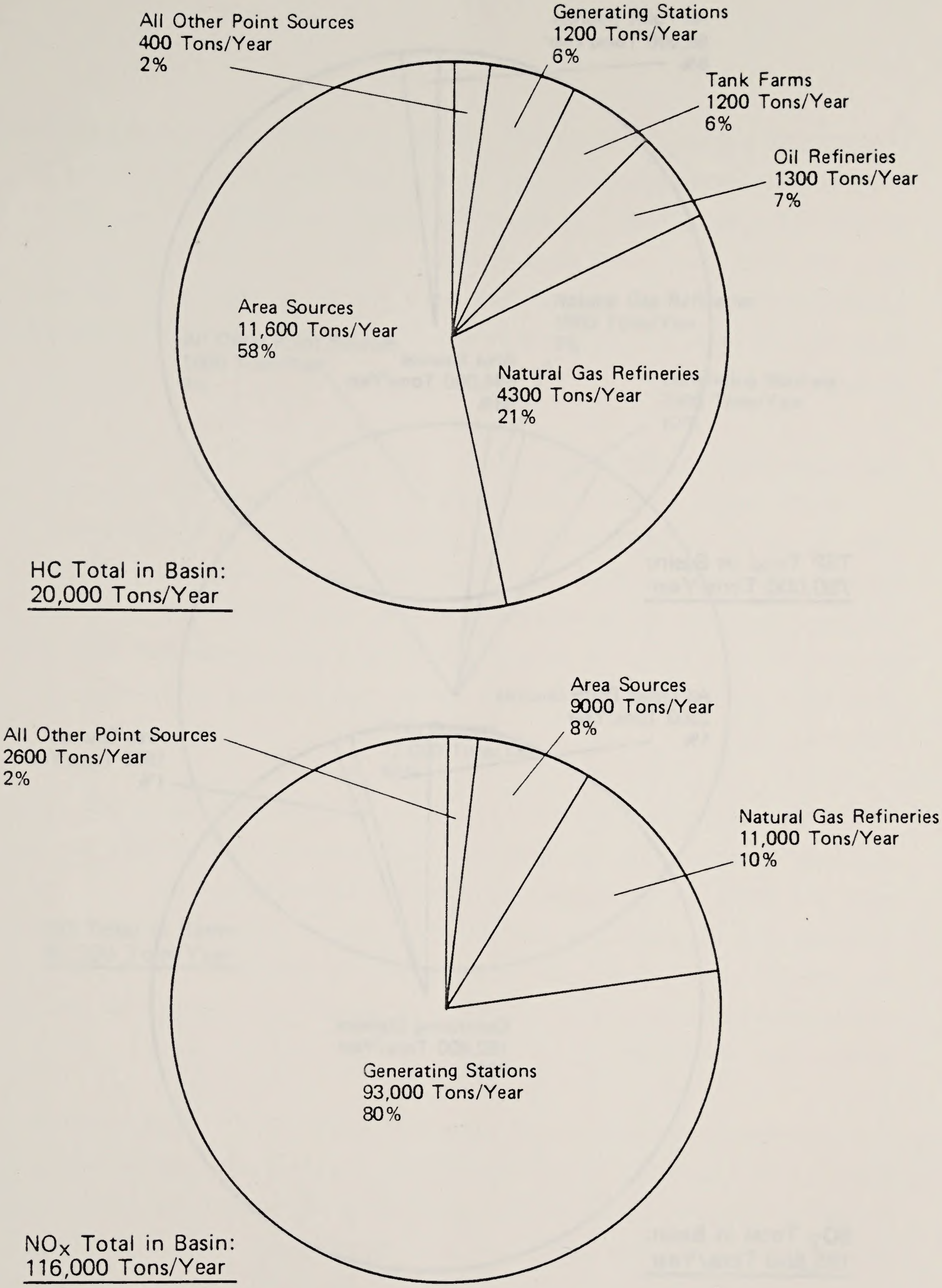
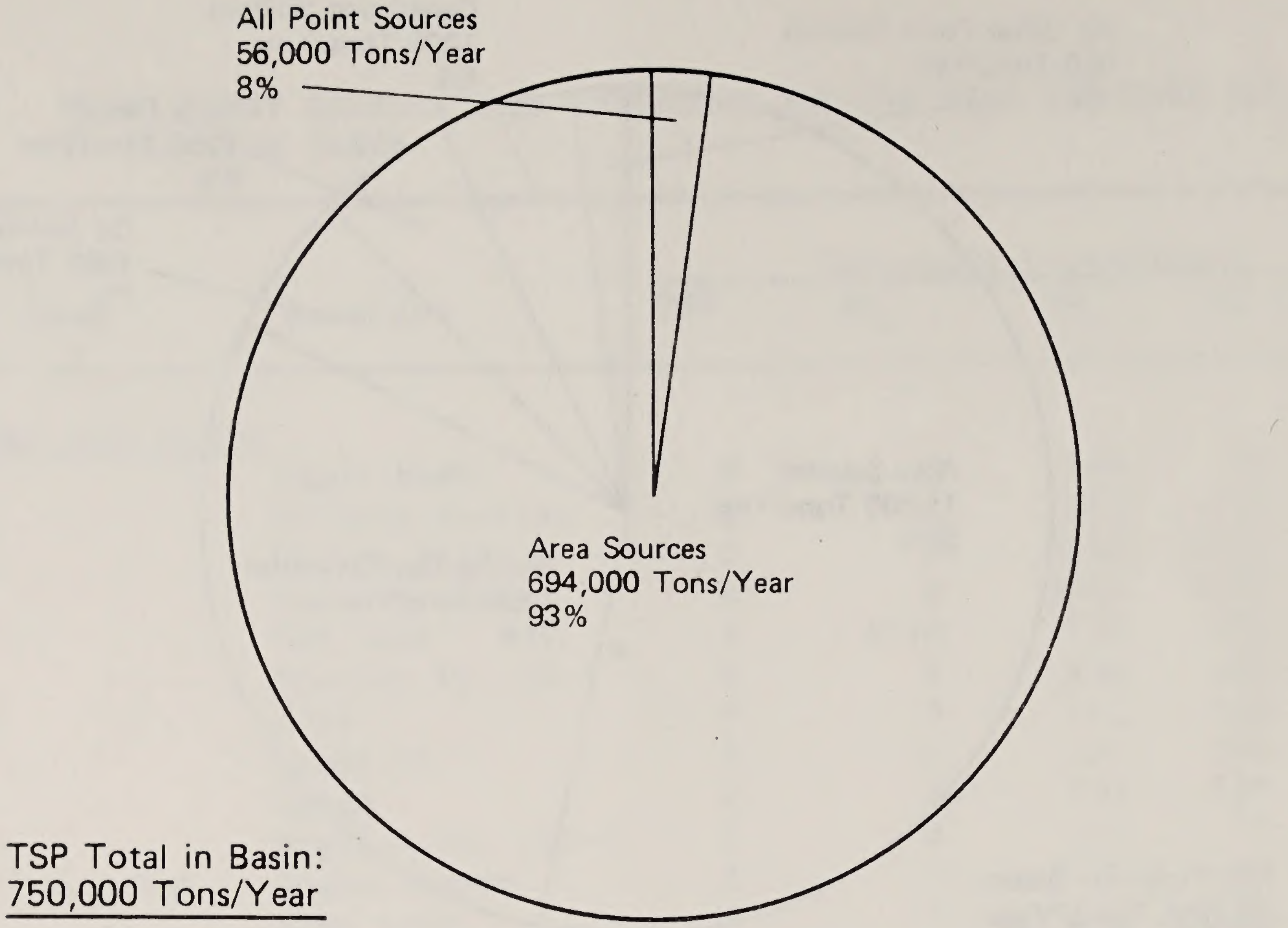


Figure 3-4. BREAKDOWN OF HYDROCARBON AND NO_X EMISSIONS IN THE SAN JUAN BASIN BY SOURCE CATEGORY



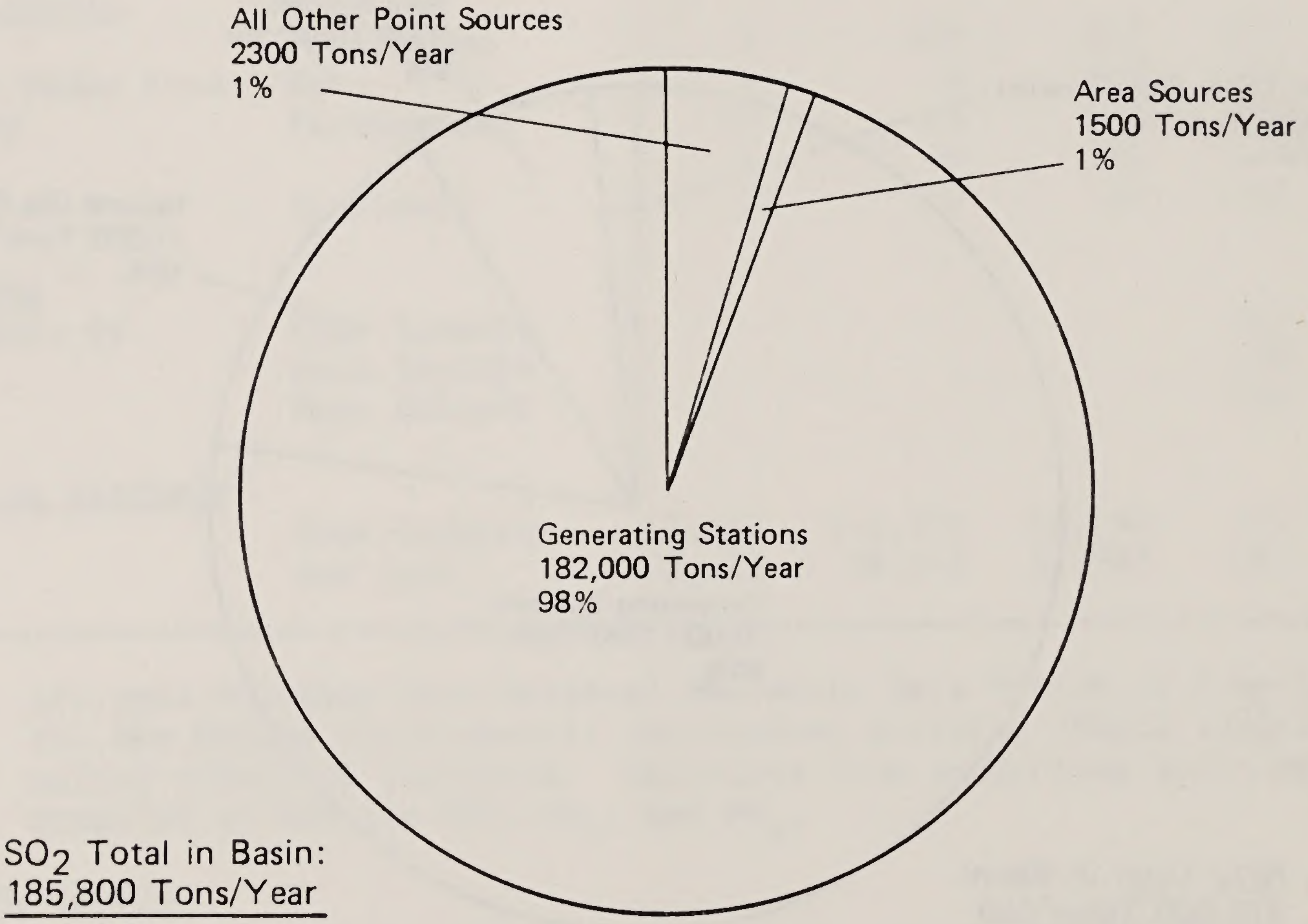


Figure 3-5. BREAKDOWN OF TSP AND SO_2 EMISSIONS IN THE SAN JUAN BASIN BY SOURCE CATEGORY

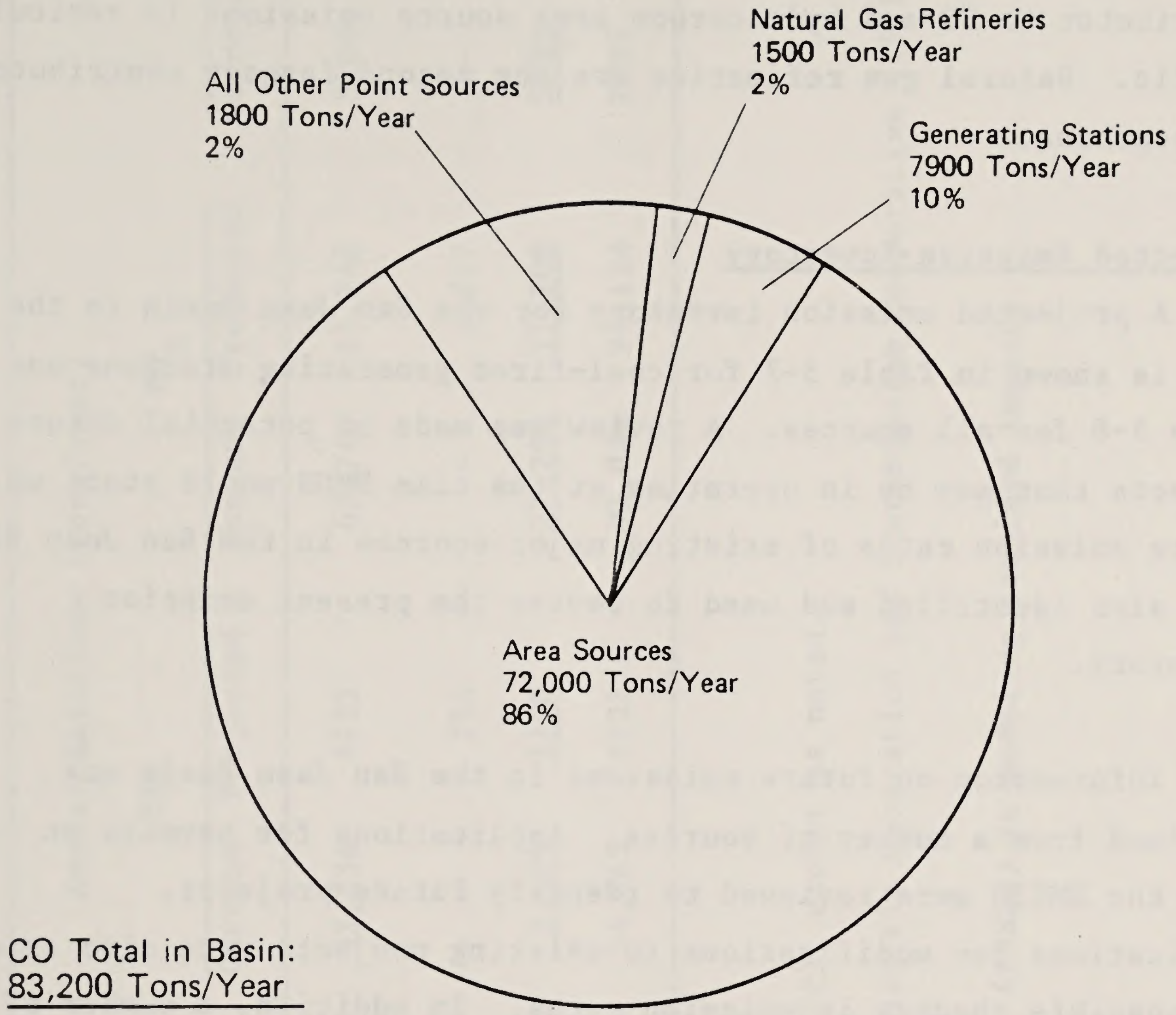


Figure 3-6. BREAKDOWN OF CARBON MONOXIDE EMISSIONS IN THE SAN JUAN BASIN BY SOURCE CATEGORY

significant point source of SO_2 and NO_x, contributing 1.2 percent and 9.6 percent, respectively. The only other significant source of NO_x is vehicular emissions, which is the major contributor to the 9208 tons per year total from area sources. Similarly, the major contributor to CO and hydrocarbon area source emissions is vehicular traffic. Natural gas refineries are the second largest contributor of hydrocarbons.

Projected Emission Inventory

A projected emission inventory for the San Juan Basin in the year 2000 is shown in Table 3-7 for coal-fired generating stations and in Table 3-8 for all sources. A review was made of potential future projects that may be in operation at the time NMGS would start up. Future emission rates of existing major sources in the San Juan Basin were also identified and used to revise the present emission inventory.

Information on future emissions in the San Juan Basin was obtained from a number of sources. Applications for permits on file with the NMEID were reviewed to identify future projects. Applications for modifications to existing projects were also examined for possible changes in emission rates. In addition, a number of environmental studies that project the future air quality in the region were reviewed.

Potential new sources of emissions consist of 1 coal-fired power plant (other than NMGS), 19 coal mines, 2 railroads, and an irrigation project. Changes in future emission rates of 2 existing power plants (Four Corners and San Juan) were also identified.

Rail Lines and Irrigation Projects. All construction operations from such projects would be temporary and result in localized

Table 3-7. CURRENT AND PROJECTED COAL-FIRED POWER PLANT EMISSIONS[a]

Generating Station	Annual Emissions (tons/year)							
	SO_2		TSP		NO_x		CO	
	Current	Projected	Current	Projected	Current	Projected	Current	Projected
Four Corners[b]	143,579	44,184	52,236	4723	65,746	65,746	5100	5100[d]
Prewitt-Escalante[c]	-	1,702	-	254	-	3,827	-	428[d]
San Juan[b]	38,343	40,346	2,629	3750	27,298	37,700	2795	3945[d]
Total	181,922	86,232	54,865	8727	93,044	94,124	7895	9586

[a] Based on allowable emission.

[b] Emission as reported from PNM (1982f), except as noted.

[c] Emission as reported from Plains Electric Generation and Transmission Cooperative (1978); plant will not be operational until 1983.

[d] Projected emissions as used by ERT (1982a) in modeling combined impact.

Table 3-8. PROJECTED FUTURE SAN JUAN BASIN EMISSION INVENTORY

Type of Sources of Emission	TSP			SO_2			NO_x			CO		
	1980 t/yr	2000 t/yr	Percent Change	1980 t/yr	2000 t/yr	Percent Change	1980 t/yr	2000 t/yr	Percent Change	1980 t/yr	2000 t/yr	Percent Change
Total Area Sources[a]	694,000	902,200		1,480	1,924		9,200	11,960		72,000	93,600	
All Point Sources Excluding Power Plants[b]	1,335	1,335		2,304	2,304		12,131	12,131		3,220	3,220	
Total[c]	695,335	903,535	30	3,784	4,228	12	21,331	24,091	13	75,220	96,820	29
Power Plants	54,865	8,727		181,922	86,232		93,044	94,124		7,895	9,586	
Total All Sources	750,200	912,262	22	185,706	90,460	-51	114,375	118,215	3	83,115	106,406	28

[a] Includes all nonpoint sources.

[b] Includes all point sources except power plants.

[c] Total of all sources except power plants.

intermittent emissions composed predominantly of fugitive dust. Gaseous emissions resulting from fuel combustion by construction and maintenance vehicles and trains would be relatively small.

Surface Coal Mines. Gaseous pollutants associated with these projects will be emitted only from fuel combustion sources (vehicles and electric generators). Such emissions will be relatively small and have little effect on air quality. Any emissions from blasting or accidental ignition of coal should be small because of their very infrequent occurrence.

Particulate matter generated by wind erosion and mining activities will be the only significant pollutant emitted during surface mining. These emissions will be generated near ground level or, in the case of pit operation, below ground level. Although the emissions of particulate matter from these sources might result in relatively high ambient concentrations of particulate matter near the mines, there is little probability that such matter would be transported any distance. This inference is supported by studies of particulate emissions performed for surface mining activities (U.S. Dept. of Interior 1978a). These studies indicate that increases in ambient levels of particulate matter seldom exceed 5 $\mu g/m^3$ above baseline concentrations at distances greater than 3 miles from the mining activities (U.S. Dept. of Interior 1978a).

Coal-Fired Power Plants. The projected changes in the emissions from coal-fired generating stations over the next 20 years are given in Table 3-7. The Prewitt-Escalante 233-MW generating station is under construction and will be in operation in the early 1980s. A new 500-MW unit will be added to the three existing units of the San Juan Generating Station. Emission increases from the additional equipment would be partially offset by additional emission controls to be added to both the San Juan and Four Corners generating stations. Total generating capacity of the San Juan Basin will be increased from 3275 MW to 4028 MW.

Current emissions are based on allowable rates for the San Juan and Four Corners generating stations in 1980. Prewitt-Escalante will not be operational until 1983, so only projected emissions are reported. Future emissions are based on changes in state regulations, an additional unit at San Juan, and the Prewitt-Escalante generating station becoming operational.

Residential, Vehicular, and Area Source Emissions. Pollutant emissions resulting from future increases in residential heating, vehicular use, and area sources (oil fields, pumps, natural gas processing plants) are a function of population density. Thus the future increase of such emission sources is assumed to be directly proportional to the increase in population over the next 20 years in the San Juan Basin. This approach is conservative, since increased air pollution control efficiencies of vehicles are not taken into consideration.

Based on information in the Social and Economic Conditions Technical Report, population in the San Juan Basin is expected to increase by 30 percent by the year 2000. Thus the area source emissions tabulated for the present are increased by a factor of 1.3 to represent the future emissions from these sources. These projected emissions are presented in Table 3-8.

3.6 ESTIMATED FUTURE BASELINE CONCENTRATIONS

San Juan River Valley

Future baseline concentrations in the San Juan River valley were calculated using a proration technique based on present and future emission rates presented in Table 3-8. It was assumed that the concentration of pollutants observed is directly proportional to the net emissions in the San Juan Basin. For each pollutant of interest, the current average baseline level for each time period, as presented in Tables 3-3 and 3-4, was multiplied by the percent change from the current to future emission rates, as presented in Tables 3-9 and 3-10, resulting in the estimated future baseline concentration. All data used, and future baseline values calculated, are reported in Tables 3-9 and 3-10. Because CO levels measured in the San Juan River Valley were at or below threshold of detection (with the exception of two monitors in Farmington) scale up of such values were considered unwarranted. The monitors in Farmington because of their location would only reflect emissions from an urban street, and are not representative of area-wide emission of CO.

The assumption that maximum observed concentrations are directly proportional to the net San Juan Basin emissions is reasonable for monitor sites that are not near large emission sources but, as discussed previously, could be unreasonable in the San Juan River valley. A monitoring site located close to a large emission source such as the Four Corners Generating Station would predominantly reflect emissions only from that source. Changes in the current to projected emission rate from that source could be different from the changes in the net emissions for the San Juan Basin. This difficulty was overcome by using the average of the maximum values observed for all the monitors in the San Juan River valley.

Area of Expected Maximum Impact of NMGS

As discussed in detail in Section 4.0, dispersion modeling analyses have been conducted which examine the combined effects of the Four Corners, San Juan, and Prewitt-Escalante power plants with and without NMGS in the area of NMGS's expected maximum impact. The

Table 3-9. ESTIMATED FUTURE BASELINE CONCENTRATIONS IN THE SAN JUAN RIVER VALLEY COMPARED WITH STATE AMBIENT STANDARDS

Pollutant	Sampling Time	Current Baseline[a]	Projected Percent Change[b]	Projected Baseline[c]	Percent of State Standard for Projected Baseline
SO_2	Annual	0.008 ppm	-51	0.004 ppm	20
	24-Hour Maximum	0.043 ppm	-51	0.021 ppm	21
NO_x	Annual	0.011 ppm	3	0.011 ppm	22
	24-Hour Maximum	0.070 ppm	3	0.072 ppm	72
NO_2	Annual	0.007 ppm	3	0.007 ppm	14
	24-Hour Maximum	0.036 ppm	3	0.036 ppm	36
Particulates	Annual	39 $\mu g/m^3$	-	39 $\mu g/m^3$	65
	24-Hour Maximum	39 $\mu g/m^3$	-	39 $\mu g/m^3$	26

[a] From Table 3-3.

[b] From Table 3-8.

[c] Calculated by changing current baseline by percentage in Projected Percent Change column.

Table 3-10. ESTIMATED FUTURE BASELINE CONCENTRATIONS IN THE SAN JUAN RIVER VALLEY COMPARED WITH FEDERAL AMBIENT STANDARDS

Pollutant	Sampling Time	Current[a] Baseline ($\mu g/m^3$)	Projected[b] Percent Change	Projected[c] Baseline ($\mu g/m^3$)	Percent of Federal Standard for Projected Baseline
SO_2	Annual	21	-51	10	13
	24-Hour Maximum	112	-51	55	15
	3-Hour Maximum	356	-51	175	13
NO_2	Annual	13	3	13	13
TSP	Annual	47	-	47	63
	24-Hour Maximum	47	-	47	31

[a] From Table 3-4; monitored values reported in ppm and converted to $\mu g/m^3$ assuming 760 mm pressure.

[b] From Table 3-8.

[c] Calculated by changing current baseline by percentage in Projected Percent Change column.

maximum emission rates that would be allowed under regulations at the time that NMGS would come on-line were used as input to the computer models. As such, the results of this modeling provide estimates of future concentration increases in ambient air from generating stations, with and without NMGS, in the area of expected maximum impact (i.e., within 12 miles of the project site). These predicted concentrations are presented in Section 4.5.

The future ambient concentrations will be the sum of the concentration increase resulting from generating stations in addition to the other anthropogenic sources of emissions in the San Juan Basin, long-range transport from anthropogenic sources outside the San Juan Basin, and natural sources. The total contribution from emissions from all these sources must be examined in order to project future ambient concentrations with and without NMGS.

Concentration increases resulting from the major anthropogenic sources of emissions have been calculated using computer-simulated modeling of generating stations emissions. Other sources of anthropogenic emissions include those listed in Table 3-6 as well as long-range transport (i.e., copper smelters, urban plumes) from outside the San Juan Basin.

Since only the power plants were modeled, an evaluation of the baseline levels without these sources (i.e., "non-power plant" baseline) is necessary. This is done only to permit the comparison of modeled impacts with ambient standards.

The non-power plant baseline is the highest concentrations that have been measured at the project site monitoring station that cannot be attributed to either the Four Corners or San Juan power plant. Methodology for selecting these values is presented in Appendix C.

These values are then adjusted to represent the future non-power plant values that can be expected in that area. This is done by multiplying such concentrations by the ratio of future emissions without generating stations to present emissions without generating stations in the San Juan Basin for the pollutants SO_2 and NO_2. (These ratios are derived in Section 3.5.) Because concentration increases of CO due to NMGS are computed to be below the levels used in defining the geographic area of influence (see Section 2.0), further study of this pollutant is not warranted.

The adjusted non-power plant values for SO_2 and NO_2 are added to the results of the combined modeling analysis for the above-mentioned power plant sources, resulting in estimated concentrations with and without NMGS. Appendix C describes the methodology for the selection of the SO_2 and NO_2 non-power plant baseline values and the adjusted future values that are used in Section 4.5. The present and future non-power plant values for this region are presented in Table 3-11.

In the case of total suspended particulate matter, non-power plant levels are assumed to be the lowest annual average observed at the project site monitor. These values are not adjusted to future emission rates because of the following considerations: (1) the distance of the Four Corners and San Juan power plants from this site; the total emissions of particulate matter from these sources are judged not to contribute significantly to concentrations measured at the project site; and (2) the majority of particulate matter emissions in the San Juan Basin have been identified as area source emissions. However, the Baseline 1 and 2 inventories include a mine that would be located near the NMGS coal handling facilities. Modeling has been conducted by ERT (1981c, 1982b) to assess the particulate matter concentration increases due to this mine in combination with NMGS and

Table 3-11. RANGE OF CURRENT AND PROJECTED NON-POWER PLANT BASELINES

Pollutant	Averaging Period	Current Level[a]	Projected Percent Change[b]	Future Non-Power Plant Baseline[c]
SO_2	Annual Average	0.001 ppm	12	0.001 ppm
	24-Hour	0.005-0.010 ppm[d]	12	0.006-0.011 ppm
	3-Hour	0.005-0.020 ppm[d]	12	0.006-0.022 ppm
NO_2	Annual Average	0.002 ppm	13	0.002
	24-Hour	0.005-0.015 ppm[d]	13	0.006-0.017 ppm
TSP	Annual Geometric Mean	35 $\mu g/m^3$	e	45-52 $\mu g/m^3$
	24-Hour	35 $\mu g/m^3$	e	102-103 $\mu g/m^3$

[a] From Appendix C.

[b] From Table 3-8.

[c] Calculated by increasing current baseline by percentage in Projected Percent Change column.

[d] Range of possible baseline concentrations.

[e] TSP concentrations were not adjusted via emission ratios for reasons discussed in the text. Concentration increases due to a future hypothetical mine to be located adjacent to NMGS were added to the current TSP level to obtain the future level.

the associated coal and ash handling facilities. This is discussed in detail in Section 4.0. The increase due to the hypothetical mine is added to the current TSP baseline value, resulting in a projection of future TSP concentrations in the project area.

3.7 NOISE

The Noise Control Act of 1972 established a national policy "to promote an environment for all Americans free from noise that jeopardizes their public health and welfare." The act provides for a division of powers among the federal, state, and local governments. Currently, New Mexico has no noise regulations. The EPA has suggested noise levels that it has identified as necessary to protect public health and welfare with an adequate margin of safety. The EPA recommends an upper level of 55 decibels (dB) for outdoor areas classified as residential or agricultural, and for other outdoor areas where people spend varying amounts of time. This level has been established as a guideline for future legislation. Since no such legislation exists in New Mexico, this EPA level is used here for guidance only.

Noise Level Criteria

The EPA (1974a) has established noise level criteria recommended for use in community environments. Table 3-12 identifies levels necessary to protect public health and welfare, with an adequate margin of safety, from effects ranging from interference with normal activity to loss of hearing sensitivity. The table classifies various environments according to the primary activities that are likely to occur within each.

The units of measure used in this table are the 24-hour equivalent sound level ($L_{eq(24)}$) and the day-night equivalent sound level

Table 3-12. YEARLY AVERAGE[a] EQUIVALENT SOUND LEVELS IDENTIFIED AS REQUISITE TO PROTECT THE PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY

		Indoor			Outdoor		
	Measure	Activity Interference	Hearing Loss Consideration	To Protect Against Both Effects	Activity Interference	Hearing Loss Consideration	To Protect Against Both Effects
Residential with Outside Space and Farm Residences	L_{dn}	45		45	55		55
	$L_{eq(24)}$		70			70	
Residential with No Outside Space	L_{dn}	45		45			
	$L_{eq(24)}$		70				
Commercial	$L_{eq(24)}$	b	70	70[c]	b	70	70
Inside Transportation	$L_{eq(24)}$	b	70	b			
Industrial	$L_{eq(24)}$[d]	b	70	70[c]	e	70	70
Hospitals	L_{dn}	45		45	55		55
	$L_{eq(24)}$	45	70			70	
Educational	$L_{eq(24)}$	45		45	55		55
	$L_{eq(24)}$[d]		70			70	
Recreational Areas	$L_{eq(24)}$	b	70	70[c]	d	70	70
Farm Land and General Unpopulated Land	$L_{eq(24)}$				d	70	70

Source: EPA 1974a.

Note: The exposure period that results in hearing loss at the identified level is a period of 40 years.

[a] Refers to energy rather than arithmetic averages.

[b] Since different types of activities appear to be associated with different levels, identification of a maximum level for activity interference may be difficult except in circumstances where speech communication is a critical activity.

[c] Based only on hearing loss.

[d] An $L_{eq(8)}$ of 75 dB may be identified in these situations as long as the exposure over the remaining 16 hours per day is low enough to result in a negligible contribution to the 24-hour average, i.e., no greater than an L_{eq} of 60 dB.

[e] Based on lowest level.

(L_{dn}). These units of measure are described by the EPA (1974) in detail. Briefly, $L_{eq(24)}$ is the average sound level in a 24-hour period with equivalent weighting throughout the entire period. The L_{dn} is also a 24-hour average level, but increased weighting is placed on nighttime hours (11 p.m. to 7 a.m.) to simulate the normal increase in human sensitivity to noise at night. Thus nighttime sound levels for the 24-hour period are increased by 10 dB before averaging.

As indicated in Table 3-12, the EPA suggests that indoor levels above 45 dB (L_{dn}) may interfere with normal activities such as spoken communication in the home and in some work and educational environments. An L_{dn} of 55 dB is suggested to protect against interference in many outdoor areas, while an L_{dn} of 70 dB is suggested to protect against hearing loss. In some areas of the country these levels have been adopted as goals for use in planning. New Mexico currently has no specific legal noise standards or criteria. Figure 3-7 provides examples of typical L_{dn} sound levels measured in various areas of the country. The L_{dn} scale has been used in this baseline study.

Existing Noise Levels

The proposed site is in a remote location in which the only major noise sources are vehicles traveling on roads. For the purposes of this report, the Bisti and De-na-zin Wilderness Study Areas have been identified as potential sensitive receptors. Monitoring at the Bisti WSA was performed by PNM at the southeastern corner of the boundary at the closest point to the proposed NMGS (2.7 miles). At the De-na-zin WSA, noise measurements were made at the southwestern corner of the boundary at the point closest to the proposed NMGS (3.5 miles). Measurements were not made at the western boundary of the Bisti WSA, where Highway 371 runs alongside. Thus it is reasonable to expect that noise levels at the western boundary of the Bisti WSA would be higher than the 32 to 35 dB(A) levels measured at the other locations.

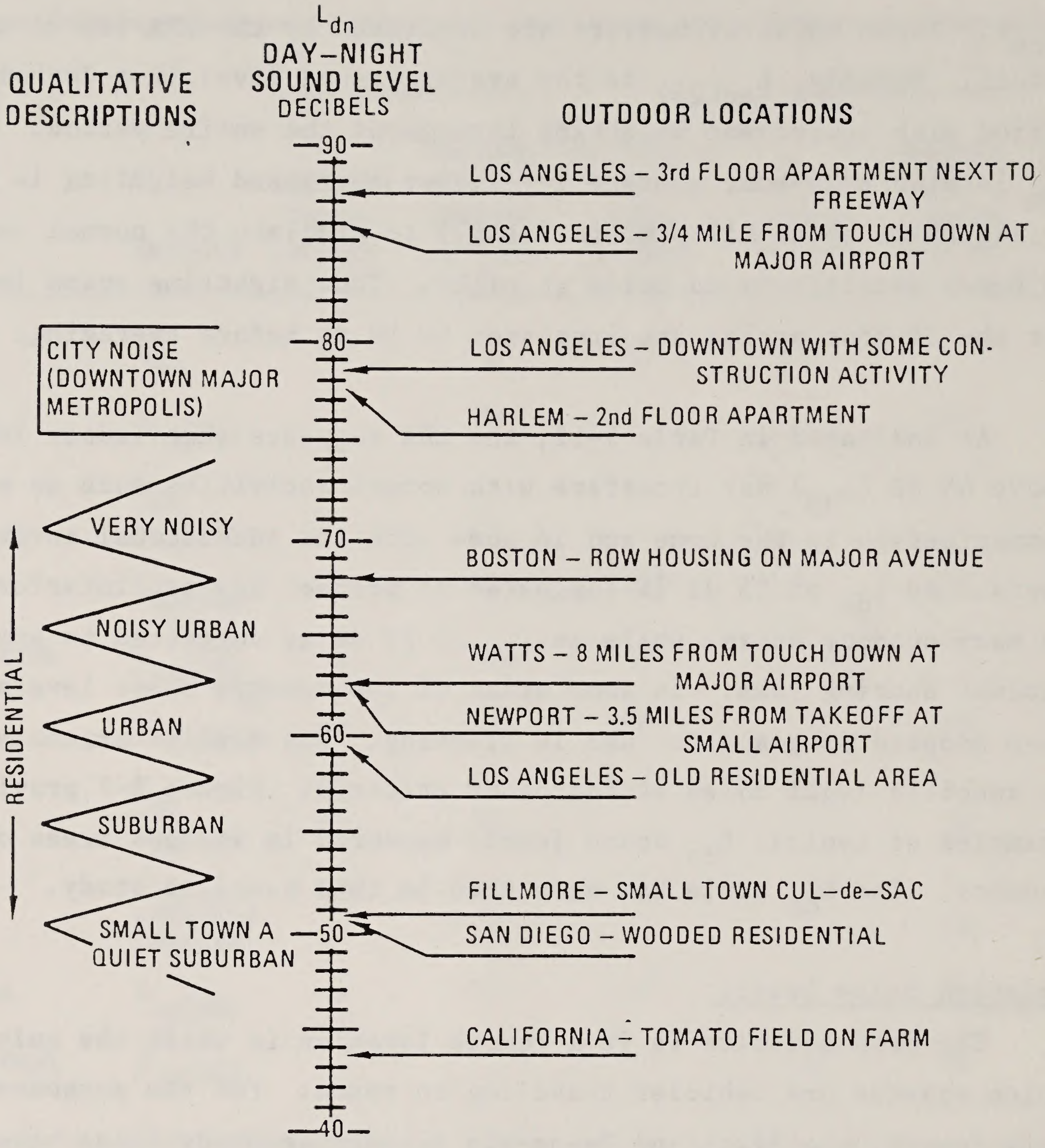


Figure 3-7. OUTDOOR DAY-NIGHT SOUND LEVELS AT VARIOUS LOCATIONS

Based on this, a baseline level of 35 dB(A) should be representative of the secluded areas in the geographic area of influence.

Future Noise Levels Without NMGS

Noise sources have been identified that are expected to affect NMGS's geographic area of influence for noise. These are (1) the mine that would be located near the NMGS coal- and ash-handling facilities; and (2) future vehicle traffic on NM 371 and County Road C-15, including employee-related traffic associated with the mine.

Information regarding the mine has been included in an air quality modeling study conducted by ERT (1982b), which is discussed in Section 4.0. The study makes assumptions about the size and activities associated with the mine and refers to it as the "hypothetical mine."

Table 3-13 presents "future baseline" noise levels at the boundaries of the Bisti and De-na-zin WSAs, as well as at points 1/4 mile and 2000 feet from NM 371 and County Road C-15 within the respective WSAs.

Appendix B contains descriptions of the calculation procedures used to derive these values. This section describes the methods used in the noise analysis for the hypothetical mine and future traffic flows. Noise sources associated with the hypothetical mine are the mine activity itself, automobile and haul truck traffic, and blasting.

Automobile and Haul Truck Traffic. Automobile traffic noise levels associated with projected traffic flows, including hypothetical mine employees, were predicted using the nomograph presented in Figure 3-8. The nomograph requires information related to automobile speed,

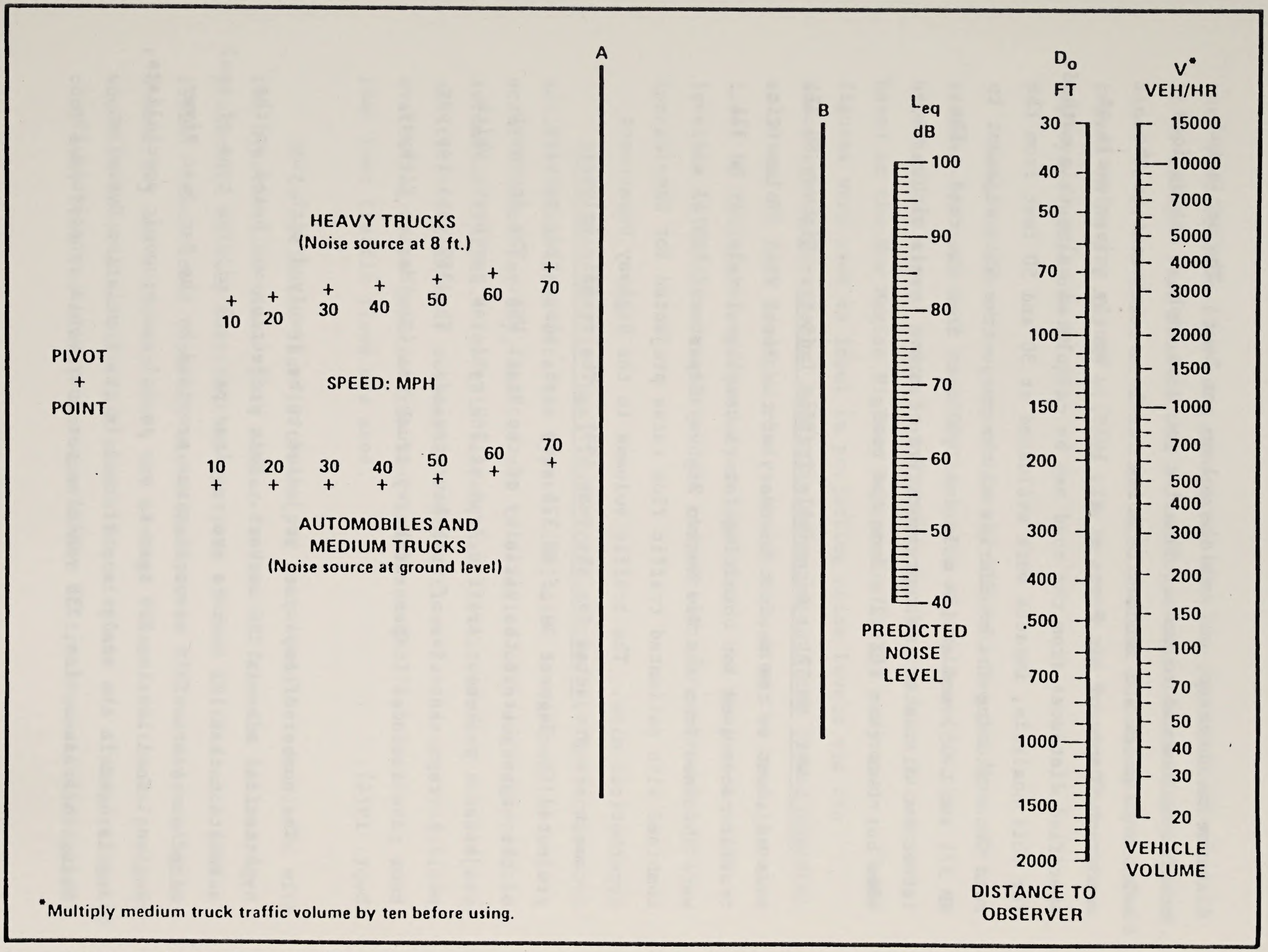
Table 3-13. FUTURE BASELINE NOISE LEVELS AT THE BISTI AND DE-NA-ZIN WSAs WITH RESPECT TO DISTANCE FROM NM 371 AND COUNTY ROAD C-15

		Noise Levels [dB(A)][a]			
		Distance from Road			
Receptor Area	Time of Day	30 ft	50 ft	1/4 mi	2000 ft
Bisti WSA	Peak-hour traffic	76	73	51	49
	Nonpeak traffic	75	71	49	47
De-na-zin WSA	Peak-hour traffic	35-65	35-61	35-40	35
	Nonpeak traffic	35-71	35-68	35-46	35-41

[a] Noise levels include blasting, automobile and haul truck traffic, and mine noise.

[b] For the Bisti WSA, NM 371 is used; for the De-na-zin WSA, County Road C-15 is used.

[c] Noise levels are stated as a range, since it is not known what volume of employee traffic or haul trucks from the hypothetical mine would use Road C-15. The lower values are representative of the ambient level measured there, and are indicative of minimal traffic flow (i.e., less than 1 vehicle per hour, average). The upper values are indicative of maximum employee and haul truck traffic from the hypothetical mine.



*Multiply medium truck traffic volume by ten before using.

Source: Department of the Air Force et al. 1978.

Figure 3-8. L_{eq} NOMOGRAPH FOR STREET VEHICLE ROADWAY NOISE distance to observer, and vehicle volume per hour. The projected traffic is assumed to travel 50 miles per hour (mph). Assumptions related to truck and automobile noise levels are inherent in the nomograph (Dept. of Air Force et al. 1978). Hourly noise levels at specified distances from the road may be calculated using this method. For this analysis, impacts were evaluated at 30 and 50 feet from the road (constituting the boundaries of the respective WSAs adjacent to NM 371 and C-15) and at 1/4 mile and 2000 feet from the road. The latter two distances are representative of noise levels within the WSAs but less than 1/2 mile from the road.

Bisti WSA, NM 371: Automobile Traffic Impacts. Highway NM 371 runs adjacent to the western boundary of the Bisti WSA. Volumetric traffic rates used for obtaining future baseline levels for NM 371 were obtained from the New Mexico Highway Department (1974) and combined with estimated traffic flow rates projected for the hypothetical mine. The traffic volumes in the Highway Department document are projected for the year 1997. The traffic volumes projected for Segment 20 of NM 371 were used, since this portion of the highway is in the vicinity of the Bisti WSA. The document projected a peak-hour traffic load of 380 vehicles per hour, which would be representative of rush-hour periods. The 380 vehicles per hour rate includes 16 percent heavy truck use (New Mexico Highway Dept. 1974).

The number of employees projected to be involved with the hypothetical mine is 230 workers. This projection was based on the assumption that 103 workers are required per each million tons of coal mined per year. This assumption was provided by the San Juan River Regional Coal Leasing EIS team to our social and economic specialists, and is used in the analysis performed in the Cumulative Overview. Using this assumption, 230 vehicles per hour would constitute the rush-hour traffic flow rate associated with the hypothetical mine. It is assumed that none of the 230 employee vehicles are heavy trucks. Since it is not known at this time what portion of the employees would travel on NM 371 and NM 44, for this study it is assumed that all employees would use NM 371.

Based on the above, approximately 550 vehicles per hour are assumed for peak-hour traffic, inclusive of employees of the hypothetical mine. A total of 61 heavy trucks per hour is assumed, based on the New Mexico Highway Department (1978) projection. These figures were used as input in projecting noise levels via the nomograph (Figure 3-8). Resulting noise impacts are 76 and 73 dB(A) at 30 and 50 feet from the road. At 1/4 mile from the road, a noise level of 51 dB(A) is projected; at 2000 feet, the projected noise level is 49 dB(A). Details of the computations are presented in Appendix B.

Bisti WSA, NM 371: Haul Truck Traffic Impacts. Haul truck activity associated with the hypothetical mine is assumed (1) to occur 8 hours per day, and (2) not to coincide with employee-related autombile traffic. For this reason, haul trucks are not treated as additive to peak-hour automobile traffic flows in this analysis. In evaluating noise impacts from haul trucks on NM 371, therefore, non-peak hour traffic flows are used.

It is estimated that 13 trucks per hour would be associated with the hypothetical mine. This number is derived from the estimated production of 2.25 million tons per year of coal at this mine (ERT 1982b). Haul truck capacity was assumed to be 85 tons. Assuming an 8-hour day and a 250-day year, the average rate of 13 trucks per hour would be associated with this mine. Since trucks are transporting the coal away from the mines, the same number of trucks must also return empty, accounting for twice as many trucks on the highways in the same time period. Thus a maximum of 26 trucks per hour is assumed for purposes of computing noise impacts.

Nonpeak traffic flow rates projected by the New Mexico Highway Department (1974) for the year 1997 are 103 automobiles and 23 heavy trucks per hour. Combining the truck traffic from the hypothetical mine results in a total of 49 heavy trucks per hour. Resulting noise impacts calculated using the nomograph are 75 and 71 dB(A) at 30 and 50 feet from the road, respectively. At 1/4 mile from the road, the projected noise level is 49 dB(A). At 2000 feet, the noise level projected is 47 dB(A).

De-na-zin WSA, Road C-15: Automobile Traffic Impacts. Information on projected traffic flows on County Road C-15 are not available. Road C-15 is a little-used thoroughfare that is sometimes impassable during severe weather. Consultation with our transportation specialist indicates an average traffic flow of 20 vehicles per day, assumed to be primarily automobiles. The hourly traffic volume is thus less than 1 vehicle per hour. This volume represents a negligible amount, and the noise level that is most indicative of this would be the ambient level of 35 dB(A) measured at the De-na-zin WSA. It is not known at this time what percent of the 230 employees associated with the hypothetical mine would travel on Road C-15. Noise impacts were calculated based on the maximum volume of 230 vehicles per hour on this road, and the future baseline noise levels along C-15 are thus represented as a range. The lower end of the range is indicated by the 35 dB(A) level; the upper end of the range represents a traffic volume of 230 vehicles per hour.

Projected noise levels assuming the maximum traffic on C-15 are 65 and 61 dB(A) at 30 and 50 feet from the road, respectively. At

1/4 mile, the level is projected to be 40 dB(A); at 2000 feet, the level is calculated to attenuate to the measured ambient level of 35 dB(A).

De-na-zin WSA, Road C-15: Haul Truck Traffic Impacts. Similar to the situation described above for automobile traffic on this road, it is not known to what degree haul trucks from the hypothetical mine would use Road C-15. For this reason, future baseline noise impacts are stated as a range, with the lower end representing the ambient measured level of 35 dB(A). The upper end represents the noise impacts associated with the maximum level of 26 trucks per hour associated with this mine. Projected noise levels at 30 and 50 feet from the road are 71 and 68 dB(A) respectively. At 1/4 mile, the noise level projected is 46 dB(A). A level of 41 dB(A) is projected at 2000 feet from the road.

Mining Activity Noise. Noise measurements made at the Navajo Mine near the Four Corners Power Plant (U.S. Dept. of Interior 1976) have been examined. These measurements reflect noise from draglines and dozers as well as from drilling and shovel activities. It is expected that noise levels associated with these activities at the hypothetical mine would be similar: approximately 78 dB(A) at the mine boundary. The noise levels at the Bisti and De-na-zin WSAs due to these continuous noise sources at the hypothetical mine can be projected by using a formula for noise attenuation.

Calculations of noise levels at distances from the noise source are based on the assumption that a noise level at 50 feet from the source (denoted by N_{50}) is reduced by 6 dB for each doubling of distance away from the source (Peterson and Gross 1972). This premise can be stated as an equation:

$$N_D = N_{50} - \frac{6\text{ dB} \times \log_{10}(D/50\text{ ft})}{\log_{10}2} \qquad (1)$$

where N_D and N_{50} are expressed in dB(A). N_D represents the noise level at the distance D (feet) from the noise source. N_{50} represents the noise level at 50 feet from the noise source.

Using the above equation, distances (D) of 2.0 and 3.5 miles, and a noise level (N_{50}) of 78 dB(A) at the mine, the noise of the mine would attenuate to 31 and 27 dB(A) at the boundaries of the Bisti and De-na-zin WSAs, respectively. This does not take into account attenuation due to noise barriers. Since there is elevated terrain between the hypothetical mine and the receptors, the terrain would act as a noise barrier and additional attenuation can be assumed. Experimentation and observation indicate that a barrier may account for an attenuation of 24 dB(A) (Mestre and Wooten 1980). Applying this to the 31 and 27 dB(A) noise impacts from the mine, the resulting noise levels at the Bisti and De-na-zin WSA boundaries would be 7 and 3 dB(A), respectively. These noise levels, when combined with the future baseline levels due to automobile and haul truck traffic discussed above, result in negligible increases above baseline. (Computation is made using the decibel addition procedure described in Section 2.9.) Thus noise from the hypothetical mine operation would not be discernible at the Bisti or De-na-zin WSA.

Blasting Noise. Noise levels associated with blasting are based on noise measurements made by PNM (1982e) at the San Juan Coal Company mine in Waterflow, New Mexico. The monitoring has shown that a blast has a duration of approximately 7 seconds in which the noise level is above 50 dB(C) (C-weighted decibels), and three seconds above

80 dB(C). The peak noise level measured was 97 dB(C). The 7-second time equivalent noise level (L_{eq}) was calculated to be approximately 89 dB(C) for the 7 seconds of the blast. The measurements were made at approximately 1500 feet from the blast. The measured values correspond to an impulse noise level (i.e., level at 50 feet from the noise source) of 119 dB(C), using the formula mentioned above.

The units of C-weighted decibels are used in the measurement of blasting due to the structural vibration aspect of this noise source. Structural vibration is related to annoyance, which would not be adequately represented by using the A-weighted scale. In computing a composite description of the noise level environment, the C-weighted scale may be supplemented by the A-weighted scale, since the two are comparable in the frequencies to which the ear is most sensitive (Dept. of the Air Force et al. 1978).

Using the 6 dB(A) attenuation formula, an average blast would attenuate to a level of approximately 73 dB(C) at the southeastern boundary of the Bisti WSA (approximately 2 miles from the hypothetical mine) and to a level of approximately 68 dB(C) at the southwestern boundary of the De-na-zin WSA (approximately 3.5 miles). These projections do not take into account the attenuation due to barriers. As mentioned previously, the hypothetical mine is separated from the Bisti WSA by elevated terrain. This is also the case for De-na-zin. In addition, since blasting would occur at ground and subsurface levels, the blasting pits themselves would act as noise barriers. Applying the 24 dB(A) attenuation due to barriers to the above figures, the instantaneous (i.e., 7-second) noise levels associated with blasting are estimated to be 49 dB(C) at the Bisti WSA and 44 dB(C) at the De-na-zin WSA.

These figures by themselves provide more an indication of maximum intermittent noise levels at the WSAs rather than an "average" noise level that may be expected. "Average" noise levels are termed L_{eq} levels and may represent specific intervals of time. It is appropriate to calculate L_{eq} values of one hour at these receptors, due to blasting.

On the average, there would be two blasts per week associated with the hypothetical mine. On a particular day when a blast would occur there would thus be one hourly interval within the day in which noise levels would be representative of this blast. It is appropriate, then, to combine this noise level for its 7-second duration with the projected noise levels associated with peak hourly traffic flows on NM 371 and Road C-15, as well as with haul truck traffic associated with the hypothetical mine.

Time-equivalent (L_{eq}) noise levels may be obtained using the following equation:

$$L_{eq} = 10 \log^{10} \left(\sum_{i=1}^{n} x_i \; 10^{Li/10} \right) \qquad (2)$$

where L_i is a noise level for a particular event, and x_i is the fraction of the total time that the event occurs. Assuming that a blast lasts for approximately 7 seconds, the fraction of time, x_i, for a blast would then be the ratio of 7 seconds to one hour (the period of time for which the L_{eq} is being calculated). This ratio is 0.0019. For the remaining fraction of time, the L_i value assumed is the future baseline value projected for automobile and haul truck traffic as described above.

The details of this calculation are presented in Appendix B. Because of the short duration of the blasts, the hourly L_{eq} due to blasting is negligible.

3.8 VISIBILITY

Visibility Regulations

The EPA has established visibility protection regulations for mandatory Class I areas (December 2, 1980). The objective of these regulations is to achieve the national goals for visibility stipulated in the Clean Air Act: (1) the prevention of any future impairment of such areas, and (2) the remedying of any existing impairment of such areas.

These regulations propose protective measures that require a joint effort by the National Park Service and the individual states. The principal measures to be carried out by these entities include:

1. Identification of vistas that can be seen from a Class I area and that are considered to be an integral part of the viewing experience (integral vistas).
2. Identification of existing stationary sources that cause visibility impairment in any mandatory Class I area or any integral vista of such an area.
3. Installation of applicable retrofit technology on any such source identified in item 2 above.
4. Control of new or modified sources.
5. The development of a long-term strategy by the individual states to meet the national goal.

The EPA regulations are in the process of being implemented. The National Park Service has conducted investigations to identify integral vistas and possible sources of existing visibility impairment. In the project region, the Park Service has designated Shiprock as an integral vista of the Mesa Verde National Park. With respect to new or modified sources, the implementation of visibility protection for such sources is carried out under the PSD regulations.

These regulations require that new or modified sources demonstrate that there will be no significant visibility impairment or deterioration in all areas, not just Class I areas. The regulations also provide qualitative definitions of "significant impairment" and "adverse impact" with respect to visibility. (These are described in Section 2.5.)

In addition to the visibility regulations of the EPA, the National Park Service Organic Act also authorizes visibility protection for national parks. Specifically, the Act states that the fundamental purpose of national parks is "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (39 Stat. 535, August 25, 1916). Although Chaco Culture National Historical Park is not designated a Class I area subject to PDS, the overall National Park Service mandate cited above would require this area to be examined as well.

Visibility Conditions in the Project Region

The maximum distance at which the outlines of a target can be recognized against the horizon by the eye is determined by the contrast threshold. Any object viewed through the atmosphere becomes invisible once its contrast relative to the background is less than the contrast threshold. Visibility is the distance at which an object is seen with a contrast exactly equal to the contrast threshold or the maximum distance at which the outlines of a target can be recognized against the horizon as background.

Visibility impairment is a function of the amount of light scattering and absorption by matter in the atmosphere. Aerosols (fine liquids or particles suspended in air) account for most of the light scattering. Light absorption is predominately a result of gases (e.g., NO_2) and, to a lesser extent, particles.

A particle-free "clean" atmosphere at sea level has a maximum visibility of 190 miles. Visibility impairment results from the introduction into the atmosphere of light scattering and absorption material from both natural and anthropogenic sources.

Principal air pollutants that can directly impair visibility are fine particles and NO_2. Sulfur dioxide emissions are transformed into sulfates, which generally are fine particles. Windblown dust is also a major contributor of fine particles. Anthropogenic activities that disturb soil cover add to the amount of windblown dust.

Reduced visibility in the southwestern United States has been associated with regional episodes of both increased sulfur and natural dust emissions (Cahill et al. 1981). An identifiable impact from southern California smog has been found on the visibility in Arizona (Macias et al. 1981). In a study of the composition of pollutants and visibility, fine sulfur was the only element that showed a significant correlation with visibility at Chaco Canyon (Pitchford et al. 1981).

During the late 1960s, copper smelters accounted for over 90 percent of the total sulfur emissions in the Southwest. A 9-month copper strike permitted investigators to correlate reduced SO_2 emissions and sulfate levels with increased visibility. Significant improvements in visibility were found throughout the Southwest. In the Farmington area there was a significant improvement of the visual range when the winds were from the direction of the smelters (Latimer et al. 1978).

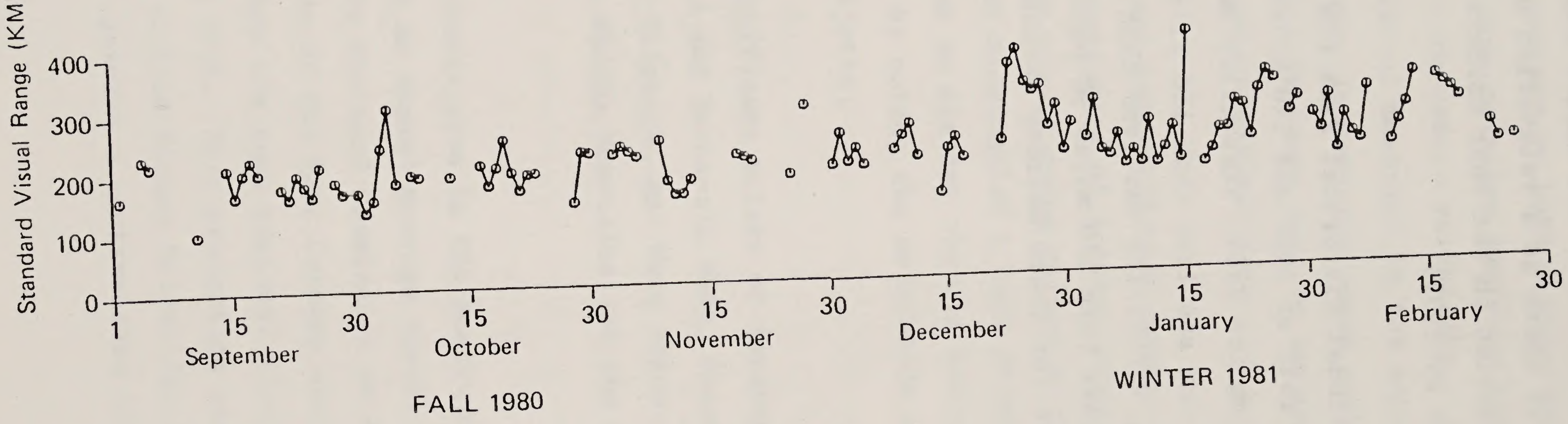
Visibility conditions are strongly influenced by variations in meteorological parameters on both a short-term and seasonal basis. For example, increased relative humidity favors growth of atmospheric aerosols, that in turn reduce visibility. Increased wind speeds cause increased dispersion of material in the atmosphere, thus improving visibility. However, in semiarid areas such as the project region, higher wind speeds also cause dust to become suspended in the atmosphere, thus reducing visibility.

The easiest and currently most common method of assessing the visibility characteristics of a given region is by quantifying the visual range. The visual range refers to the maximum distance at which a viewer can distinguish a dark object (such as a mountain) from the horizon. When no distant objects are within view, visual range can be estimated by noting the coloration and light intensities of the sky and nearby objects.

Visually significant points of interest in the project region include the Bisti and De-na-zin WSAs, Chaco Culture National Historical Park, Shiprock, and Mesa Verde. Other visual points of interest are the Chuska Mountains and the San Pedro Parks Wilderness Area.

The Four Corners area in the Southwest currently enjoys excellent visibility, with an annual average visual range of 80 miles for 1980 (NCAQ 1981). The National Commission on Air Quality (see Glossary) conducted a study of the Four Corners area with respect to visibility and concluded that the same regional visibility characteristics would persist through 1995. This projection assumes high levels of growth in the study area (Los Alamos Scientific Laboratory 1980). This projection also assumed a continuation of current regulatory requirements for copper smelters in New Mexico and Arizona. They conclude, however, that if there is a relaxation of emission standards for major sources of pollution in the Four Corners area, visibility impairment could increase by 1995.

At Chaco Culture National Historical Park the median visibility was 120 miles during the fall of 1980 and 140 miles during the winter of 1981 (NPS 1981). During the fall, visibility was less than 90 miles 10 percent of the time and less than 150 miles 90 percent of the time. During the winter, visibility was less than 110 miles 10 percent of the time and less than 170 miles 90 percent of the time. A cumulative frequency chart for Chaco Culture National Historical Park is given in Figure 3-9.



Source: NPS et al. 1981.

Figure 3-9. DAILY VARIATION OF STANDARD VISUAL RANGE: CHACO CULTURE NATIONAL HISTORICAL PARK

4.0
ENVIRONMENTAL CONSEQUENCES

The effect of the proposed NMGS with respect to pollutant concentration increases, radiological impacts, and noise has been explored. This section discusses the methodology used in each analysis and presents the results.

Air pollution concentration increases were investigated through dispersion modeling, most of which was conducted by PNM's contractor, Environmental Research & Technology (ERT). Noise levels and radiology were explored using mathematical and chemical analytic techniques, which are explained in detail in later sections.

The air quality analysis indicates that maximum concentration increases attributable to NMGS would occur within 12 miles (20 km) of the plant site. Total future concentrations would be below applicable state and national ambient air quality standards.

Noise impacts from NMGS would be insignificant in the sensitive receptor areas of the De-na-zin and Bisti WSAs and Chaco Culture National Historical Park. There is a potential for a significant noise impact at the De-na-zin WSA, due to increased employee traffic on Road C-15, associated with NMGS.

The radiological impact from airborne effluents released during coal combustion by NMGS would be below standards used for protection of individuals from exposure to radiation. These standards are used as an indicator of significance as defined in the Framework for Analysis (Section 2.0).

4.1 CONSTRUCTION

Air Quality

Construction of the proposed NMGS would take place over approximately a 10-year period. The principle sources of air pollution during construction would be construction equipment. This equipment would cause emissions of fugitive dust and gaseous pollutants (engine exhaust). Gaseous emissions would be a minor source of air pollution and would not be expected to have a significant impact on ambient air quality.

In order to assess the possible impact of fugitive dust emissions, the amount of dust to be emitted during the peak construction year was estimated. The major source activities during this "worst-case" period are expected to be vehicular travel on unpaved roads, site earthwork, and wind erosion of exposed surfaces.

Fugitive dust from vehicle travel on unpaved surfaces was estimated using an uncontrolled emission factor of 5.15 pounds per vehicle mile (ERT 1982b) and an estimated maximum annual vehicle mileage of 405,800 miles (PNM 1982c). This yields an uncontrolled emission of 1045 tons per year.

Uncontrolled emissions from site earthwork were estimated using a factor of 1.2 tons/acre-month (EPA 1979b) and assuming that a total of 800 acres would be disturbed, spread evenly over a 14 month period. Thus emissions would be about 68 tons per month or 816 tons per year.

Uncontrolled emissions from wind erosion were estimated using a factor of 1200 pounds per acre per year (EPA 1978a). This factor was developed for conditions similar to those at the proposed site. During a worst case year a maximum of about 730 acres would be exposed. Thus emissions would be about 438 tons per year.

Based on the above, worst case annual uncontrolled fugitive dust emissions would be about 2300 tons. These emissions can be compared to those from mining and coal and ash handling (1351 tons per year). These source types are similar in that both are mostly ground-level emissions. As discussed in Section 4.5 emissions from mining and coal and ash handling are not predicted to have a significant impact on ambient air quality. Although some construction and mining activities may occur concurrently, these emissions are expected to have only a localized impact, based on dispersion modeling of mining emissions (ERT 1982b).

Noise

Representative levels of construction noise generated by individual items of equipment are listed in Table 4-1. As indicated in the tabulation, typical individual noise levels range from 80 to 98 dB(A) at 50 feet from the source. Construction equipment use schedules are not available at this time. As a result, the following analysis is general and assumes that the construction of NMGS would be similar to the construction of an average large industrial plant as described by the EPA (1975). Construction activity comprises the following phases: clearing, excavation, foundation, erection, and finishing. Of these, the excavation (site preparation) phase is estimated to be the noisiest.

Equivalent sound levels, L_{eq}, are computed using the maximum sound level emitted by the equipment and the fraction of time that the maximum level is emitted, based on the EPA method discussed in Section 3.7. Equipment that would be used for the construction of a power

Table 4-1. CONSTRUCTION EQUIPMENT SOUND LEVELS AND USE FACTORS FOR EXCAVATION OF LARGE INDUSTRIAL PLANTS

Equipment	Number of Units	Total Noise Level at 50 ft (dB[A])[a]	Use Factor	L_{eq} for Specific Equipment[b]
Air Compressor	1	81	1.0	81
Backhoe	2	88	0.16	80
Dozer	3	92	0.4	88
Generator	1	78	0.4	74
Loader	2	87	0.4	83
Rock Drill	1	98	0.02	81
Shovel	1	82	0.4	78
Truck	4	85	0.26	79
		Total L_{eq} = 91.3 dB(A)[c]		

[a] Source: EPA (1975).

[b] L_{eq} values computed as a function of use factor, based on the following EPA (1974) formula: $L_{eq} = 10 \times \log_{10}$ [antilog (total noise level/10) x use factor]

[c] Individual L_{eq} values are summed by using the following EPA (1974) method: total $L_{eq} = 10 \times \log_{10} \sum_{i=1}^{n}$ [antilog $(L_{eq(i)}/10)$]

plant, along with the sound levels and use factors, are presented in Table 4-1.

The individual noise levels are converted to individual one-hour L_{eq} values via the respective use factors. The resulting hourly L_{eq} values are summed logarithmically to obtain the total noise level from all equipment. (The method of decibel addition is described in Section 2.9).

The resulting one-hour L_{eq} value is 91 dB(A) at a distance of 50 feet from the equipment. Using noise propagation formulas (previously discussed in Section 3.7), the estimated equivalent sound level for the excavation phase is 65 dB(A) in the immediate vicinity of the plant (i.e., within 1000 feet of the plant). At greater distances the noise diminishes to the extent that at the closest sensitive area (the Bisti Wilderness Study Area, 2.7 miles away), the noise level due to excavation is computed to be 42 dB(A). At the De-na-zin WSA, located approximately 4.7 miles from NMGS, the noise level is computed to be 37 dB(A). As discussed in Section 3.7, the elevated terrain between the NMGS site and the WSAs would act as a natural noise barrier, contributing to an attenuation of approximately 24 dB(A) (Mester and Wooten 1980). Thus, taking into account the natural noise barriers, noise impacts due to construction activities are calculated to be 18 and 13 dB(A) at the Bisti and De-na-zin WSAs respectively.

These noise impact levels are combined with the range of future baseline levels projected for these areas (discussed in Section 3.7). The method of addition of decibel levels is described in Section 2.9. Because the noise impact levels due to construction are low at these receptors, total combined levels are expected to increase a negligible amount. Based on this, it is not expected that noise levels due to construction would be discernible at these receptor locations.

4.2 EMISSIONS RESULTING FROM PROJECT OPERATION

The proposed power plant would emit various quantities of air pollutants, including particulate matter, nitrogen oxides, carbon monoxide, and sulfur oxides. Sources of atmospheric emissions from NMGS include (1) coal- and ash-handling facilities and (2) fuel combustion. Because of the coal reserves located near the proposed NMGS site, it is anticipated that surface mining would be developed at some time. It is likely that a mine would be located near the NMGS coal-handling facilities. It is assumed for this analysis that this mine is located directly adjacent to and to the north of the plant site. This mine shall be referred to as the hypothetical mine.

Coal- and ash-handling facilities as well as the hypothetical mine would result in particulate matter emissions that are primarily fugitive emissions, with controlled emissions from crushing and grinding vented through baghouses or other suitable controls.

The proposed coal-fired NMGS would consist of four 500-MW units, each with a separate stack. The stack may be as high as 575 feet with a range of 400 to 575 feet being considered. A summary of estimated emissions from the power plant, hypothetical mine, and associated coal- and ash-handling facilities is presented in Table 4-2. The following description of the hypothetical mine and the proposed coal- and ash-handling facilities and proposed power plant is based on information provided by PNM and its air quality contractor (ERT 1981d, 1982b). A more detailed description is given in Appendix D.

Table 4-2. SUMMARY OF EMISSIONS FROM THE PROPOSED NMGS AND ASSOCIATED COAL- AND ASH-HANDLING FACILITIES

	Emissions[a]													
	SO_2		NO_x		TSP		NMVOC[b]		CO		Be		Pb	
Source	lb/hr	t/yr	lb/hr	t/yr	lb/hr	t/yr	lb/hr	t/yr	lb/hr	t/yr	lb/hr	t/yr	lb/hr	t/yr
NMGS	7436	26,055	9842	34,485	656	2300	13.2	46	1317	4600	0.16	0.6	2.6	9.2
Coal- and Ash-Handling	–	–	–	–	143.2	267	–	–	–	–	–	–	–	–
Hypothetical Mine	–	–	–	–	390.0	1084	–	–	–	–	–	–	–	–
Total	7436	26,055	9842	34,485	1189.2	3651	13.2	46	1317	4600	0.16	0.6	2.6	9.2

[a] Annual emission rates for NMGS are based on 80 percent capacity. Annual emission rates for coal- and ash-handling facilities are based on frequency of operation of the various pieces of equipment. TSP values do not include wind-dependent emissions.

[b] NMVOC = Nonmethane volatile organic compounds

HYPOTHETICAL MINE AND COAL- AND ASH-HANDLING FACILITY

It is assumed that the hypothetical surface coal mine would use draglines for removal of the covering layer of overburden and to expose the coal seams. The coal would then be mined using a truck/shovel combination. Emission calculations of fugitive dust, and subsequent modeling are based on full-scale mining operations at the hypothetical mine, with a total production of 2.25 million t/yr from a single mine pit north of the plant, and an additional 6.75 million t/yr transported by truck from other pits in the area to the hypothetical mine for primary and secondary crushing (ERT 1982b).

Four major steps assumed in the mining operations at the hypothetical mine would be (1) surface material removal, (2) overburden removal, (3) coal removal and transport, and (4) reclamation. Coal- and ash-handling and transfer operations within the power plant area would be conducted using a covered conveyor system. After primary and secondary crushing, coal would be transferred to four open storage piles and reclaimed through an underground vibrating grate. After pulverization, coal would be pneumatically moved to boilers for combustion. Ash produced by coal combustion would be collected in four enclosed storage silos and transported as needed in haul trucks. Emergency storage piles would be constructed to contain a three-month supply of primary crushed coal.

Emission Factors

Emissions of particulate matter from fugitive emission sources as well as controlled stack emission sources (e.g., secondary crushing) were calculated using factors selected from current literature sources as described in Appendix D. The emission factors used are presented in Table 4-3.

Table 4-3. FACTORS FOR UNCONTROLLED EMISSIONS USED FOR NMGS HYPOTHETICAL MINE AND COAL- AND ASH-HANDLING OPERATIONS

Operation	Emission Factor Units	Emission Factor[a]
Topsoil Scraping	lb/yd^3	0.35
Topsoil Dumping	lb/yd^3	0.03
Drilling (Overburden)	lb/hole	1.5
Blasting (Overburden)	lb/blast	49.8
Drilling (Coal)	lb/hole	0.22
Blasting (Coal)	lb/blast	58.53
Dragline	lb/yd^3	0.021
Coal Shovel	lb/ton	0.0066
Dozers (Coal)	lb/hr	32
Bottom Dump Truck	lb/ton	0.0165
Dozers (Overburden)	lb/hr	32
Grader	lb/hr	32
Unpaved Haul Roads		
Haul Trucks	lb/vmt[b]	5.15
Water Trucks	lb/vmt[b]	2.06
Utility Vehicles	lb/vmt[b]	1.29
Wind Erosion	ton/ac-yr[c]	$0.0058u^3$ (d)
Secondary Crushing	lb/ton[e]	0.06
Coal Conveying	lb/ton[e]	0.05
Coal Transfer Points	lb/ton[e]	0.023
Stockpile Load-In	lb/ton[e]	$0.0013u$[d]
Stockpile Load-Out	lb/ton[e]	$0.00047u$[d]
Coal Transfer by Front-End Loader	lb/vmt[b]	0.31

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[a] Source: ERT (1982b); described further in Appendix D.

[b] vmt = vehicle mile traveled.

[c] Tons of emissions per acre per year for exposed areas.

[d] u is average wind speed in meters per second.

[e] Pounds of emissions per ton of material worked.

The emission factors selected for use in computation of particulate matter emissions by PNM's contractor (ERT) were based on a review and evaluation of the fugitive dust emission factors available from literature sources. A full description of the evaluation process is contained in a report entitled "EIS Impact Analysis of Fugitive Dust Emissions from a Hypothetical Mining Operation Located Adjacent to the Proposed New Mexico Generating Station" (ERT 1982b). The calculations are presented in the above document.

Emissions from Hypothetical Mine and Coal- and Ash-Handling Operations

Total fugitive emissions for the hypothetical mine and coal- and ash-handling operations for NMGS were calculated by ERT using operational parameters supplied by PNM. Operational parameters used by ERT are presented in Table 4-4. Emissions were determined by multiplying the operational parameters by the emission factor for each operation. Total annual and hourly emissions in grams per second for the coal- and ash-handling operations were computed by ERT and are reported in Table 4-5 along with the assumed control technology and the controlled emission rate. Table 4-6 presents the emissions computed for the hypothetical mine.

The uncontrolled fugitive emissions for the hypothetical mine and coal and ash handling would be 2866 t/yr. Controlled emissions based on the assumed control technology would be 1351 t/yr.

PLANT EMISSIONS

Air pollutant emissions associated with the power plant are a function of fuel combustion, primarily in the vapor-power cycle of the steam electric system. The coal-fired NMGS would consist of

Table 4-4. OPERATIONAL PARAMETERS USED IN ASSEMBLING PARTICULATE MATTER AND FUGITIVE DUST EMISSIONS INVENTORY FOR NMGS HYPOTHETICAL MINE AND COAL- AND ASH-HANDLING OPERATIONS

Operational Parameter	Value
Coal Throughput Rate	9.0×10^6 t/yr
Emergency Coal Storage	45 acres
Emergency Coal Handling[a]	750,000 t/yr
Emergency Coal Transfer[b]	16,608 mi/yr
Active Coal Storage	4 acres
Fly-ash Loading	16 hr/d, 5 d/wk, 50 wk/yr
Fly-ash Hauling	
Haul Trucks	60,184 mi/yr
Water Trucks	23,332 mi/yr
Stripping Ratio	5.8 yd^3 overburden/ton of coal
Overburden Removal Rate	1.31×10^7 yd^3/yr[c]
Haul Roads - Coal haul	167,700 vmt/yr[d]
Utility vehicles	27,152 vmt/yr
Fly ash haul	99,600 vmt/yr[c]
Water truck	40,000 vmt/yr[c]
Blasting (Coal)	50 blasts/yr[c]
Blasting (Overburden)	50 blasts/yr[c]
Drilling (Coal)	18 holes/blast
Drilling (Overburden)	18 holes/blast
Coal Mining Rate (Bisti)	2.25×10^6 t/yr
Coal Processing Rate	9.0×10^6 t/yr
Fly Ash Dumping	16 hr/d, 5 d/wk, 50 wk/yr
Acres Mined	125 ac/yr
Exposed Acreage Prior to Reclamation	125 ac/yr
Topsoil Removal Rate	363,000 yd^3/yr[c]
Graders (1)	8 hr/d, 5 d/wk, 50 wk/yr

Table 4-4. OPERATIONAL PARAMETERS USED IN ASSEMBLING PARTICULATE MATTER AND FUGITIVE DUST EMISSIONS INVENTORY FOR NMGS HYPOTHETICAL MINE AND COAL- AND ASH-HANDLING OPERATIONS (concluded)

Operational Parameter	Value
Overburden Removal Hours	24 hr/d, 7 d/wk, 52 wk/yr
Coal Removal Hours	16 hr/d, 5 d/wk, 50 wk/yr
Topdressing Removal Hours	16 hr/d, 5 d/wk, 50 wk/yr
Topdressing Stockpile Surface Area	9.4 acres[c]
Average On-site Wind Speed	3.39 m/sec[c]
Crushing Hours	16 hr/d, 5 d/wk, 50 wk/yr

Source: ERT (1982b).

[a] Intermittent source only, active approximately one month out of a year (16 hr/d, 20 d/yr).

[b] Transfer of coal from the emergency storage pile to the active storage piles by front-end loader.

[c] Calculated values (ERT 1982b).

[d] Coal haul vehicle miles traveled include an additional 6.75 million t/yr over haul roads located within the assumed hypothetical mine lease area from other pits located in the area, for a total production of 9 million t/yr.

Table 4-5. PARTICULATE MATTER AND FUGITIVE DUST EMISSIONS INVENTORY FOR NMGS COAL AND ASH-HANDLING OPERATIONS

Operation	Uncontrolled Emissions (g/sec)			Control Technology Assumed	Controlled Emissions (g/sec)			
	Annual	Hourly	Daily		Factor	Annual	Hourly	Daily
1. Secondary Crusher	1.29	2.83	1.89	Baghouse	0.01	0.01	0.03	0.02
2. Conveyors								
- Plant boundary	5.39	11.81	7.87	Enclosure	0.1	0.5	1.18	0.79
- Transfer facility to active storage	2.98	6.53	4.35	Lowering well	0.20	0.60	1.31	0.07
- Active storage to coal bunker	2.98	2.98	2.98	Dustless loader	0.30	0.89	0.89	0.89
3. Transfer point before active storage (1)	2.98	6.53	4.35	Enclosures	0.10	0.40	0.65	0.44
4. Transfer points after active storage (4)	2.98	2.98	2.98	Enclosure	0.10	0.30	0.30	0.30
5. Emergency Operations[a]								
- Load-out	0.02	—[a]		—	1.0	0.02	—[a]	
- Load-in	0.05	—[a]		—	1.0	0.05	—[a]	
- Reclaim conveyor	0.54	14.78		Enclosure Watering	0.1	0.05	1.48	
- Transfer	0.12	3.34		—	0.5	0.06	1.67	
6. Wind Erosion								
- Active coal pile	0.26	—[a]		Windbreak	0.70	0.02	—[a]	
- Emergency coal pile	0.29	— a		stabilizer	0.30	0.09	—[a]	
7. Ash Handling								
- Load-out from	0.22	0.49	0.33	High moisture content	0.20	0.04	0.10	0.07
- Ash hauling[b]	8.33	18.24	12.17	Watering	0.50	4.17	9.18	6.08
8. Rail Carload in	0.36	0.78	0.52	—		0.36	0.78	0.52
9. Diesel Exhaust	0.12	0.28	0.17		1.0	0.12	0.28	0.17

Source: ERT (1982b).

[a] Intermittent source only, active approximately 1 month out of a year (16 hr/day, 20 d/yr).

[b] Including water truck emissions.

[c] Value of short-term emissions dependent on wind speed.

Table 4-6. FUGITIVE DUST EMISSIONS INVENTORY FOR THE HYPOTHETICAL MINING OPERATION

	Uncontrolled Emissions (g/sec)			Assumed Control	Control	Uncontrolled Emissions (g/sec)		
Operation	Annual	Hourly	Daily	Technology	Factor	Annual	Hourly	Daily
Dragline	3.94	3.94	3.94	—	1.0	3.94	3.94	3.94
Haul roads								
-to primary pit	4.76	10.40	6.95	Watering	0.50	2.38	5.21	3.47
-to secondary pit (west)	4.28	9.37	6.25	Watering	0.50	2.14	4.68	3.12
-to secondary pit (east)	4.19	9.17	6.11	Watering	0.50	2.09	4.59	3.06
Blasting (coal)	0.04	0.09	0.06	—	1.0	0.04	0.09	0.06
Blasting (overburden)	0.04	0.08	0.05	—	1.0	0.04	0.08	0.05
Drilling (coal)	0.003	0.006	0.004	—	1.0	0.003	0.006	0.004
Drilling (drilling)	0.02	0.04	0.03	—	1.0	0.02	0.04	0.03
Bottom drop truck	2.14	4.68	3.12	—	1.0	2.14	4.68	3.12
Coal shovel	0.02	0.05	0.03	—	1.0	0.02	0.05	0.03
Primary crushing	2.59	5.67	3.78	Water spray	0.10	0.26	0.57	0.38
Secondary crushing								
conveyors	7.77	17.0	11.34	Water spray	0.10	0.78	1.70	1.13
-primary to secondary crusher	6.48	14.19	9.45	Enclosure	0.10	0.65	0.42	0.95
-secondary crusher to loadout facility	0.50	1.09	0.77	Enclosure	0.10	0.05	0.11	0.07
Loadout facility	0.04	0.09	0.06	—	1.0	0.04	0.09	0.06
Wind erosion (unreclaimed area)	4.07	—*	—*	—	1.0	4.07	—*	—*
Wind erosion (mining area)	3.25	—*	—*	—	1.0	3.25	—*	—*
Wind erosion (stockpile area)	0.06	—*	—*	—	1.0	0.06	—*	—*
Fly Ash dumping	0.22	0.49	0.33	10% moisture content of ash	0.20	0.04	0.10	0.07
Topsoil scraping	1.83	4.0	2.67	—	1.0	1.83	4.0	2.67
Topsoil dumping	0.16	0.34	0.23	—	1.0	0.16	0.34	0.23
Grader	0.92	2.0	1.34	—	1.0	0.92	2.0	1.34
Dozers (coal)	1.84	4.03	2.68	—	1.0	1.84	4.03	2.68
Dozers (overburden)	4.03	4.03	4.03	—	1.0	4.03	4.03	4.03
Diesel exhaust	0.40	1.00	0.66	—	1.0	0.40	1.0	0.66

*Value of short-term emissions dependent on wind speed.

four 500-MW units, each served by a separate stack. These units are proposed to come on-line according to the following schedule:

- Unit 1: 1990
- Unit 2: 1993
- Unit 3: 1995
- Unit 4: 1998

However, for the purpose of impact assessment, the ultimate 2000-MW capacity was assumed. Upset conditions such as failure of pollution control equipment would be infrequent and temporary, and as such are not expected to result in significant impacts.

The proposed plant would require two types of fuel for operation. The primary fuel is expected to be locally mined subbituminous coal. The secondary fuel is expected to be No. 2 or No. 6 fuel oil produced in New Mexico. For conservatism, all emission calculations are based on the combustion of coal. Tables 4-7 and 4-8 provide analyses of the coal that would be used in the power plant.

Subbituminous coal would be used in the steam generation system that supplies steam to the turbine generator and plant ancillary systems that are not supplied by the auxiliary boiler. Initially, coal is proposed to be supplied from the Sunbelt Mining Company's (SMC) Bisti mine, located adjacent to the NMGS site.

Fuel oil would be used to produce steam for the plant auxiliary steam system during plant startup and maintenance. The composition of the No. 6 fuel oil anticipated to be used is shown in Table 4-9. Auxiliary steam would be used for station heating, deaerator pegging steam, steam coil air heater requirements, main steam generator ignitor oil supply, and condenser air ejectors.

Table 4-7. SMC BISTI MINE COAL ANALYSIS

	As Received (raw)	
Proximate Analysis	Typical	Range
Moisture (%)	16.7	11.0 to 23.03
Ash (%)	19.6	8.33 to 30.35
Volatile (%)	29.6	23.85 to 39.81
Fixed Carbon (%)	34.1	26.26 to 41.80
Total	100.0	
Btu per Pound (as received)	8,300	6870 to 10,546
Btu per Pound (dry)	10,400	8185 to 12,406
Sulfur (%)	0.54	0.30 to 0.74
Sulfur Forms		
Pyritic Sulfur (%)	0.15	0.05 to 0.69
Sulfate Sulfur (%)	0.01	0.00 to 0.02
Organic Sulfur (%)	0.38	0.25 to 0.53
Water-Soluble Alkalis		
Water-Soluble Na_2O	0.6	0.34 to 1.40
Equilibrium Moisture	16.3	
Hardgrove Gindability Index	47.8	43.5 to 58.7
Ultimate Analysis		
Carbon (%)	48.96	39.62 to 57.52
Hydrogen (%)	3.62	3.18 to 3.80
Nitrogen (%)	0.88	0.67 to 1.14
Chlorine (%)	0.00	0.00 to 0.01
Sulfur (%)	0.53	0.30 to 0.71
Ash (%)	19.03	8.24 to 30.44
Oxygen (%)	9.66	8.27 to 10.71
Moisture (%)	17.32	12.95 to 25.28
Moisture Analysis (Ash)		
Phosphorus Pentoxide (P_2O_5)	0.1%	0.03 to 0.35%
Silica (SiO_2)	56.8%	46.66 to 63.92%
Ferric Oxide (Fe_2O_3)	3.7%	2.43 to 5.91%
Alumina (Al_2O_3)	27.4%	19.68 to 36.30%
Titania (TiO_2)	0.8%	0.69 to 1.04%
Calcium Oxide (CaO)	3.8%	1.54 to 4.83%
Magnesium Oxide (MgO)	0.9%	0.64 to 1.82%
Sulfur Trioxide (SO_3)	1.9%	0.32 to 7.35%

Table 4-7. SMC BISTI MINE COAL ANALYSIS (concluded)

Proximate Analysis	As Received (raw) Typical	As Received (raw) Range
Potassium Oxide (K_2O)	0.8%	0.34 to 1.84%
Sodium Oxide (Na_2O)	2.1%	1.15 to 3.15%
Undetermined	1.7%	
Total	100.0%	
Fusions		Reducing
Initial Deformation		2260 to +2700°F
Softening (H = W)		2325 to +2700°F
Hemispherical (H = 1/2W)		2460 to +2700°F
Fluid		2585 to +2700°F

Source: Western Coal Company, 1978, unpublished data.

Table 4-8. TRACE ELEMENT CONCENTRATION--SMC BISTI MINE COAL

Element	Range in Concentration (in ppm by weight)	Element	Range in Concentration (in ppm by weight)
Antimony	0.1 - 1	Neodymium	3 - 21
Arsenic	0.2 - 10	Nickel	1 - 16
Barium	41 -1500	Niobium	4 - 24
Beryllium	0.1 - 6	Praseodymium	1 - 10
Boron	3 - 68	Rhenium	tr
Bromine	0.1 - 4	Rubidium	2 - 940
Cadmium	0.3 - 1	Samarium	2 - 6
Cerium	9 - 250	Scandium	0.9 - 7
Cesium	0.4 - 6	Selenium	0.3 - 2
Chromium	2 - 18	Silver	tr - 0.4
Cobalt	0.4 - 8	Strontium	30 - 390
Copper	4 - 270	Tantalum	tr
Dysprosium	1 - 4	Tellurium	0.1 - 0.6
Erbium	0.3 - 2	Terbium	0.1 - 0.8
Europium	0.1 - 1	Thallium	tr - 0.9
Fluorine	24 - 220	Thorium	7 - 20
Gadolinium	0.2 - 2	Thulium	tr - 0.2
Gallium	4 - 36	Tin	tr - 6
Germanium	0.1 - 3	Tungsten	tr - 2
Hafnium	tr - 3	Uranium	2 - 9
Holmium	0.4 - 2	Vanadium	10 - 82
Iodine	tr - 0.3	Ytterbium	tr - 2
Lanthanum	8 - 87	Yttrium	5 - 36
Lead	1 - 20	Zinc	1 - 18
Lithium	4 - 660	Zirconium	35 - 160
Lutetium	tr - 0.4		
Manganese	1 - 120		
Mercury	0.03- 0.22		
Molybdenum	2 - 9		

Source: Western Coal Company (1978), unpublished data.

Methods of analysis: atomic absorption, flameless atomic absorption (mercury only), specific ion electrode (fluorine only).

Table 4-9. ANALYSIS OF SECONDARY FUEL

	No. 6 Fuel Oil[a]	No. 2 Fuel Oil[b]
Specific Gravity at 60°F	0.95	0.85
Flash Point (°F)	150	178 (closed-cup)
Pour Point (°F)	110	15 (summer)
Viscosity (SSU)	5000 at 110°F	32 at 140°F
Carbon (percent)	85.9	86.3
Hydrogen (percent)	10.1	12.9
Oxygen (percent)	0.5	0.43
Nitrogen (percent)	0.5	0.03
Sulfur (percent) (max)	3.0	0.5
Vanadium (ppm)	800	Not Available
Ash (percent)	0.10	0.001
Heating Value (Btu/lb)	18,200	19,500

[a] Source: PNM unpublished data, 1978.

[b] Source: Union Oil of California.

The primary function of the auxiliary boiler would be to provide sufficient capacity to make steam during plant startup operations. The required capacity of the auxiliary boiler has not yet been determined. The boiler is anticipated to be used twice a year, for 2 to 4 weeks during scheduled maintenance intervals. For the rest of the year, auxiliary steam would be supplied from the main unit's boiler.

Because of the temporary nature of the auxiliary boiler operation, and the fact that emissions from this boiler would be substantially less than those from the main unit (as discussed in further detail below), all subsequent modeling analyses are based on combustion of coal in the plant itself. Emission rates (both short-term and annual) of air pollutants are presented below. These rates were input to the various dispersion models to predict downwind ambient concentrations, as discussed further in Section 4.5.

Sulfur Dioxide, Oxides of Nitrogen, and Particulate Matter

Emission estimates for sulfur dioxide, oxides of nitrogen, and particulate matter are based on the maximum allowable emission rate provided under NMEID Regulations 602 and 603 and EPA's NSPS for power plants. Specifically, these regulations limit emissions for the respective pollutants by the following amounts:

Sulfur dioxide: 0.34 lb/10^6 Btu (NMEID Regulation 602)

Oxides of nitrogen: 0.45 lb/10^6 Btu (NMEID Regulation 603)

Particulate matter: 0.03 lb/10^6 Btu (EPA's NSPS Regulation: 40 CFR 60, Subpart Da)

Based on a maximum heat input of 21,870 x 10^6 Btu/hr, the short-term emissions of these pollutants have been calculated assuming a 100 percent load:

Sulfur dioxide: 7436 lb/hr (26,055 t/yr)

Oxides of nitrogen: 9842 lb/hr (34,485 t/yr)

Particulate matter: 656 lb/hr (2300 t/yr)

The annual emission rates stated above are based on an 80 percent capacity for all four units.

Carbon Monoxide

Based on the EPA (1979b) emission factor of 1 pound of CO per ton of coal burned, and a coal feed rate of 1317 t/hr, total carbon monoxide emissions are computed to be approximately 1317 lb/hr (4600 t/yr based on an 80 percent capacity). The coal feed rate is based on a heat input of approximately 21,870 x 10^6 Btu/hr and an energy content of 8300 Btu/lb of coal.

Nonmethane Volatile Organic Compounds (VOC)

Based on information obtained from EPA (1978b), the emission factor for nonmethane VOC from the combustion of coal is 0.01 lb of nonmethane VOC per ton of coal. Based on the above coal feed rate of 1317 t/hr, the emissions of nonmethane VOC are thus computed to be approximately 13.2 lb/hr (46 t/yr based on an 80 percent capacity).

Lead

Based on average lead content of 10 ppm in the coal and a 90 percent control rate by particulate control equipment, lead emissions are computed to 2.6 lb/hr (9.2 t/yr).

Emissions for lead, beryllium, VOC, and carbon monoxide were based on four units and an 80 percent capacity factor for annual values and at a 100 percent capacity factor for short term values (PNM 1981b).

4.3 COMPLIANCE WITH REGULATIONS AND EMISSIONS STANDARDS

Regulations that would affect the proposed power plant are discussed in Section 3.0. This section discusses the proposed power plant with regard to compliance with the appropriate regulations.

FEDERAL REGULATIONS

Prevention of Significant Deterioration

The Prevention of Significant Deterioration (PSD) permit program applies to areas of the country in which the air quality is better than the national ambient air quality standards. The goals of the program as stipulated in the Clean Air Act and its relationship to this analysis are addressed in detail in Section 2.0. Briefly, the basic intent of the PSD regulations is to keep "clean air clean." This is accomplished by placing ambient air quality limitations for SO_2 and particulate matter above what is termed a "baseline concentration." These limitations are called "increments," which differ depending on the class designation of the area in which the project is locating, as well as the areas that the project would affect. Sources subject to PSD must use Best Available Control Technology (BACT) and must also demonstrate that the applicable PSD increment limits would not be exceeded.

Federal Land Managers have input to the PSD permitting process if a project would have an air quality impact in a Class I area. If a

Federal Land Manager finds that emissions from a proposed project would have an adverse impact on the "air quality related values" of a Class I land area, the government department with authority over such lands may recommend to EPA that the permit be denied. This recommendation can be made even though compliance with the Class I increment limits are demonstrated. "Air quality related values" include fish and wildlife resources, vegetation, archaeologic sites, and soil impacts.

In the opposite situation in which the Class I increment limits are predicted to be exceeded, the PSD regulations allow the owner of the proposed project to appeal to the Federal Land Manager. The owner must then demonstrate to the satisfaction of the Federal Land Manager that the emissions from the project will not adversely affect the air quality related values. If the Federal Land Manager concurs with this demonstration, a permit may be issued that would allow the project to comply with less stringent air quality increments in the Class I area.

The NMGS is required to be permitted under these regulations. Partial PSD authority was delegated by EPA, Region VI, to the NMEID. Thus, PNM will be making application with the NMEID for a PSD permit.

New Source Performance Standards

The proposed power plant would be in compliance with the NSPS for electric utility steam generating units (40 CFR 60, Subpart Da) which stipulates the following emissions rates:

Sulfur dioxide: 0.6 lb/10^6 Btu

Nitrogen oxides: 0.5 lb/10^6 Btu

Particulate matter: 0.03 lb/10^6 Btu

Nuclear Regulatory Commission

There are no applicable regulations with which coal-fired power plants must be in compliance.

STATE REGULATIONS

In addition to the PSD permit, a permit to construct would also be required from the NMEID, under New Mexico Environmental Improvement Board Air Quality Control Regulation 702. The review procedure is such that compliance with EPA's PSD regulations should satisfy the requirements of Regulation 702.

The proposed power plant would also be in compliance with the following emission regulations:

Regulation 504:	establishes emission limit for particulate matter from coal-burning equipment of 0.05 lb/10^6 Btu, and limits fine particulate matter emissions of less than 2 microns (μm) in diameter to 0.02 lb/10^6 Btu.
Regulation 602:	establishes emission limit for sulfur dioxide for coal-burning equipment of 0.34 lb/10^6 Btu, that begins commercial operation after December 31, 1982.
Regulation 603:	establishes emission limit for nitrogen dioxide for new coal-burning equipment of 0.45 lb/10^6 Btu.

Regulation 672:	requires controls for coal preparation plants to include hoods, shields, or sprays to prevent particulate matter from becoming airborne. It also requires watering of haul roads where reasonably necessary to minimize fugitive dust emissions.
Standards for Protection Against Radiation:	establishes ambient levels of radioactive material for sources that must be either registered or licensed by the NMEID. Coal-fired power plants do not emit sufficient radiation to require registering or licensing.

4.4 CONTROL TECHNOLOGIES

PNM has not yet made the final selection of air pollution control equipment, but is considering various technologies to be used for the control of particulate matter, nitrogen oxides, and sulfur dioxide. The technologies that are chosen must be able to achieve the emission limitations discussed above, and must also be demonstrated to comply with EPA's BACT requirement.

The control technologies that are being considered are described in detail in the Project Description Technical Report.

CONTROLS SELECTED FOR COAL- AND ASH-HANDLING FACILITIES

As discussed in Section 4.2, fugitive particulate matter emissions would be controlled through the use of baghouses, enclosures, and lowering wells for crushing, conveying, and transfer operations. Watering roads as well as the use of chemical stabilizers would reduce emissions of fugitive dust from roads and from wind erosion of storage piles. The load-out of ash from silos would be controlled by maintaining a high moisture content in the ash itself. Fugitive emissions associated with the hauling of ash would be controlled by road watering.

These techniques are commonly used and most are recognized by the EPA as satisfying the requirements of BACT (EPA 1980d). Such measures will result in emission reductions by as much as 99 percent for some operations; on the average, emissions would be reduced by 73 percent as a result of implementing the control measures described above.

4.5 AIR QUALITY PROJECTIONS

DESCRIPTION OF ANALYSIS

The effect of air pollutant emissions from the proposed NMGS on local and regional air quality was investigated through dispersion modeling. Four different air quality analyses have been performed by ERT, under contract to PNM:

- Projection of air quality impacts for NMGS alone in the low-terrain areas within 30 miles (50 km) of NMGS

- Projection of air quality impacts for NMGS alone in the high-terrain areas at distances as far as 78 miles (125 km), including Mesa Verde National Park, the San Pedro Parks Wilderness Area, and the San Juan River valley region,

- Combined impact analysis of NMGS with San Juan, Four Corners, and Prewitt-Escalante generating stations in both low- and high-terrain areas

- Combined impact analysis of the hypothetical mine, and coal- and ash-handling facilities

The descriptions of the meteorological data used, the methods for reducing the data, and the modeling analyses themselves are contained in the following reports:

- Preparation of Hourly Meteorological Data and Analysis of Atmospheric Stability for Dispersion and Visibility Modeling Analyses of the New Mexico Generating Station (ERT 1981a)

- EIS Impact Areas and Low-Terrain Modeling of the Proposed New Mexico Generating Station (ERT 1981b)

- EIS High-Terrain Modeling of the Proposed New Mexico Generating Station (ERT 1981e)

- EIS Analysis of Fugitive Dust Emissions from the proposed New Mexico Generating Station (ERT 1981c)

- Addendum to EIS High-Terrain Modeling of the Proposed New Mexico Generating Station (ERT 1981f)

- EIS Combined Impacts Modeling of the Proposed New Mexico Generating Station (ERT 1982a)

- EIS Impact Analysis of Fugitive Dust Emissions from a Hypothetical Mining Operation Located Adjacent to the Proposed New Mexico Generating Station (ERT 1982b)

Projected concentrations were obtained by modeling the Four Corners, San Juan, and Prewitt-Escalante generating stations in combination with NMGS. These sources were selected for inclusion in this modeling analysis, since their combined emissions (both SO_2 and NO_2) make up approximately 95 percent of the total emissions in the San Juan Basin. Other sources in the San Juan Basin identified and discussed in Section 3.0 were judged to be too small to result in a regional impact. Such sources can be shown to have an impact in the immediate area surrounding the facility; however, it is judged unlikely that the impact from them would extend to such a degree that NMGS would add significantly to its concentration.

The small sources, as well as area sources (residential heating and vehicular emissions) have been represented by adjusting the "non-power plant" baseline using the method outlined in Section 3.6. The total projected concentrations were then obtained by adding the future non-power plant baseline to the resulting projected concentration increase due to the NMGS Four Corners, San Juan, and Prewitt-Escalante generating stations.

Modeling analyses for the low terrain area within 47 miles (75 km) of NMGS were based on the use of EPA's MPTER model. For high terrain, and combined impact analyses, initial modeling was performed using EPA's COMPLEX I model. Worst-case meteorological conditions, i.e., those associated with the computed highest concentrations in high-terrain areas, were then identified based on these runs (ERT 1981b, 1981e, 1982a). Refined modeling was then performed with the conditions identified, using a more sophisticated model called the Rough Terrain Dispersion Model (RTDM) developed by ERT.

Both the COMPLEX I and MPTER models predict hourly concentrations for all sources at each receptor, based on the hourly data input to the model. For a single year, 8760 hourly concentrations are calculated for each receptor and the five highest such concentrations are selected for printout at each location. The highest concentration at each receptor then has associated with it a worst-case scenario. COMPLEX I and MPTER calculate 1-, 3-, 8-, 24-hour, and annual averages. Since the modeling analyses used as input the 3-year meteorological data base measured at the proposed NMGS site, modeled concentration values for each receptor location have associated with them an actual worst-case meteorological day. Thus, a modeled concentration at a receptor represents the highest level computed out of the entire 3-year data set of meteorological scenarios.

A description of the models used and their applicability to the analyses is included in Appendixes E and F. Further information regarding MPTER and COMPLEX I is available in the EPA user's guides for these models (EPA 1980e).

SOURCE DATA

Plant Stack Emissions and Parameters

Source data used to characterize NMGS and the Four Corners, San Juan, and Prewitt-Escalante generating stations are presented in Table 4-10. In the modeling analysis, it was assumed that the proposed coal-fired NMGS would consist of four 500-MW units, each with a separate 400-foot stack. The emissions from NMGS presented in Table 4-10 represent the total for all four units, although the stack exhaust characteristics reflect those from each of the four identical stacks.

Table 4-11 presents NMGS parameters for operating conditions at 80 percent and 50 percent plant load in addition to the 100 percent load listed on Table 4-10. Modeling estimates were performed at all three loads. For 80 and 50 percent loads, flow rates and emission rates were linearly scaled down to estimate these parameters at the reduced loads. The exhaust temperature was assumed to remain constant

Table 4-10. EMISSION RATES AND STACK PARAMETERS FOR MAJOR SOURCES

Generating Station	Units	Generating Capacity (MW)	East Coord. (km, UTM)	North Coord. (km, UTM)	Base Elevation (ft, msl)	Stack Height (m)	Flow Rate (m^3/sec)	Exhaust Temp. (°K)	Emissions (g/sec)			
									SO_2	TSP	NO_x	CO
NMGS	1-4	2000	753.3	4011.0	5903	122.0	1286.1	333.2	936.7	84.0	1239.8	166.0
Prewitt-Escalante	1	235	764.7	3922.0	6900	152.4	322.0	325.0	61.2	9.2	137.8	19.3
San Juan	1 & 2	710	728.7	4075.6	5308	122.0	704.0	353.0	680.0	42.0	485.8	59.0
	3 & 4	1000	728.7	4075.6	5308	122.0	1205.0	353.0	958.0	66.0	600.6	83.0
Four Corners	1 & 2*	350	725.3	4063.2	5340	76.2	765.0	324.0	378.0	25.0	346.0	30.7
	3	225	725.3	4063.2	5340	76.2	425.0	324.0	245.0	16.0	223.0	19.9
	4 & 5*	1510	725.3	4063.2	5340	116.0	2655.0	327.0	1632.0	95.0	1324.0	132.8

Source: ERT (1982a).

*Served by a common stack.

Table 4-11. NMGS EMISSION RATES AND STACK EXHAUST PARAMETERS AT REDUCED LOADS

Parameter	80 Percent Load	50 Percent Load
Volumetric Flow Rate (m^3/sec) (per unit)	1029	643
SO_2 Emission Rate (g/sec) (total of four units)	749	468
TSP Emission Rate (g/sec) (total of four units)	67	42
CO Emission Rate (g/sec) (total of four units)	133	83
NO_x Emission Rate (g/sec) (total of four units)	992	620

Source: ERT, 1981b.

at all loads, based on preliminary engineering design information. Annual averages assumed an average 80 percent capacity factor for all sources.

The modeling of NMGS emissions assumed that all the stacks are collocated at the coordinates specified in Table 4-10.

The Prewitt-Escalante Generating Station is under construction at a site about 50 miles (80 km) south of the proposed NMGS location. Prewitt-Escalante has received a PSD permit for one unit rated at approximately 235 MW. Emission rates and stack parameters represent compliance with all state and federal emission limitations and information presented in the PSD permit.

The San Juan Generating Station consists of four units, each with a separate stack. It is located approximately 40 miles (65 km) north-northwest of the proposed NMGS Bisti site and about 13 miles (21 km) west-northwest of Farmington. The stack exhaust parameters in Table 4-10 are identical for Units 1 and 2, and for Units 3 and 4. Stack emissions represent the total of Units 1 and 2, and of Units 3 and 4.

The fourth facility is the Four Corners Power Plant, located about 35 miles (56 km) to the north-northwest of the proposed NMGS plant site. This facility consists of five units with four stacks; Units 1 and 2 emit through a common stack. The emissions in Table 4-10 represent the total of Units 1 and 2 combined, Unit 3, and Units 4 and 5 combined. The Four Corners plant is undergoing construction of additional control equipment. Current design information provided to PNM by the operator of Four Corners indicates that Units 4 and 5 will emit through a common stack once the SO_2 control system is on-line in late 1984. The values shown in Table 4-10 are based on this future design and control scenario.

Fugitive Dust Source Configuration

The annual and 24-hour averaged fugitive dust and particulate matter emissions from the hypothetical mine and coal- and ash-handling facilities are discussed in Section 4.2. In addition to the fugitive dust sources, projected particulate matter emissions from NMGS were also included in the modeling analysis.

Size Characteristics of Fugitive Particulate Matter

The parameters defining particle deposition and gravitational settling are determined by the particle size distribution. The particle size distribution selected for this study represents average values developed from data measured downwind of mining operations by PEDCo/MRI (1981). The five particle size classes that form this distribution are as follows:

<2.5 μm	3%
2.5-5.0 μm	4%
5.0-10.0 μm	9%
10.0-15.0 μm	5%
>15.0 μm	79%
	100%

Gravitational settling velocities were calculated for each particle size class using Stokes' Law, a particle density of 2.0 $\mu g/cm^3$ and a characteristic diameter. Deposition velocities were estimated from the theoretical curves developed by Sehmel and Hodgson (1974) for a surface roughness length of 5 cm. All deposition parameters used in the MINE modeling analysis are presented in Table 4-12.

Table 4-12. KEY DEPOSITION PARAMETERS USED IN THE AIR QUALITY MODELING ANALYSIS OF FUGITIVE DUST EMISSIONS FROM NMGS

Particle Size Class	Distribution	Range of Particle Sizes (μm)	Characteristic Particle Size (μm)	Gravitational Settling[a] Velocity (cm/sec)	Deposition[b] Velocity (cm/sec)
1	3%	0-2.5	1.1	0.000072	0.008
2	4%	2.5-5	3.3	0.000642	0.014
3	9%	5-10	7.0	0.00292	0.020
4	5%	10-15	12.0	0.00856	0.024
5	79%	>15	20.0	0.0238	0.033

SOURCE: PEDCo/MRI (1981).

[a] Based on Stokes' Law for particles of spherical size and diameter equal to the characteristic particle size. Also, the density of the particles was assumed to be 2 g/cm^3.

[b] The deposition velocity is the sum of the gravitational settling velocity plus the velocity attributable to turbulent mixing. Calculated from the curves of Sehmel and Hodgson (1974) for a surface roughness length of 5 cm.

GENERAL APPROACH

Sulfur Dioxide and Nitrogen Dioxide

The size of the geographic area of influence of NMGS is defined by a radius of approximately 47 miles (75 km) in the southwest and westerly directions. In the other directions, concentration increases due to NMGS alone fall below the EPA-specified levels within 30 to 40 miles (50 to 65 km). Modeling with MPTER was conducted for NMGS alone in the low-terrain areas surrounding the plant site, out to 47 miles (75 km). To obtain total future concentrations, the major sources that would contribute to such levels (e.g., Four Corners, San Juan, and Prewitt-Escalante generating stations) were modeled along with NMGS using the COMPLEX I model. These computed values were then added to the appropriate future non-power plant baseline level, for SO_2 and NO_2 predictions. The maximum concentration of SO_2 and NO_2 computed in this manner within the geographic area of influence was located about 9 to 10 miles (15.1 to 15.5 km) from the proposed plant for short-term averaging periods (e.g., 3-hour and 24-hour). Maximum annual concentrations of SO_2 and NO_2 from the above sources were predicted to occur approximately 25 miles (40 km) north of NMGS.

The major contributors to these NO_2 and SO_2 concentration levels were Four Corners and San Juan power plants; the contribution from NMGS at these locations was negligible. However, since these values are the highest computed in the geographic area of influence, it is obvious that even at locations where San Juan and Four Corners power plants contribute negligible amounts and the contribution from NMGS dominates, such concentrations would not exceed the maximums at these locations.

For purposes of computing the "most likely" concentrations due to NMGS, the modeled concentrations of NMGS alone (using MPTER) are reported. Since the highest levels are projected to occur infrequently, a more realistic concentration estimate at points of maximum concentration in the vicinity of NMGS is obtained by the following procedure:

1) The range of concentrations predicted to occur most frequently (i.e., 99 percent of all hours computed) is reported.

2) These concentrations are added to the background concentrations that occur the majority of the time in the project area. Such values are best represented by using the future annual non-power plant baseline for the specific pollutant that has been monitored at the project site.

Particulate Matter

In the case of TSP concentrations, the geographic area of influence due to stack emissions of particulate matter from NMGS extends only 8 miles (12.5 km) from the proposed plant for the 24-hour average. For the annual average concentration increase, the value computed due to stack emissions was below the EPA-specified level used in defining the geographic area of influence. Similarly, the value computed for the 24-hour averaging period associated with stack TSP is less than that computed for the fugitive dust emissions from the hypothetical mine and coal- and ash-handling facilities. Both the 24-hour and annual maximum concentration increases associated with the above fugitive dust sources were predicted to occur within approximately 3 miles (5 km) of the plant site. Thus, the maximum 24-hour concentration increase of particulate matter due to NMGS stack emissions occurs at a different location than the increase associated with fugitive dust emissions and cannot be combined. Concentrations due to Four Corners and San Juan were predicted to occur well out of the range of the 3-mile (5 km) fugitive dust impact area; also the concentration increases of TSP due to these sources were predicted to be less than the values associated with the NMGS fugitive dust sources. Based on this, the fugitive dust concentration increases associated with the hypothetical mine and NMGS coal- and ash-handling facilities represent the highest TSP concentration increase. As such they are combined with the non-power plant baseline for comparison with the federal and New Mexico ambient air quality standards.

Carbon Monoxide

Carbon monoxide concentration increases associated with NMGS were predicted to be below the EPA-specified levels used to define the geographic area of influence. As such, detailed discussion of future CO concentration levels in the project area is not warranted.

Stagnation Episode

Stagnation episodes may be defined as the persistence of low wind speed conditions for extended periods of time. These episodes are typically associated with quasi-stationary anticyclones, and usually occur in the eastern portions of the United States. The project region does not usually experience stagnation episodes of long duration, as evidenced by the 3-year meteorological data base collected by PNM at the project monitor site.

The effect of air pollutant emissions during stagnation episodes was simulated using dispersion modeling. Because these episodes would not be expected to persist for periods of longer than a few hours, compliance with the 3-hour SO_2 standard was assessed. This was done by inputting maximum (100 percent capacity) SO_2 emissions into the EPA PTMAX model. This model produces short-term concentration increases for a variety of meteorological scenarios.

Although these concentration predictions are strictly applicable only to periods of a few minutes, they were assumed to represent a 3-hour period in order to simulate stagnation episodes. The low wind speed scenarios, i.e., wind speeds less than 2.0 m/sec were evaluated as being possible candidate scenarios.

The PTMAX model predicted a concentration increase of less than 100 $\mu g/m^3$ for stable conditions and low wind speeds. This increase is less than that predicted from modeling using actual meteorological data. This is because the power plant plume would rise to great heights under low wind speed conditions, thus reducing ground-level concentrations. Higher wind speeds reduce plume rise and thus increase ground-level concentrations.

Based on the above, further discussion of these episodes with repect to the other pollutant emissions does not appear to be warranted.

ESTIMATED POLLUTANT CONCENTRATIONS

Maximum concentration increases of pollutants due to NMGS were computed to occur in the general vicinity (within 12 miles or 20 km) of the project site. Concentration increases due to NMGS in areas outside a 47 mi (75 km) radius were small, and below EPA-specified levels in the San Juan River valley area as well as the Class I areas of Mesa Verde National Park and the San Pedro Parks Wilderness Area. The specified levels have been established by the EPA and are used in this analysis to define the geographic area of influence of the project as discussed in Section 2.4. Maximum predicted concentrations are presented in Tables 4-13 and 4-14, which provide comparisons with the New Mexico and federal standards, respectively. Conversion of modeled values in $\mu g/m^3$ to ppm is described in Appendix B.

Table 4-13. RANGE OF MAXIMUM COMBINED IMPACT CONCENTRATIONS PROJECTED FOR PROJECT VICINITY AND COMPARISON WITH NEW MEXICO AMBIENT AIR QUALITY STANDARDS

		Concentrations (ppm)			
Pollutant	Averaging Time	Combined Maximum Concentration[a]	Future Non-Power Plant Baseline	Total	New Mexico Standards
Sulfur Dioxide	24-hour	0.054	0.006-0.011	0.060-0.065	0.10
	Annual	0.006	0.001	0.007	0.02
Nitrogen Dioxide	24-hour	0.054	0.006-0.017	0.060-0.071	0.10
	Annual	0.007	0.002	0.009	0.05
Total Suspended Particulate	24-hour	13-27 $\mu g/m^3$ [b]	102-103 $\mu g/m^3$	115-130 $\mu g/m^3$	150 $\mu g/m^3$
	Annual	3-5 $\mu g/m^3$ [b]	45-52 $\mu g/m^3$	48-57 $\mu g/m^3$	60 $\mu g/m^3$

[a] Modeled concentrations are computed in micrograms per cubic meter ($\mu g/m^3$). Conversion to parts per million (ppm) from $\mu g/m^3$ is described in Appendix A.

[b] These values represent the maximum modeled concentrations of fugitive dust emissions from the hypothetical mine added to the non-power plant baseline value of 35$\mu g/m^3$. As in the case of coal- and ash-handling facilities, these maximums are predicated to occur within 3 miles (5 km) of NMGS.

Table 4-14. RANGE OF MAXIMUM COMBINED IMPACT CONCENTRATIONS PROJECTED FOR PROJECT VICINITY AND COMPARISON WITH NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Concentrations ($\mu g/m^3$) Combined Maximum Concentration	Future Non-Power Plant Baseline[a]	Total	National Standard
Sulfur Dioxide	3-hour	601	16-58	617-659	1300
	24-hour	118	16-29	134-147	365
	Annual	13	3	16	80
Nitrogen Dioxide	Annual	10	4	14	100
Total Suspended Particulate	24-hour	13-27[b]	102-103[c]	115-130	150
	Annual	3-5[b]	45-52[c]	48-57	75

[a] Non-power plant baseline values were derived from monitored concentrations reported in parts per million (ppm). Conversion to $\mu g/m^3$ from ppm is described in Appendix A.

[b] Concentrations of TSP shown here are representative of fugitive dust emissions resulting from the coal- and ash-handling facilities. These maximums are predicted to occur within 3 miles (5 km) of NMGS. They are stated as a range here due to the close proximity of receptors to one another.

[c] These values represent the maximum modeled concentrations of fugitive dust emissions from the hypothetical mine added to the non-power plant baseline value of 35 $\mu g/m^3$. As in the case of coal- and ash-handling facilities, these maximums are predicted to occur within 3 miles (5 km) of NMGS.

Sulfur Dioxide

The three generating stations (Four Corners, San Juan and Prewitt-Escalante) in combination with NMGS were modeled using COMPLEX I at receptors located within NMGS' geographic area of influence. The three-hour maximum was predicted to occur approximately 9 miles (15.1 km) east-northeast from NMGS and was computed to be 0.276 ppm. The 24-hour maximum of 0.054 was predicted to occur approximately 10 miles (15.5 km) north of NMGS. The annual average concentration predicted was 0.006 ppm, located approximately 25 miles (40 km) north of NMGS.

The 3-hour increase was combined with the range of 3-hour future non-power plant baseline values (0.006-0.022 ppm), resulting in a range of total concentrations from 0.282 to 0.298 ppm. The 24-hour increase was combined with the future non-power plant baseline values, resulting in a range of total concentrations from 0.060 to 0.065 ppm. The total annual concentration computed in this manner is 0.007 ppm.

Impact Due to NMGS Alone. The maximum SO_2 concentration increase due solely to NMGS on an annual average basis was computed to be 0.002 ppm at a point 12 miles north-northeast of the plant site (ERT 1981e). Maximum 3- and 24-hour concentration increases associated with NMGS were computed by MPTER to be 0.133 and 0.029 ppm, respectively. These concentration increases are computed to occur at a point 8 miles (12.5 km) southeast of the plant site.

Most Likely Short-Term Concentration in Area of Expected Maximum Impact. As discussed above in the General Approach section, to obtain a more realistic concentration estimate at the points of maximum concentration in the vicinity of the proposed power plant, it is necessary to examine the projected frequency of occurrence of both the modeled concentration increases and baseline values. The maximum concentration increases of the 3- and 24-hour SO_2 values reported above for the vicinity of NMGS are projected to occur less than 1.0 percent of the time. For most of the time (approximately 99 percent) the maximum downwind concentration increases due to NMGS in the vicinity of the project would be less than 0.076 ppm for the 3-hour averaging period and less than 0.017 ppm for the 24-hour period (ERT 1981b). Combining these values with the future annual non-power plant SO_2 baseline results in the most likely (i.e., 99 percent of the time) concentrations as follows:

3-hour: less than 0.077 ppm
24-hour: less than 0.018 ppm

Areas of Special Interest. Concentration increases from NMGS within Chaco Culture National Historical Park were modeled using RTDM, and were much smaller than the values discussed above. The RTDM model was used as a refined modeling technique after identifying worst-case receptors and meteorological conditions via COMPLEX I as a screening technique. The RTDM mode was judged appropriate for this locale and is discussed in Section 2.6 and Appendix E. The maximum 24-hour SO_2 increase computed for Chaco was 0.005 ppm. The maximum 3-hour value computed was 0.012 ppm (ERT 1981f).

Concentration increases due to NMGS in the San Pedro Parks Wilderness Area and Mesa Verde National Park were also calculated in response to concerns raised in public scoping meetings and because of the requirement by federal managers to consider impacts to Class I areas in the decision-making process. Maximum concentration increases computed by RTDM in Mesa Verde National Park were 0.0006 and 0.003 ppm for the 24- and 3-hour averaging periods, respectively, and were below EPA-specified values used in defining the geographic area of influence. Increases computed by the conservative COMPLEX I model in the San Pedro Parks Wilderness Area were 0.0009 and 0.003 ppm for the 24- and 3-hour averaging periods, respectively. Annual concentration increases likewise are below the EPA-specified values in these areas, with computed values of 0.0003 ppm in Mesa Verde and 0.00005 ppm in San Pedro Parks (ERT 1981e). For comparison purposes, the computed concentration increases, expressed in $\mu g/m^3$ are presented in Table 4-15, along with EPA's PSD increments for Class I areas (both San Pedro Parks and Mesa Verde are so designated by the EPA). The Class I PSD increments are used here as a "benchmark" for comparison.

Nitrogen Dioxide

Maximum annual concentration increases due to NMGS combined with the three power plants were computed using COMPLEX I. The value predicted was 0.007 ppm at a point approximately 25 miles (40 km) north of NMGS. This concentration increase was combined with the non-power plant baseline value for NO_2, resulting in a total concentration of 0.009 ppm, which is below the New Mexico and federal standards (see Tables 4-13 and 4-14).

The 24-hour concentration increases due to NMGS combined with the three power plants were also computed using COMPLEX I. The value predicted by COMPLEX I was 0.051 ppm at a point approximately 10 miles north of NMGS. However, the 24-hour maximum concentration increase due to NMGS alone, predicted by MPTER, was 0.054 ppm at a point approximately 8 miles (12.5 km) southeast of NMGS. The apparent anomaly is explained by subtle differences between the two models. COMPLEX I provides a more realistic treatment of complex terrain than MPTER. Also, MPTER calculates concentrations based on a horizontal dispersion coefficient, while COMPLEX I uses the sector-averaging approach. These models are discussed in Appendix E. For conservative purposes, the higher value of 0.054 ppm will be used to represent the maximum concentration increase associated with the above-mentioned sources.

Table 4-15. CONCENTRATIONS INCREASES OF SO_2 IN SAN PEDRO PARKS WILDERNESS AREA AND MESA VERDE NATIONAL PARK, AND COMPARISON WITH PSD CLASS I INCREMENTS

Averaging Period	Location	Maximum Concentration Increase due to NMGS ($\mu g/m^3$)*	PSD Class I Increment ($\mu g/m^3$)
3-hour	San Pedro Parks	5.5	25
	Mesa Verde	7.1	25
24-hour	San Pedro Parks	2.0	5
	Mesa Verde	1.3	5
Annual	San Pedro Parks	0.1	2
	Mesa Verde	0.6	2

*Source: ERT, 1981e.

The value of 0.054 ppm was combined with the range of 24-hour future non-power plant baseline values (0.006 to 0.017 ppm) resulting in a range of total concentrations from 0.06 to 0.071 ppm, all below the New Mexico standard of 0.100 ppm.

The maximum annual NO_2 concentration increase due to NMGS alone is estimated to be 0.003 ppm, at a point located 12 miles (20 km) north-northeast of the project site (ERT 1981e).

Most Likely Short-Term Concentration in Area of Expected Maximum Impact

Using the same approach as for SO_2, frequencies of maximum predicted NO_2 concentration increases due to NMGS alone were examined. Most of the time (99 percent), maximum downwind concentration increases due to NMGS would be less than 0.031 ppm for the 24-hour averaging period. Combining this value with the future annual NO_2 non-power plant value results in a total of approximately 0.033 ppm.

Areas of Special Interest. Concentration increases in the Chaco Culture National Historical Park were calculated using RTDM and are computed to be small. The 24-hour increase due to NMGS in that area is predicted to be 0.008 ppm (ERT 1981f).

Although no Class I increments have been established for NO_2, calculation of NO_2 concentration increases due to NMGS were performed for the San Pedro Parks Wilderness Area and Mesa Verde National Park. The maximum concentration increase computed by RTDM in Mesa Verde National Park was 0.001 ppm, which is 1 percent of the New Mexico 24-hour NO_2 standard. COMPLEX I modeling resulted in projected concentration increases no greater than 0.002 ppm in the San Pedro

Parks Wilderness Area. This value is approximately 2 percent of the New Mexico standard.

Total Suspended Particulate (TSP)

Two separate modeling analyses were conducted for emissions of particulate matter. These were (1) the analyses of stack emissions from NMGS and (2) fugitive particulate matter emissions from the hypothetical mine and NMGS' coal- and ash-handling facilities. Concentration increases of TSP were low for both sources of such emissions. As discussed in the General Approach sections, the concentration increases associated with the stack emissions occur at a different location than that associated with the fugitive emissions and can not be combined. Also, concentrations due to Four Corners and San Juan occur well out of the range of the geographic area associated with the fugitive dust sources. The fugitive dust-related concentration increases also represent the highest values, and are therefore used in the comparison with the applicable ambient standards.

Concentration Increases Associated with Fugitive Particulate Matter Sources. Fugitive particulate emissions from the hypothetical mine and NMGS' coal- and ash-handling facility were modeled using the MINE model (ERT 1982b). The range of maximum annual concentration increases of TSP due to the hypothetical mine were predicted to be 10-17 $\mu g/m^3$, all occurring within 3 miles (5 km) of NMGS. The hypothetical mine (assumed to be adjacent to the plant site) is not a part of the San Juan River Regional Coal EIS, nor is it part of the PRLA Environmental Assessment. For this reason, it is treated as part of the "future baseline." As such, concentration increases due to the hypothetical mine are added to the 35 $\mu g/m^3$ TSP baseline value for the project area. Future annual baseline values for the project area calculated in this manner range from 45 to 52 $\mu g/m^3$ (see Tables 4-13 and 4-14).

The range of maximum annual increases associated with the coal- and ash-handling facilities were predicted to be in the range of 3 to 5 $\mu g/m^3$, again all occurring within 3 miles (5 km) of NMGS. Combining the range of increases with the range of future baseline values results in a range of total predicted values from 48 to 57 $\mu g/m^3$, which is below both the New Mexico and the federal ambient standards (see Tables 4-13 and 4-14). This value occurs close to the sources of fugitive particulate matter (i.e., the mine and coal- and ash-handling facilities). Concentrations decrease rapidly with distance (ERT 1981c, 1982b).

The 24-hour maximum concentration increases of TSP due to the hypothetical mine were predicted to be in the range of 67-68 $\mu g/m^3$, within approximately 3 miles of NMGS. Combining these values with the 24-hour TSP baseline value of 35 $\mu g/m^3$ results in future baseline values in the range of 102 to 103 $\mu g/m^3$. The range of concentration increases associated with the coal- and ash-handling facilities was predicted to be from 13 to 27 $\mu g/m^3$, also within 3 miles of NMGS. Combining these increases with the future baseline range of values, results in a range of total concentrations from 115 to 130 $\mu g/m^3$, which is below the applicable New Mexico and federal ambient standards. As stated above, such concentrations decrease rapidly with distance from the mine and plant. It should also be noted that for legal reasons, concentration increases due to the mine would not be considered to consume increment.

Concentration Increases Associated with Stack Particulate Matter Emissions. Annual concentration increases from the stack emissions were below the EPA specified level of 1.0 $\mu g/m^3$ used for defining the geographic area of influence. The maximum 24-hour impact projected by the combined COMPLEX I modeling of NMGS with Four Corners, San Juan, and Prewitt-Escalante resulted in a concentration increase prediction of 6.0 $\mu g/m^3$ at a point approximately 10 miles north of NMGS.

Modeling of NMGS alone with the MPTER model, resulted in a concentration prediction of 5.7 $\mu g/m^3$ at a point approximately 8 miles southeast of NMGS. Combining the higher 6.0 $\mu g/m^3$ concentration with the baseline value of 35 $\mu g/m^3$, results in a total of 41 $\mu g/m^3$.

Because the concentration increases of particulate matter due to the hypothetical mine and coal- and ash-handling facilities are confined to a 3-mile (5 km) area surrounding the plant site, there would be minimal interaction at the point of maximum impact due to combined power plant sources.

An examination of the concentration increases due to NMGS alone indicates that most of the time (i.e., 99 percent of the time) 24-hour concentration increases of TSP are predicted to be below 3 $\mu g/m^3$.

Ozone

The EPA considers nonmethane volatile organic compounds (VOC) to be precursors to the formation of ozone in the atmosphere. As discussed earlier in this section, nonmethane VOC emissions would be approximately 36 tons per year from NMGS.

Ozone has not been considered a problem in this area of New Mexico, as confirmed by discussions with the NMEID (1981b). Based on the low level of VOC emissions, it is not anticipated that the federal ozone standard would be violated as a result of power plant operations.

4.6 EFFECT OF NMGS ON VISIBILITY

This section describes the methodology and results of an analysis conducted to assess possible visibility impairment due to NMGS at key viewing locations: Mesa Verde National Park, San Pedro Parks Wilderness Area (both are Class I areas), and Chaco Culture National

Historical Park. The latter area, although not a Class I area, is examined because it has been identified as a special concern in public scoping meetings. Visibility impacts are reviewed and regulated through two mechanisms: the EPA's PSD regulations (discussed earlier) and the visibility regulations (published in the December 2, 1980, Federal Register). The latter regulation was promulgated in compliance with the Clean Air Act. The Act states that the national goal is "prevention of any further, and the remedying of any existing impairment of visibility in mandatory Class I federal areas." To accomplish this goal, the 36 states containing mandatory Class I areas were required to incorporate visibility protection provisions into their State Implementation Plans.

Historical visibility trends in the Southwest were investigated by Trijonis and coworkers (Trijonis and Yuan 1978, Marians and Trijonis 1979). Visibility data were summarized according to three time periods. From the late 1940s to the mid-1950s there were small increased-visibility trends in some areas and slight decreases in others. During the mid-1950s to the early 1970s, almost all areas showed a decrease in visibility of from 10 to 30 percent. From the early 1970s to the mid-1970s, visibility generally increased by about 5 to 10 percent.

The prevention of future visibility impairment is addressed primarily through the provisions contained in the PSD regulations, but may also be regulated through measures adopted in individual State Implementation Plans. At this time, programs which go beyond the PSD regulations with respect to visibility protection have not as yet been promulgated by the state of New Mexico.

Under the PSD regulations, a new project may be denied a permit if a Federal Land Manager and the state pollution control agency (in this case the NMEID) demonstrate that the project would adversely affect visibility in a Class I area, or an "integral vista" that is associated with such Class I area.

The analysis was performed for PNM by Systems Applications, Inc. (SAI). The PLUVUE model was run by SAI to evaluate the projected visibility effects associated with NMGS. A detailed description of the modeling techniques is included in their report (SAI 1981).

CHARACTERIZATION AND EVALUATION OF VISIBILITY IMPAIRMENT

"Visibility impairment," as used in this analysis, refers to the perception of air pollution in the atmosphere. The guidelines for the characterization of visibility impairment and the criteria by which they are judged are discussed in Section 2.5. There are three basic types of visibility impairment. The first is termed "plume blight" and refers to the comparison of a plume with the background atmosphere. The second type of impairment is termed "regional haze" and is characterized by a uniform reduction in visual range in all directions. The third type is "layered discoloration" and refers to bands of discoloration observable above the surrounding terrain.

The only models currently available for assessment of visibility impacts quantify the effects of plume blight rather than regional haze or layered discoloration. The latter types of impairment are not easily attributable to a single source, and there are no widely accepted modeling techniques with which to quantify them.

MODEL DESCRIPTION

The PLUVUE model proceeds by calculating atmospheric discoloration through the computation of pollutant concentrations at each point downwind in the plume. The concentrations of particular constituents determine the light extinction and optical depth of the plume and hence the effects of the plume on visual phenomena. Primary emissions (sulfur dioxide and nitric oxide) do not scatter light and do not cause any impairment to visual acuity. However, they convert in the atmosphere to secondary constituents, such as nitrogen dioxide, which do impair visual perception. Nitrogen dioxide can in turn be converted to nitric acid vapor, which under some circumstances may form nitric acid, ammonium nitrate, or nitrate aerosols, which can have an effect on light transmission. Nitrogen dioxide and fine particulate matter play an important role in the formation of visible plumes from large stationary sources (NCAQ 1981).

Sulfur dioxide emissions convert to sulfate aerosols and can be further transformed into such constituents as sulfuric acid, ammonium sulfate, and similar aerosol-forming compounds. In the atmosphere, the aerosols often form or grow into a size in the range that is most effective at scattering visible light. With the passage of time and distance downwind, the primary emissions will settle from the plume or will have diffused to such an extent that plume contrast will be reduced below the limits of human perception. The PLUVUE model is designed to predict the above effects; that is, transport, diffusion, chemical conversions, optical effects, and removal by surface deposition or by precipitation scavenging.

The PLUVUE model employs a Gaussian formulation for transport and dispersion. The spectral radiance for light intensity at 39 wavelengths between 0.36 and 0.75 micron (μm) is calculated for views with and without the plume. This encompasses most of the visible light range perceivable by the human eye. The changes in the spectrum are used to calculate various parameters that predict the coloration of the plume and contrast reduction caused by the plume.

The four key visual perception parameters (SAI 1981) for predicting the visual impact are

- Reduction in visual range
- Contrast of the plume against the viewing background at 0.55 μm wavelength
- Blue-red ratio of the plume
- Color difference parameter, ΔE

PLUVUE calculates these parameters in two modes. In the plume-based mode, visual effects are calculated for a variety of lines of sight and observer locations relative to a plume. In the observer-based mode, the observer is fixed in position and visual effects are calculated for various lines of sight for a given geometry defined by the plume, the observer, and the sun's elevation. In the calculations performed for the PNM project, only the observer-based calculations were carried out. Once the observer position is specified, the direction of the plume trajectory is then calculated using specific meteorological data and other data relevant to the observation: day of the year, and time of day. The program then internally calculates the observer-sun-plume angle and the degree of visual impact that is encountered. PLUVUE then calculates several effects for a given downwind distance along the plume. One such effect is the horizontal line of sight from the observer to the plume with a clear sky background. The calculation specifies the various observation angles and observer/plume distances for calculating visual impairment. In this mode, a second calculation evaluates the effect of the plume on horizontal views with white, gray, or black target objects, such as terrain, in the background.

Atmospheric chemistry is dealt with through simplified kinetic equations, which assume the primary kinetic mechanisms in the conversion of nitrogen oxide to nitrogen dioxide and sulfur dioxide to sulfates. In addition, routines are included for particle growth by coagulation and by hygroscopy and the consequent changes in absorption and scattering coefficients with particle size.

ESTIMATED VISIBILITY IMPACTS

Calculations were carried out for each of the observer locations (Chaco Culture National Historical Park, Mesa Verde, San Pedro Parks). At each of the three locations four wind directions, three stability classes, and three wind speeds were used for a total of 108 PLUVUE runs. For each observer location the wind directions were selected so as to provide worst-case plume trajectories. These trajectories were those which would cause the plume to be transported between the observer and elevated terrain background. The possible channeling of winds because of complex terrain was also considered. For each case, the four visual impact parameters were calculated as a function of horizontal direction (azimuth) from which an observer at a specified location is viewing the plume. Calculations took into account the downwind extent of the plume, that is, the along-plume distance that constituents were transported, as well as the presence of any elevated terrain that interfered with the view of the plume from the observation point.

General visual range in the area, although it may be affected by NMGS, cannot be calculated with this model or with any existing model. Further, field measurements have found PLUVUE to overpredict visual impact. Hence, the absolute error for worst-case impacts may be quite large, and larger than the absolute error for less severe cases. Of the parameters calculated by PLUVUE, the one most relevant to this analysis is the color difference parameter, ΔE. This value provides an indication of the plume coloration.

The ΔE level has been calculated for each of the 108 PLUVUE runs as well as the frequency of occurrence of the meteorological condition associated with each value. The frequency is expressed in percent of mornings or afternoon hours. As discussed in Section 2.5, a plume with an associated ΔE level above 4 is indicative of the occurrence of a visible plume, and is defined as an indicator of significance. The frequency of occurrence of all calculated ΔE values that are greater than 4, 5, and 10 were tabulated for each viewing site for each season. A ΔE level of 5 represents a plume that is slightly more perceptible than one with a ΔE level of 4. A ΔE level of 10 is judged to represent a highly visible plume. The percent frequency of occurrence of a particular ΔE level was based upon the number of mornings or afternoons on which the ΔE level was predicted to occur, compared to the total number of days in the period. These levels were obtained from Table 6 and Figures 11, 12, and 13 in the SAI (1981) analysis. Conversion of frequency of occurrence to actual number of mornings and afternoons resulted in fractional values in most instances. For this reason, the number of occurrences are expressed as a range. In those cases for which the occurrence was 0.5 per day or less, these were reported as zero.

Table 4-16 presents the morning and afternoon occurrences of E levels above 4, 5, and 10 predicted for each viewing site. As the table indicates, plumes are predicted to be visible only infrequently, mainly in the morning hours before nocturnal inversions are destroyed by convective mixing.

The resulting calculated impacts for the 108 modeling runs indicate that:

a. From the observer point at Chaco Culture National Historical Park, the maximum occurrence of perceptible plume

Table 4-16. SUMMARY OF PROJECTED FREQUENCY OF OCCURRENCE OF NMGS PLUME DISCOLORATION PERCEPTIBLE FROM THREE VIEWING LOCATIONS

		Number of Mornings or Afternoons with E Level Greater Than Indicated Value					
		$\Delta E > 4$		$\Delta E > 5$		$\Delta E > 10$	
Viewing Location	Season	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Chaco Culture National Historical Park	Spring	9-10	1-2	4-5	0-1	0	0
	Summer	5-6	0	1-2	0	0	0
	Fall	9-10	0-1	4-5	0	0-1	0
	Winter	12-13	2-3	6-7	1-2	0-1	0
	Annual Total[a]	36-37	5-6	17-18	2-3	1-2	0
Mesa Verde National Park	Spring	1-2	0-1	0-1	0	0	0
	Summer	1-2	0	0-1	0	0	0
	Fall	2-3	0-1	1-2	0	0	0
	Winter	1-2	1-2	0-1	0	0	0
	Annual Total[a]	7-8	2-3	4-5	0-1	0-1	0
San Pedro Parks	Spring	0-1	0	0	0	0	0
	Summer	1	0	0	0	0	0
	Fall	1	0	0	0	0	0
	Winter	0-1	0	0	0	0	0
	Annual Total[a]	1-2	0-1	0-1	0	0	0

Source: SAI (1981)

Note: Fractional occurrences that are 0.5 or less are represented as zero.

[a] Annual and seasonal numbers reflect rounding.

discoloration is likely to be during the winter, indicating that the plume may be noticeable (i.e., E>4) approximately 12-13 mornings and 2-3 afternoons. On an annual basis such discoloration is also predicted to occur infrequently: 36-37 mornings and 5-6 afternoons for an entire year. Highly perceptible plume discoloration (E>10) is predicted to occur 1-2 mornings and zero afternoons for an entire year, with maximum occurrence indicated in the fall and winter.

b. From Mesa Verde National Park, perceptible plume discoloration is projected to occur infrequently. On an annual basis such discoloration is projected to occur 7-8 mornings and 2-3 afternoons for an entire year. Highly perceptible plume discoloration is predicted to occur approximately 0-1 mornings and zero afternoons for an entire year.

c. Impacts projected from San Pedro Parks are lower than the other two sites, and perceptible plume discoloration is projected to occur 1-2 mornings for an entire year.

The above predictions of the infrequent occurrence of a visible plume agrees with experience with operating power plants in the project area. Typically, modern power plants utilize high-efficiency particulate matter controls that greatly reduce visible near-source plumes. Photo 1 shows the San Juan Generating Station during operation when approximately 1063 MW of power was being generated. The proposed NMGS would be similar in design to the San Juan plant. Visible plumes may appear at greater downwind distances as atmospheric conversion of NO_x occurs. These plumes typically appear as a thin brown ribbon and have been observed 20 miles from the San Juan Generating Station (PNM 1982e).

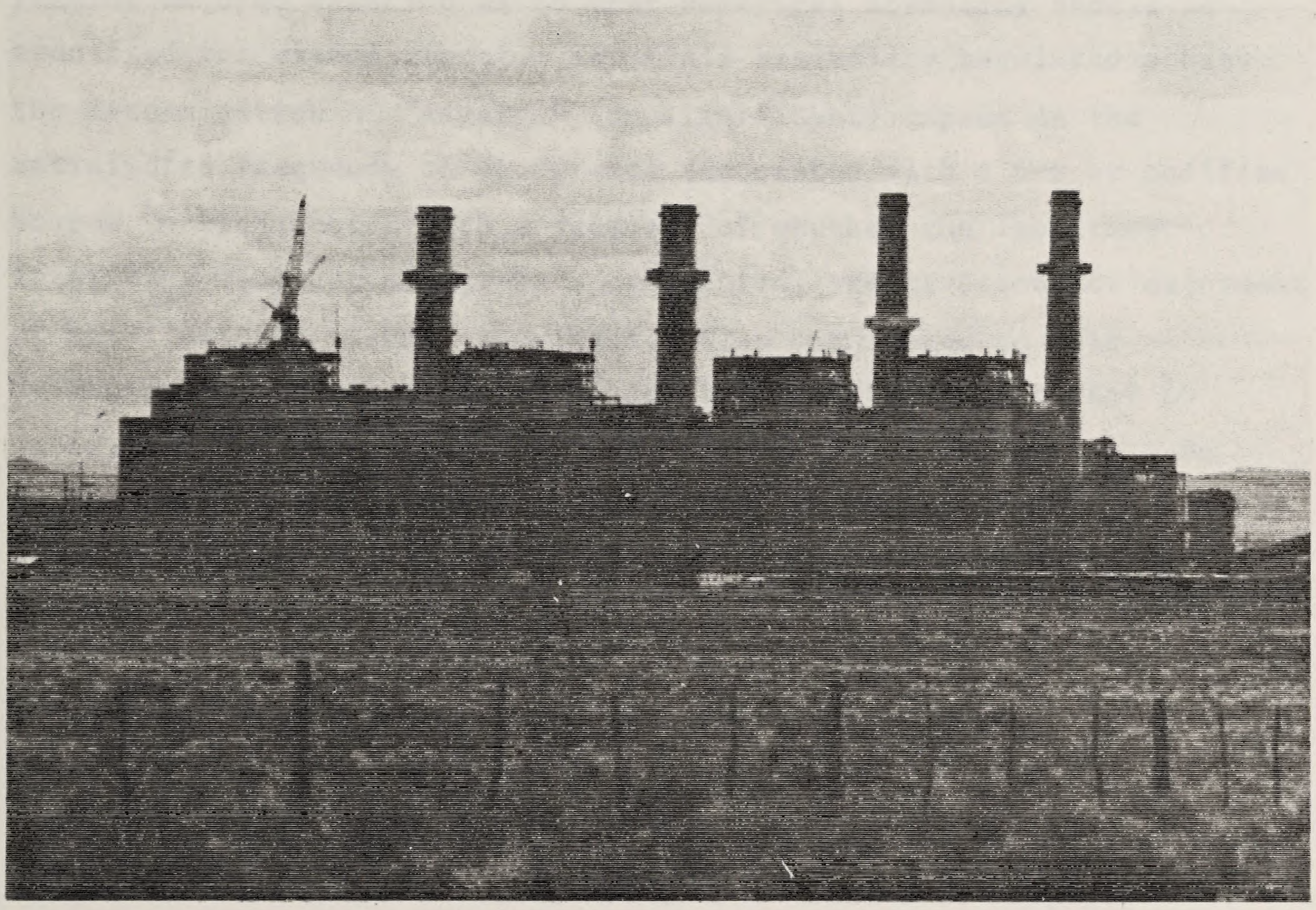


Photo 1. SAN JUAN GENERATING STATION IN OPERATION

It should be noted that there are no existing numerical standards specifying visual impairment. The perceptibility of a plume does not in and of itself require that it be classifed as a visual impairment, a visual degradation, or a visible blight on the landscape. It remains an open question as to what numerical standards should be specified for visual impact. The EPA's visibility regulations base the determination of "adverse" (or significant) impact on the anticipated frequency of occurrence associated with a new or modified source in conjunction with a judgment of whether the impairment interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience. Also considered in this determination are the time that such impairments are expected to occur, and the intensity, duration, and extent of impairment. No further guidance is provided by EPA for relating quantitative aspects of color, contrast and visual range with adverse or significant impact.

VISIBILITY IMPACTS OF COAL- AND ASH-HANDLING FACILITIES

Visibility impacts from coal- and ash-handling facilities cannot be quantified because of the absence of a model that computes visibility effects from point and area sources. It is expected, however, that the increased particulate levels emanating from these facilities would be visible only within the immediately vicinity of NMGS. It is not likely that the fugitive particulate matter associated with this operation would experience a significant degree of buoyant "lift," since such emissions would be released at or near ground level and because the matter would be relatively heavy.

REGIONAL HAZE

As discussed above, the visibility regulations promulgated by the EPA, and subsequent visibility models resulting from the regulations, address only plume blight impairment. Regional haze evaluation requires more sophisticated models and more information than is currently available to relate impacts to specific sources, or source categories (NCAQ 1981). The regulations currently in effect are directed at plume blight; later phases are expected to address regional haze at such time as techniques are developed by which this phenomenon can be evaluated.

Regional haze may be considered as a widespread, regionally homogenous impairment to visibility that results from a multitude of sources (EPA 1980f). Recent studies (Macias et al. 1981, Hall 1981) indicate that major contributors to this problem include atmospheric aerosols and particulate matter. These have been linked to a wide variety of sources, both natural and anthropogenic, including power plants, smelters, urban areas, wildfires and natural windblown dust. Pollutants emitted by these sources may be transported great distances, and thus contribute to visibility impairment in regions far removed from the source location. In addition, pollutants may undergo chemical changes during atmospheric transport.

Although several studies of regional haze have been, or are being, conducted this complex problem is little understood, and no EPA-approved analytical models for regional haze currently exist (EPA 1980f). Thus it is not possible to assess the contribution of a single source (such as NMGS) on future levels of regional haze (NCAQ 1981). The degree of visibility impairment would depend on season and the distribution of sources of pollutant emissions. Although NMGS would emit pollutants that may result in aerosol formation, and thus contribute to regional haze, it is not possible to quantify this contribution.

The National Commission on Air Quality, in its report to Congress (NCAQ 1981), projected that the Four Corners region would have, through 1995, the same regional visibility characteristics that currently exist. This projection is based on the assumption of continuation of current regulatory requirements for 90 percent control of copper smelters in nearby southern New Mexico and southern Arizona. Increased regulatory requirements that control emissions from large emission sources other than smelters could also result in improved visibility in this region. The decrease of copper smelting operations in the future would have an effect as well.

If, however, emission regulations are relaxed for smelters and other sources of similar magnitude of emissions, it is likely that visibility impairment in this region would be greater by 1995.

4.7 RADIOLOGICAL EFFECTS OF NMGS

There is a potential impact from the release of radionuclides in the airborne effluent of coal-fired power plants. Small quantities of uranium 238, uranium 235, thorium 232, and their daughter products are contained in coal. During combustion of coal a small amount of these radionuclides are released as particulate matter along with the gaseous radon radionuclides.

Many studies have been conducted to determine the amount of radioactive material and the potential radiological impact of the airborne effluents from coal-fired power plants. These studies have shown that the release of radioactive material is well below the radiation protection guides set forth in the Code of Federal Regulations (10 CFR 20). A similar analysis was conducted for the projected emissions from NMGS. Results were then compared with both the federal (10 CFR 20) and New Mexico standards for protection against radiation for unrestricted areas. These standards are presented for comparison purposes only. There are no standards applicable to release of radionuclides from coal-fired power plants.

The emission rates for nongaseous radioactive material with half lives greater than several minutes were determined based on the trace element content of SMC Bisti Mine coal and coal ash content. It was assumed that all the thorium (Th) and uranium (U) found in the coal remained in the ash. It was also assumed that the concentrations of ^{232}Th, ^{238}U, ^{235}U, along with all the isotopes in their respective chains were the same as those constituents in the ash.

Annual emissions of nongaseous radionuclides were calculated based on the annual emission of TSP projected for NMGS. Maximum 24-hour and annual concentrations were derived from the results of TSP modeling of such emissions from the stacks.

The gaseous radionuclides radon 222 and radon 220 along with the daughter products of radon 220 were conservatively assumed to be completely released during coal combustion. Concentrations of radionuclides were determined at the maximum impact point from the MPTER Modeling of NMGS. The radon concentration at the stack exit was prorated by the ratio of the total suspended particulate level at the stack exit to that at the maximum 24-hour impact point and maximum annual concentration.

A summary of the results of the radionuclide emissions from NMGS at the highest impact point is given in Table 4-17. The maximum annual concentration increase is predicted to be 3.4×10^{-6} picocurie per liter. Calculation methods are presented in Appendix G.

4.8 PROJECTED NOISE IMPACTS OF NMGS

There are no specific state or federal standards for outdoor noise levels. As discussed in Section 2.0, a level of 55 dB(A) is

Table 4-17. PROJECTED RADIONUCLIDE EMISSIONS FROM NMGS AT HIGHEST IMPACT POINT [a]

Isotope	Annual Emission (Ci/yr)	Maximum 24-hour Concentration (pCi/l)	Annual Concentration (pCi/l)[b]	Comparison with Annual Unrestricted Standard[c] % of NMEID	Comparison with Annual Unrestricted Standard[c] % of NRC
Uranium 238 Chain					
^{238}U, ^{234}Th, ^{234}Pa, ^{234}U, ^{230}Th, ^{226}Ra, ^{218}Po, ^{214}Pb, ^{214}Bi, ^{214}Po, ^{210}Pb, ^{210}Bi, ^{210}Po	2.9×10^{-1}	7.8×10^{-7}	4.1×10^{-9}	2.0×10^{-3}	5.9×10^{-3}
Uranium 235 Chain					
^{235}U, ^{231}Th, ^{231}Pa, ^{227}Ac, ^{227}Th, ^{223}Ra, ^{211}Pb, ^{211}Bi	8.2×10^{-3}	2.2×10^{-8}	1.2×10^{-9}	1.7×10^{-3}	1.3×10^{-3}
Thorium 232 Chain					
^{232}Th, ^{228}Ra, ^{228}Ac, ^{228}Th, ^{224}Ra, ^{212}Pb, ^{212}Bi	1.2×10^{-1}	3.3×10^{-7}	1.7×10^{-8}	1.2×10^{-3}	1.2×10^{-3}
Radon					
^{220}Rn	11	2.9×10^{-5}	1.5×10^{-6}	1.5×10^{-5}	1.5×10^{-5}
^{222}Rn	14	3.7×10^{-5}	1.9×10^{-6}	6.3×10^{-5}	6.3×10^{-5}
Total	25	6.6×10^{-5}	3.4×10^{-6}	0.0049	0.0085

[a] Located 8 miles southeast of plant site.

[b] Based on maximum modeled annual TSP concentration increase.

[c] No radioisotope emission standards apply to coal-fired power plants. These standards apply to unrestricted areas around a registrant's plant (i.e., uranium mill) and are presented for comparison purposes only (see Section 2.0).

suggested as a guideline to ensure protection of public health and welfare with an adequate margin of safety in residential areas (EPA 1974a). This EPA guideline applies to residential areas. It is used in this study for purposes of assessing potential health impacts and activity interference. As discussed in Section 2.0 a change in noise levels that increases baseline by greater than 9 dB(A) is defined as an indication of significance in areas of interest such as the wilderness study areas.

Study Methodology

During operation, noise impacts would be caused mostly by boilers, fans and motors (Edison Electric Institute 1978). Thus during operation, any noise impacts would be caused by the complex interaction of several sources.

In order to mathematically simulate the impact of noise sources, information is needed concerning the source strength, relation of sources to each other and location of any barriers (e.g., storage piles, earthberms). The contribution of noise from each source at a given receptor point can then be calculated and summed using methods such as those suggested by Peterson and Gross (1972). The existing background level at any given receptor must also be considered.

The above approach is limited in that detailed project design information is needed in order to make accurate predictions. These data are not currently available for the proposed NMGS. Because of this, a two-stage approach to impact analysis was taken. The first step consisted of reviewing several analyses conducted for coal-fired generating stations of various sizes to determine if significant impacts had been predicted or identified. The second step was to perform noise monitoring at various distances from the San Juan Generating Station, currently in operation (ambient monitoring was also performed in the wilderness study areas so as to determine existing levels at receptors of interest as discussed in Section 3.0).

Also of concern are potential noise impacts resulting from increased traffic due to NMGS employees travelling to and from the power plant. This was investigated using the same techniques described for the calculation of future baselines described in Section 3.0. Detailed calculations are presented in Appendix A.

NMGS Noise Impacts

No significant adverse noise impacts from power plants were identified in the literature reviewed. These analyses included the following:

- Environmental analysis for the Plains-Escalante Generating Station (Burns and McDonnell 1978)
- Final Environmental Impact Statement: Proposed Modifications to the Four Corners Power Plant and Navajo Mine (U.S. Dept. Interior 1976)
- Environmental analysis for Craig Station Unit 3 (Burns and McDonnell 1979)

These analyses predict that noise levels near a typical generating station may range from 40 to 70 dB(A) at plant boundaries and decrease to background levels within 2 to 3 miles.

Ambient noise monitoring was performed at receptors of interest in the project area. Specifically, monitoring was performed at points in the wilderness study areas of Bisti and De-na-zin closest to the proposed NMGS site. Background values at Bisti and De-na-zin were found to be about 32 and 35 dB(A), respectively. Future baseline levels due to automobile traffic associated with the hypothetical coal mine adjacent to NMGS could result in noise levels in the range of 49 to 76 dB(A) at the Bisti WSA, and 35 to 65 dB(A) at the De-na-zin WSA, as discussed in Section 3.0.

Probable impacts from operation of NMGS have been assessed by using monitoring data obtained in the area of the operating plants at Four Corners and San Juan. These plants should be representative of conditions during operation of NMGS. Monitoring at Four Corners showed sound levels of 55 to 83 dB(A) at the property boundary (U.S. Department of Interior 1976). Background levels were found to be about 40 dB(A). Significant impact of plant noise was not observed beyond 0.5 miles from the plant boundaries.

Monitoring at San Juan showed values of about 51 dB(A) near the property boundaries (PNM 1982d). No significant plant impact was observed at distances beyond 2 miles from the plant boundary.

The Bisti and De-na-zin WSAs are located 2.0 and 3.5 miles from the boundary of the proposed NMGS, respectively. Based on the above, power plant noise has been found to attenuate to background levels at distances of approximately 2 miles. It is concluded that at the WSAs, noise due to operation of the power plant should be barely discernable. Thus, no significant impact from NMGS is expected at these locations.

Automobile Noise Impacts

From consultation with our social and economic specialists, it was determined that maximum worker levels (construction and operation) associated with NMGS are estimated to be approximately 1800. On a two-shift per day basis, approximately 900 employees would travel to and from NMGS. This would account for 900 cars per hour, two times per day, during peak-hour traffic flow periods.

It is assumed that the employees would come from the Farmington/ Aztec area. At this time it is not known what percentage of cars would travel on NM 371 and NM 44. For purposes of conservatism, it is assumed that all cars would travel on NM 371, which runs alongside the Bisti WSA.

The figure of 900 automobiles per hour is combined with the projected automobile flow rate on NM 371, inclusive of employees associated with the hypothetical mine, as discussed in Section 3.0. Total vehicles on NM 371 are projected to be approximately 1450 cars per hour and 61 heavy trucks per hour. These values were used as input in calculating noise impacts via the nomograph (Figure 3-8). Detailed calculations are presented in Appendix B.

Noise levels at the Bisti WSA boundary were projected to increase by approximately 1 dB(A). At 2000 feet from the road, no discernible noise impact from automobile traffic due to NMGS above future baseline noise levels is projected.

Because projected traffic flows due to NMGS on Road C-15 (adjacent to De-na-zin WSA) are not known, the analysis considered the future baseline noise levels associated with negligible traffic on C-15 and the maximum traffic levels associated with the hypothetical mine. In the former situation, a moderate amount of traffic increase (i.e., 20 to 30 vehicles per hour) would be likely to cause a 9 dB(A) increase above baseline noise levels at the boundary of the WSA. In the second situation, approximately 700 vehicles per hour would be necessary to cause such an increase above baseline levels at the boundary. Within the WSA itself (1/4 mile from Road C-15), approximately 2000 vehicles per hour would be necessary to cause the 9 dB(A) increase above baseline noise levels. It is not likely that such levels of traffic would occur on C-15 as a result of NMGS. However, the former situation, which assumes a low level of traffic on C-15 in the future baseline, presents a potential for significant impact at this WSA.

4.9 EFFECT OF NMGS ON FORMATION OF ACID RAIN

There is increasing evidence that acid precipitation is responsible for substantial adverse effects on both agricultural and aquatic systems. This problem is becoming more prevalent and has both regional and worldwide implications. In many areas of the world acid precipitation has been directly linked to SO_2 anthropogenic sources and, to a lesser extent, NO_x. Fossil fuel combustion and, in particular, coal-fired power plants, are major sources of such emissions. Although knowledge about acid precipitation is rapidly increasing, there is as yet "no quantitative cause-effect relationship between pollutant emissions and the measured acidity of precipitation" (U.S. Department of Energy 1980).

This section examines the causes of acid rain, its variability and effects as well as NMGS' relation to this phenomenon. Because a direct relationship has not been established between emission rates for individual sources and downwind receptor sites, projected impacts of acid precipitation related to NMGS emissions are largely speculative. Also, although studies are in progress, no reliable baseline information on the pH level of precipitation in the San Juan Basin was available at the time of preparation of this report. However, based on the current literature and research, discussed below, no significant impact is expected from NMGS in the San Juan Basin. A potential for impact on remote but sensitive areas, particularly the high mountain lakes and streams in Colorado and northern New Mexico is discussed.

DEFINITION OF ACIDIC PRECIPITATION

The acidity of a solution can be discussed in terms of its hydrogen ion concentration. Pure water contains 1×10^{-7} gram of hydrogen ions per liter. Concentrations greater than this represent an acidic solution while concentrations lower are alkaline (basic). Generally the concentration is expressed on the pH scale, which is the negative logarithm of the hydrogen ion concentration (expressed in gram-equivalents per liter). Pure water containing 1×10^{-7} gram of hydrogen ion has a pH of 7. Levels lower than 7 represent increasing acidity. Since this is a logarithmic scale, each whole number change is a tenfold change in acidity (see Section 2.9).

Precipitation is naturally somewhat acidic (with a pH of 5.6) due to the dissolution of atmospheric carbon dioxide which forms carbonic acid. The term "acid precipitation" is generally applied to precipitation with pH lower than 5.6 indicating that sources other than carbon dioxide cause the acidity (National Commission on Air Quality 1981).

MEASUREMENTS OF ACIDIC PRECIPITATION

Annual precipitation over large areas of the world are from 5 to 30 times more acidic than a pH of 5.6 (Likens 1981). Throughout Europe, southeastern Canada and the eastern United States the average pH of precipitation ranges from 4 to 4.5 (Dillon 1978, Kurtz 1980, Wolff 1979, Vermeulen 1978, Organization for Economic Cooperation and Development 1977, Likens 1972, Sequeira 1982a, Aubertin 1976, Cogbill 1976). Precipitation with a pH as low as 2.4 has been observed (Likens 1979).

Acid precipitation has been observed in many areas in the southern and western United States. Rainfalls with pH below 4.0

are being increasingly observed in the Southeast (Haines 1979), while in Florida the annual average pH of precipitation is below 4.7 (Brezonik 1980). In the western states an annual average pH of 4.6 was reported for an area near the continental divide in Colorado (in Boulder County, 6 km east of the continental divide) (Lewis 1980); a pH of 4.1 was reported for Pasadena, California (Liljestrand 1978); and values below 5.0 appear to be typical for the Puget Sound basin and the western slope of the Cascade Mountains near Seattle (Powers 1981).

Observations of averaged levels of rain pH in some remote areas have been reported in the range of 5.30 to 6.27 (EDS 1973-74, EDS 1975-1976, NOAA 1979, Miller 1979). These values show considerable variation from year to year and a great deal of variation about the mean (U.S. Dept. of Energy 1980). The range of pH results reported by Miller (1979) for Mauna Loa, Hawaii varied from 3.84 to 6.69, which is almost 3 orders of magnitude.

CHARACTERIZATION OF ACID RAIN

Carbon dioxide plays only a minor role in the chemistry of rainwater with pH values below 5.6. Variations in pH values of rainwater below 5.6 are a function of the acidity and alkalinity of material contained in rainwater and the degree of neutralization between them. Most investigators believe that acid precipitation arises from strong acids, mainly sulfuric and nitric and to a lesser extent, hydrochloric (DOE 1980, Barrie 1981, LRTAP 1980, Kurtz 1981, Glass 1979, 1982, Likens 1979, Wolff 1979, Vermeulen 1978, Liljestrand 1978, EPRI 1979, ITFOAP 1981). Increased alkaline material are believed responsible for pHs greater than 5.6 (DOE 1980, Cooper 1976, Muhlbaier 1978, Likens 1979). It is postulated by some that decreases in the alkaline component in rainwater (e.g., calcium) contribute to lower pHs (Sequeira 1982a, 1982b).

CAUSES OF ACID RAIN

Acid precipitation is widely recognized although not universally accepted as being related to acid precursors resulting from the combustion of fossil fuels (Glass 1982, Likens 1979, NAS 1978, DOE 1980, Barrie 1981, LRTAP 1980). In Europe the increase in acid precipitation has coincided with the substantial increase in emission of sulfur oxides (Shaw 1979). Oden (1976) attributes the spread of acid rain through Europe and the increased intensity of rainfall acidity to increased anthropogenic emissions of NO_x and SO_2. In the Netherlands, decreases in the acid concentrations of rain have occurred simultaneously with a considerable reduction in SO_2 emissions (Vermeulen 1978).

The National Research Council Committee on the Atmosphere and the Biosphere (NRC 1982) reported that the circumstantial evidence for the role of power plant emissions on acid rain was overwhelming.

Based on this literature, evidence linking SO_2 and NO_x emissions to acid rain is still only circumstantial and is criticized. The relative proportion of anthropogenic and natural contributions of sulfates and nitrates found in precipitation is not known. Chemical transformations and processes are not fully understood; nor is the mechanism of long-range transport of precursors to acid precipitation well defined. The data base is not yet sufficient to conclusively show if there are changes in the natural pH of precipitation. Finally, there is no quantitative cause-effect relationship between pollutant emissions and the measured acidity of precipitation.

There are questions as to what portion of the global sulfur emissions are of anthropogenic origin and what percent are of natural origin (Eriksson 1960, Rodhe 1978, Gravenhorst 1978, Whelpdale 1978, Granat 1976). The anthropogenic fraction was first estimated at 15% and has been continuously revised upwards. The latest estimates attribute approximately two-thirds of all the global sulfur emissions to man's activities (EPRI 1979).

Nitrate levels in precipitation are much less correlated than sulfate with acid precipitation (Pack 1978). Emission inventories of nitrate, specifically the amount released from natural sources is not well understood (Fox 1976). It has been postulated that up to 50% of the tropospheric NO_2 is formed by lightning (Noxon 1978). If this is true, lightning would be the major source of nitrates found in acid precipitation.

Atmospheric transport, transformation and deposition processes of acid precipitation precursors are not fully understood and are the subject of much controversy. Low pH values in precipitation in a remote area was considered as evidence of long range transport of pollutants by one author (Miller 1979) and as evidence of naturally low pH values by another (Sequeira 1982b).

Although there is a large degree of uncertainty and controversy with respect to the current trends in and causes of acidic precipitation, the following statements are generally agreed upon by experts in the field:

- The pH of precipitation is lower in large areas of the world than what would be expected by the carbon dioxide water equilibrium.
- Sulfuric acid and nitric acid and to a lesser extent hydrochloric acid contribute to the lower pH.

- Fossil fuel combustion does form precursors to acid precipitation although its importance is not clear.

REGULATORY AND LEGISLATIVE STATUS OF ACID DEPOSITION PREVENTION PROGRAMS

Currently, there are no provisions in the Clean Air Act that specifically address the issue of long-range transport as it relates to the formation of acid rain. The National Ambient Air Quality Standards (NAAQS) stipulated under the Act primarily address the local, ground-level effects of air pollutants from stationary sources. They do not address the problems of total pollutant loading and long-range transport. Large quantities of pollution can be released without violating the ambient standards in an area, provided that such emissions are adequately dispersed. Therefore, it is possible for the states to enforce ambient air quality standards that are shown to protect public health and general welfare, as defined by the NAAQS, while still allowing pollutant emissions that can cause acid deposition problems in distant downwind regions.

Several control programs under the Act do reduce the amount of pollutants available for long-range transport and associated air quality effects. These are the non-attainment, prevention of significant deterioration, motor vehicle emissions control, and new source performance standards programs.

Congress is presently drafting revisions to the Clean Air Act and has considered measures based upon recommendations from both private and public sectors. Of particular importance are the recommendations made by the National Commission on Air Quality (NCAQ) in their report to Congress (To Breathe Clean Air: NCAQ 1981). The NCAQ was established by Congress under the Clean Air Act Amendments of

1977. The Commission was charged with the responsibility to perform an independent analysis of air pollution control and alternative strategies for achieving the goals of the Act. Long-range transport and the phenomenon of acid deposition and acid rain were included among the various issues which the Commission was mandated by Congress to address.

The principal recommendations regarding acid deposition and acid rain by the NCAQ were the following:

- Congress should provide funding to develop a long-term nationwide atmospheric deposition monitoring program. The purpose of the program would be to assess long-term trends, by geographic region, in dry and wet deposition, as well as the effects of such deposition on water and land.
- Congress should require a significant reduction by 1990 in the current level of sulfur dioxide emissions in the eastern United States. In designing a program to bring about these reductions by 1990, Congress should consider whether to adopt a phased program requiring interim reductions by 1985.

These issues have been discussed in Congress, although it is difficult to predict at this time the final form of such legislation, as well as what subsequent federal and state regulations will be written per such mandates.

Although no specific regulations have as yet been written which require measures to reduce or eliminate acid rain, there have been many studies to investigate the problem. The EPA and the Department of Energy have jointly sponsored two studies to project total emissions of sulfur dioxide and nitrogen oxides from power plants in the years 1980, 1985, 1990 and 2000. Also, Title VII of the Energy Security Act of 1980 mandates a 10-year interagency task force study of acid deposition.

Canada has recently adopted legislation allowing its Department of Environment to adopt measures to reduce SO_2 and NO_x emissions. Under this legislation, an SO_2 emissions limit has been placed on Canada's largest smelter. In addition, the Department of the Environment has obtained an agreement with the major Ontario utility to reduce its total SO_2 emissions from current levels of 500,000 tons per year to 390,000 tons per year in 1985 and to 260,000 tons per year in 1990. Emissions of NO_x from this utility must be reduced from current levels of 80,000 tons per year to 60,000 tons per year in 1985 and to 40,000 tons per year in 1990. Additional measures are currently being considered by the Department of the Environment (NCAQ 1981).

Similar provisions have been considered in Congress with respect to the Clean Air Act revisions. However, there has been opposition to such measures, with the general feeling that any such regulations required by the Clean Air Act must also require a cost-benefit analysis to be performed by the regulatory agencies (i.e., EPA and state environmental agencies).

ACID RAIN IMPACT ASSESSMENT IN SAN JUAN BASIN

The assessment of the local and regional impact of acid precipitation resulting from emissions from NMGS is based mainly on studies conducted in other areas where environmental conditions are similar to the San Juan Basin and the southwestern states. In most respects, any impact on the region by acid precipitation in general, and any resulting from NMGS, is likely to be mitigated in part by low rainfall and high alkalinity content of the soils, although certain potential sensitive areas have been identified.

The San Juan Basin has moderate to strongly alkaline soils with very little ground cover, making it susceptible to wind erosion. In other areas of the country that have basic soil and considerable windblown dust, precipitation pH values over 7 (0.1 $\mu g\ H^+$/liter) have been observed. This is a result of the neutralization effect of windblown dust on the acids carried by precipitation. It would be expected that any precipitation in this region would be naturally buffered by the windblown dust.

The deposition of acids on soils, crops, and structures is a function of both the acidity of the rainfall and the quantity of precipitation. The San Juan Basin has a relatively low annual rainfall--less than one-third of that reported in areas in which acid precipitation problems have been identified. Even if the precipitation in the San Juan Basin were to become acidic, the low frequency of rainfall is likely to result in a lower impact than that of similar pH rains in other areas of the world.

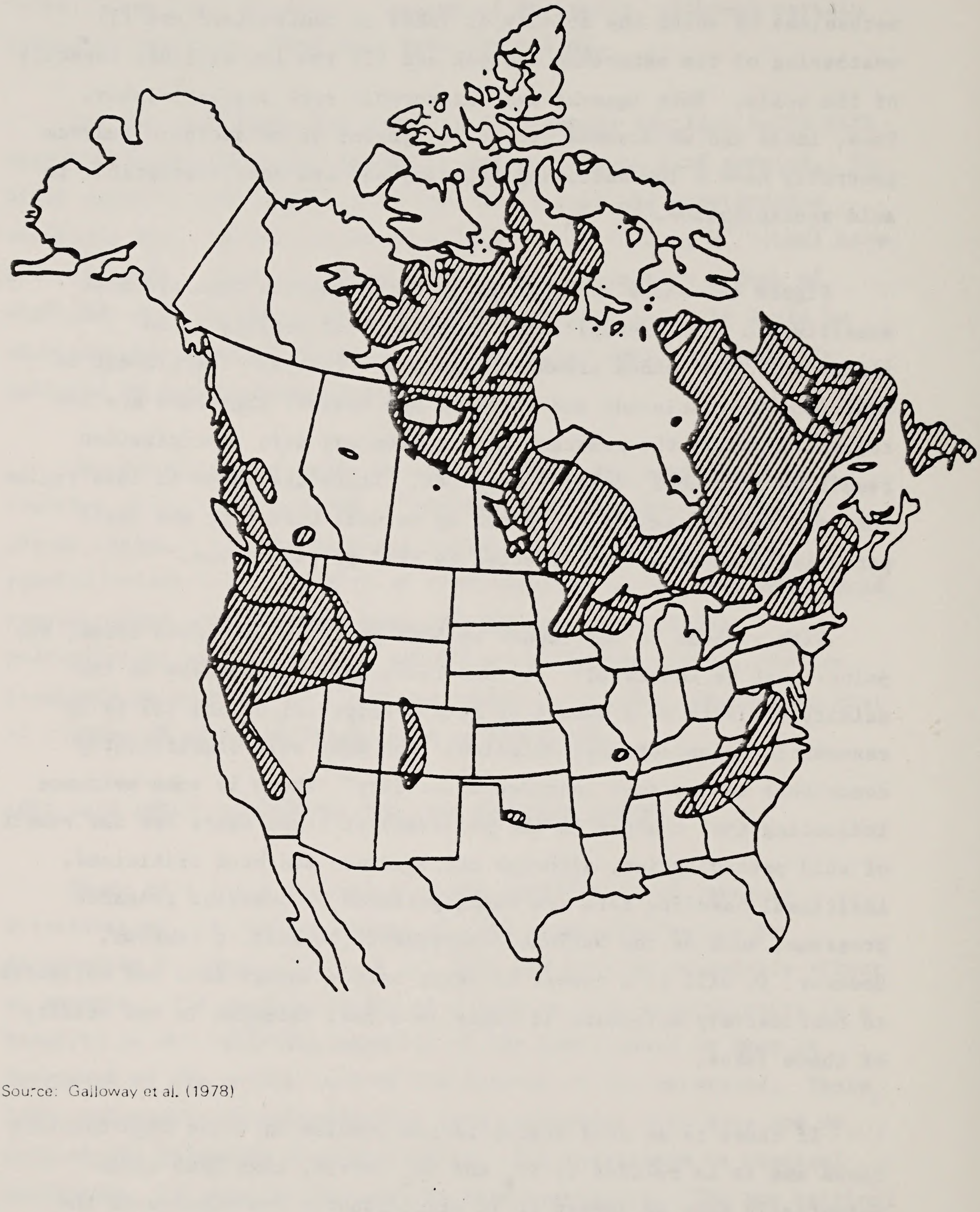
ACID RAIN IMPACT ASSESSMENT FOR HIGH MOUNTAIN LAKES

There is a large variation in the sensitivity of lakes to acidification. A similar amount of acid precipitation can be devastating to aquatic life in one lake and have no measurable effect on another. The susceptibility of a lake to acid precipitation is a function of the buffering capacity of the lake, which in turn is dependent on the composition of the bedrock of the watershed. Those lakes vulnerable to acidification have watersheds that have one or more of the following characteristics: (1) resistance to chemical weathering, (2) poor soils, and (3) thin vegetation. The two critical mechanisms by which the acidity of lakes is neutralized are (1) weathering of the watershed bedrock and (2) the ion-exchange capacity of the soils. Both igneous and metamorphic rock weather slowly. Thus, lakes and watersheds formed on igneous or metamorphic bedrock generally have a low buffering capacity and are more susceptible to acid precipitation.

Figure 4-1 shows those areas in North America that are most sensitive to acid precipitation using bedrock geology as an indicator. The shaded areas in Figure 4-1 that are the closest to NMGS (Southern Colorado and northern New Mexico) therefore are the regions in which the greatest impact from any acid precipitation resulting from NMGS would be expected. There are lakes in this region that are insufficiently protected by natural buffering and could potentially be adversely affected by acid precipitation.

With respect to any impact by NMGS on these sensitive areas, two points must be addressed: (1) Has there been an increase in the acidity of lakes as a result of acid precipitation? and (2) Is it reasonable to expect that emissions from NMGS will significantly contribute to any such increase in acidity? There is some evidence indicating that changes in the pH levels of these lakes are the result of acid precipitation, although the evidence has been criticized. Additional baseline data are being gathered by numerous research programs, such as the National Atmospheric Deposition Program. However, it will be a number of years before enough data are collected to conclusively determine if there is a real increase in the acidity of these lakes.

If there is an acid precipitation problem in these high mountain lakes and it is related to SO_x and NO_x levels, then NMGS could potentially have an impact if it significantly contributes to the



Source: Galloway et al. (1978)

Figure 4-1. REGIONS IN NORTH AMERICA WITH LAKES THAT MAY BE SENSITIVE TO ACID PRECIPITATION, USING BEDROCK GEOLOGY AS AN INDICATOR ambient NO_x and SO_x levels in this region. In an energy study conducted by the EPA (1979c), anthropogenic emissions were projected for the year 2000 for a three-state area (New Mexico, Utah, and Colorado). Based on these projected emissions, NMGS would contribute approximately 3 percent of this total. It is possible, however, that long-range transport from as far away as the West Coast could also have an impact on the formation of acidic rain in the high mountain lake areas of Colorado (Environmental Defense Fund 1981).

4.10 WEATHER MODIFICATION

The earth's temperature is the result of a balance between incoming solar radiation and outgoing terrestrial radiation (energy reflected off the earth and back into space). Atmospheric CO_2 permits incoming solar radiation to reach the earth but absorbs and reflects outgoing terrestrial radiation. Half of this reflected energy will go out to space but half will go back to earth. As the amount of CO_2 in the atmosphere increases, the amount of terrestrial energy reflected back to earth is increased. This increase in the amount of energy reaching the earth will cause a warmer temperature in the lower atmosphere. This phenomenon is termed the "greenhouse effect."

The global amount of carbon that can be considered a precursor of CO_2 is constant and stored predominately in four major reservoirs: (1) fossil fuel (oil, gas, coal, and wood), (2) the atmosphere, (3) the ocean, and (4) the biosphere (living matter). Relationships between the carbon level in each reservoir are complex and not well understood, but the removal of carbon from one reservoir will result in an increase in carbon in one or more of the others.

Much CO_2 which has been stored by plants over hundreds of millions of years in the form of coal and oil is now being released during fossil fuel combustion in a matter of a few hundred years. This may disturb the equilibrium between the four major reservoirs, and would be the cause of any greenhouse effect.

Although all the carbon dioxide released from fossil fuel combustion does not remain in the atmosphere, it has been estimated that since the Industrial Revolution, atmospheric CO_2 levels have increased 15-25 percent. A study of the average monthly CO_2 level at Mauna Loa, Hawaii, has shown that between 1958 and 1979 alone there was a 7 percent increase in atmospheric CO_2 (e.g., from 2 to 5 percent. Theoretical calculations have shown that a doubling of atmospheric CO_2 levels will lead to significant warming of the earth's atmosphere (Council on Environmental Quality 1981).

The earth's temperature and climate are also affected by the amount of clouds, dust, and other materials in the atmosphere. If the earth enters a period of increased volcanic activity, large amounts of dust would be added to the atmosphere, which would reflect incoming solar radiation and could counter any temperature increase from CO_2. The associated global temperature changes that result from volcanic activity are significant and have correlated with historical global cooling periods (Mitchell 1977).

Results of any significant warming of the earth's atmosphere (+5°F) are difficult to postulate. Possible changes could result in altered patterns of precipitation and evaporation that could shift agriculturally productive areas and cause a melting of the ice cap with a subsequent raise in sea level and flooding of coastal areas.

The greenhouse effect is not a regional problem attributed to any one source or type of source but, rather, is a global one. All fossil fuel combustion releases CO_2 and contributes to the problem. Any potential impact by NMGS would relate to the amount of CO_2 NMGS emits. At 8300 Btu/lb and an annual consumption of 7.5×10^6 tons of coal (300 million tons over the 40-year plant life), NMGS would emit 12.8×10^6 tons of CO_2 a year at peak operation (assuming an emission rate of 206 pounds of CO_2 per million Btu heat input). This emission rate represents 0.026 percent of CO_2 projected to be emitted by the year 2000 from all sources, as calculated from Table 4-18. The greenhouse effect is cumulative and relates to the emission of CO_2 over many years. Since worldwide emissions of CO_2 are projected to increase, the actual contributions of NMGS to the worldwide CO_2 budget in the year 2000 would be substantially less than 0.026 percent.

There are many uncertainties as to how increased CO_2 levels would affect the earth's climate. NMGS would contribute about 0.026 percent of the worldwide anthropogenic CO_2 emissions in the year 2000. If anthropogenic sources of CO_2 have an impact, NMGS would be a contributor to that impact, however slight. The contribution of CO_2 due to NMGS would not, however, result in a measurable temperature increase.

4.11 IMPACT OF SECONDARY EMISSIONS

Secondary emissions are those that would occur as a result of the operation of a stationary source but do not come from the source itself. For the proposed NMGS, the main secondary sources include vehicular traffic and population growth in the project area.

Table 4-18. PROJECTED WORLDWIDE ANTHROPOGENIC CO_2 EMISSION LEVELS

Energy Source	Percent Total Energy Resources[a]	Energy Demand in Year 2000 (10^{15} Btu)[b]	CO_2 Emissions ($lb/10^6$ Btu)[a]	CO_2 Emissions in Year 2000 (10^9 tons)
Coal	80.2	430.6	207	44.5
Oil	13.3	71.4	166	5.93
Gas	5.3	28.5	118	1.68
Uranium	1.2	6.4	0	0
Total	100	537[a]		52.1

[a] Source: Perry (1977).

[b] Estimate based on percent of total nonrenewable energy resources and demand of 537 x 10^{15} Btu.

Vehicular Traffic

It has been assumed that the majority of the project employees would live in the area of Farmington, approximately 35 miles from the proposed plant site. The maximum number of construction and operation employees during any one year would be about 1800. For conservatism, it is assumed that each vehicle would carry only one worker. Annual vehicle mileage would be about 46 million miles. Annual emissions have been estimated based on factors presented by the EPA (1979b) and are as follows (in tons per year):

- TSP - 29
- SO_2 - 13
- NO_x - 418
- Hydrocarbons - 209
- CO - 1464

These emissions are much less than those associated with NMGS itself, and would be spread over the entire length of roadway (35 miles). No significant impacts on ambient air quality are expected.

Growth-Related Impacts

Construction and operation of the proposed facility would lead to increases in population in the project area. This is discussed in greater detail in the Social and Economic Conditions Technical Report.

The increase in population will lead to an increase in air pollutant emissions from several sources. Construction of homes and roads would result in temporary increases of fugitive dust. Increased fuel combustion for home heating and vehicle travel would increase emissions of gaseous pollutants. Although difficult to quantify, these emissions are expected to be much less than those from the proposed plant and will be spread over a large area. They are not expected to have a significant impact on ambient air quality.

5.0

SUGGESTED MITIGATION

Several measures for the control of air pollutant emissions have been included by PNM in the project description. These include control of fugitive dust during construction and use of state-of-the-art control technology for control of operational emissions. Therefore no additional air quality mitigation measures are suggested.

6.0
UNAVOIDABLE ADVERSE IMPACTS

Construction and operation of the proposed project would cause some deterioration of air quality, and increase in noise levels, in the geographic area of influence. However, analyses indicate that ambient air quality standards would not be violated and no damage to public health and/or welfare would result. Visibility analyses indicate that plume perceptibility from the NMGS would be infrequent. Also, no damage to public health (e.g., hearing impairment) is expected from ambient noise levels resulting from plant construction or operation.

7.0

RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE AFFECTED ENVIRONMENT AND LONG-TERM PRODUCTIVITY

During the 40-year life of the project, emissions would ultimately be dispersed and eventually removed naturally from the atmosphere by wet and dry deposition. Noise pollution would cease with the abandonment of plant facilities.

8.0
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

There are no irreversible or irretrievable commitments of resources associated with air pollutant emissions or noise.

9.0

PROJECT COMPONENT ALTERNATIVES

COAL HANDLING

The Proposed Action calls for coal to be trucked from the mine and placed in either active or inactive storage piles at the plant site. One possible alternative would be to transport coal totally by conveyor from the mine to the plant. This would eliminate emissions from trucks and from the unloading hopper at the plant site. However, emissions from conveyor transfer points would be expected to increase. Thus this alternative would result in air quality impacts similar to the Proposed Action.

Another alternative would be to locate the inactive storage pile at the mine, as opposed to at the plant site. This would not alter the air quality impacts, except to move this emissions source a short distance. This alternative would also not have significantly different noise impacts from the Proposed Action.

The use of conveyors instead of trucks would be expected to yield slightly lower noise levels near the plant site but would not be expected to significantly change predicted noise impacts at the receptors of interest.

WATER SUPPLY SYSTEM

Three pipeline routes are being examined to transport water from the San Juan River to the NMGS. The proposed line (P1) would be about 40 miles long. Two alternative routes--P2 (about 43 miles long) and P3 (about 49 miles long)--are also being considered. Construction impacts would be caused by emission of fugitive dust and gaseous pollutants from heavy equipment and vehicles. These impacts would be temporary and localized and would not be expected to have a significant impact on ambient air quality. None of the alternative routes would be expected to have significant air quality or noise impacts.

Two prospective sites for water storage reservoirs are currently being considered. Construction of these reservoirs would have impacts similar to pipeline construction and neither alternative would be expected to have significant air quality or noise impacts.

TRANSMISSION LINES

Several alternate transmission line routes are currently being considered. Construction of these lines would cause minor emissions of fugitive dust and gaseous pollutants from construction equipment and vehicles. These sources would also increase noise levels. Air quality and noise impacts for any route would be temporary and localized, and would not be expected to be significant.

POSSIBLE NEW TOWN

1.0

AFFECTED ENVIRONMENT

Due to a lack of industrial development in the region surrounding the possible new town site, air quality is generally considered good. Air quality measurements of NO_2, SO_2, and total suspended particulates and meteorological conditions, wind speed, wind direction, precipitation and solar insolation, made at the proposed NMGS site 12 miles to the southwest are considered representative for the new town site. Pollutant concentrations measured at the NMGS monitor were low, and were often measured at the threshold limit of detection for the recording instruments.

2.0
ENVIRONMENTAL CONSEQUENCES

Air quality impacts that could result from a possible new town would include pollutant emissions associated with vehicles and residential home heating. Assuming an initial population of 2000, with 2000 vehicles, the estimated annual increase in local vehicular traffic is estimated to be approximately 29 million vehicle-miles. Annual emissions due to increased vehicle travel were estimated from available EPA (1979) emission factors, and are as follows (in tons per year): TSP, 19; SO_2, 17; NO_x, 260; hydrocarbons, 151; CO, 960. These emissions would be spread over the length of the local roadways, and no significant impacts are expected.

Assuming that county roadways in the vicinity of a possible new town would be paved, it is expected that emissions of particulate matter due to traffic on paved roads would be small and would have an insignificant impact on air quality in the project region.

Residential Emissions

Emissions and impacts on air quality would result from construction and activities associated with increased population in the area. The primary pollutant would be particulate, although some gaseous pollutants such as NO_x, SO_2, and CO would be emitted from the numerous combustion activities associated with home heating and internal combustion engines. Provided the possible new town would be a residential center with no additional industry, any impacts of gaseous pollutants associated with the possible new town would be minimal, since they would be relatively small and spread out over a large area.

Appendix A

CALCULATIONS FOR CONVERSION OF MONITORED AND MODELED POLLUTANT CONCENTRATION VALUES TO VARIOUS UNITS (ppm and $\mu g/m^3$)

This appendix provides the method and actual calculations made for the following conversions:

1. Current and projected pollution concentrations for the San Juan River valley expressed in ppm, converted to $\mu g/m^3$.

2. Future non-power plant baseline values expressed in ppm, converted to $\mu g/m^3$.

3. Modeled concentrations expressed in $\mu g/m^3$, converted to ppm.

CONVERSION OF SAN JUAN RIVER VALLEY MONITORED VALUES

Approach

Reference conditions of 760 mm and 25°C were assumed.

The following equation was used in all calculations:

$\mu g/m^3$ = ppm x 40.87 x M

where M = molecular weight: SO_2 = 64, NO_2 = 46.

Sulfur Dioxide.

$$\mu g/m^3 = ppm \times 40.87 \times 64$$
$$= ppm \times 2615.68$$

Nitrogen Dioxide.

$$\mu g/m^3 = ppm \times 40.87 \times 46$$
$$= ppm \times 1880.02$$

Current Baseline Values

Sulfur Dioxide.

- Annual: 0.008 ppm x 2615.68 = 20.93 ≐ 21 $\mu g/m^3$
- 24-Hour: 0.043 ppm x 2615.68 = 112.47 ≐ 112 $\mu g/m^3$
- 3-Hour: 0.136 ppm x 2615.68 = 355.73 ≐ 356 $\mu g/m^3$

Nitrogen Dioxide.

- Annual: 0.007 ppm x 1880.02 = 13.16 ≐ 13 $\mu g/m^3$

Projected Baseline Values

Sulfur Dioxide.

- Annual: 0.004 ppm x 2615.68 = 10.46 ≐ 10 $\mu g/m^3$
- 24-Hour: 0.021 ppm x 2615.68 = 54.92 ≐ 55 $\mu g/m^3$
- 3-Hour: 0.067 ppm x 2615.68 = 175.25 ≐ 175 $\mu g/m^3$

Nitrogen Dioxide.

- Annual: 0.007 ppm x 1880.02 = 13.16 ≐ 13 $\mu g/m^3$

CONVERSION OF FUTURE NON-POWER PLANT BASELINE VALUES FOR THE PROJECT SITE

Approach

The approach described above for the San Juan River valley was used for the conversions below.

Sulfur Dioxide.

- Annual: 0.001 ppm x 2615.68 = 2.6 ≐ 3 $\mu g/m^3$
- 24-Hour: 0.006 to 0.011 ppm = 0.006 x 2615.68 and 0.011 x 2615.68 = 15.69 to 28.77 ≐ 16 to 29 $\mu g/m^3$
- 3-Hour: 0.006 to 0.022 ppm = 0.006 x 2615.68 and 0.022 x 2615.68 = 15.69 to 57.54 ≐ 16 $\mu g/m^3$ to 58 $\mu g/m^3$

Nitrogen Dioxide

Annual = 0.002 ppm = 0.002 x 1880.02 = 3.76 ≐ 4 $\mu g/m^3$

CONVERSION OF MODELED VALUES

Approach

The $\mu g/m^3$ values obtained from modeling were converted to units of ppm at ambient conditions. Ambient conditions assumed a temperature of 25°C and pressure of 633 mm.

The following equation was used in all calculations:

$$\text{ppm} = \mu g/m^3 \times \frac{0.02447}{M} \times \frac{P_o}{P}$$

where M = molecular weight; SO_2 = 64, NO_2 = 46

P_o = 1 atmosphere = 760 mm

P = ambient pressure = 633 mm in all calculations

Sulfur Dioxide.

$$\text{ppm} = \mu g/m^3 \times \frac{.02447}{64} \times \frac{760}{633} = \mu g/m^3 \times 4.591 \times 10^{-4}$$

Nitrogen Dioxide.

$$\text{ppm} = \mu g/m^3 \times \frac{.02447}{46} \times \frac{760}{633} = \mu g/m^3 \times 6.387 \times 10^{-4}$$

Combined Modeling Results

Sulfur Dioxide.

- 3-Hour: $601.2\ \mu g/m^3 = 601.2 \times 4.5910 \times 10^{-4} = 0.2759 \doteq 0.276$ ppm
- 24-Hour: $117.7\ \mu g/m^3 = 117.7 \times 4.5910 \times 10^{-4} = 0.0540 \doteq 0.054$ ppm
- Annual: $12.7\ \mu g/m^3 = 12.7 \times 4.5910 \times 10^{-4} = 0.0058 \doteq 0.006$ ppm

Nitrogen Dioxide.

- 24-Hour: $80.1\ \mu g/m^3 = 80.1 \times 6.3870 \times 10^{-4} = 0.0511 \doteq 0.051$ ppm
- Annual: $10.3\ \mu g/m^3 = 10.3 \times 6.3870 \times 10^{-4} = 0.0065 \doteq 0.007$ ppm

Modeling Results of NMGS Alone

Sulfur Dioxide.

- 3-Hour: $290\ \mu g/m^3 = 290 \times 4.5910 \times 10^{-4} = 0.1331 \doteq 0.133$ ppm
- 24-Hour: $64\ \mu g/m^3 = 64 \times 4.5910 \times 10^{-4} = 0.0293 \doteq 0.029$ ppm
- Annual: $3.6\ \mu g/m^3 = 3.6 \times 4.5910 \times 10^{-4} = 0.0016 \doteq 0.002$ ppm

Nitrogen Dioxide.

- 24-Hour: $85\ \mu g/m^3 = 85 \times 6.3870 \times 10^{-4} = 0.0542 \doteq 0.054$ ppm
- Annual: $4.8\ \mu g/m^3 = 4.8 \times 6.3870 \times 10^{-4} = 0.0030 \doteq 0.003$ ppm

Most Likely Short-Term Concentration

Sulfur Dioxide.

- 3-Hour: $166\ \mu g/m^3 = 166 \times 4.5910 \times 10^{-4} = 0.0762 \doteq 0.076$ ppm
- 24-Hour: $37\ \mu g/m^3 = 37 \times 4.5910 \times 10^{-4} = 0.0169 \doteq 0.017$ ppm

Nitrogen Dioxide.

- 24-Hour: $49\ \mu g/m^3 = 49 \times 6.3870 \times 10^{-4} = 0.0313 \doteq 0.031$ ppm

Chaco Culture National Historical Park

Sulfur Dioxide.

- 3-Hour: $26\ \mu g/m^3 = 26 \times 4.5910 \times 10^{-4} = 0.0119 \doteq 0.012$ ppm
- 24-Hour: $10\ \mu g/m^3 = 10 \times 4.5910 \times 10^{-4} = 0.0046 \doteq 0.005$ ppm

Nitrogen Dioxide.

- 24-Hour: 13 $\mu g/m^3$ = $13 \times 6.3870 \times 10^{-4}$ = 0.0083 ≐ 0.008 ppm

Mesa Verde National Park

Sulfur Dioxide.

- 3-Hour: 7.1 $\mu g/m^3$ = $7.1 \times 4.5910 \times 10^{-4}$ = 0.0033 ≐ 0.003 ppm
- 24-Hour: 1.3 $\mu g/m^3$ = $1.3 \times 4.5910 \times 10^{-4}$ = 0.00059 ≐ 0.0006 ppm

Nitrogen Dioxide.

- 24-Hour: 1.7 $\mu g/m^3$ = $1.7 \times 6.3870 \times 10^{-4}$ = 0.0011 ≐ 0.001 ppm

San Pedro Parks

Sulfur Dioxide.

- 3-Hour: 5.5 $\mu g/m^3$ = $5.5 \times 4.5910 \times 10^{-4}$ = 0.0025 ≐ 0.003 ppm
- 24-Hour: 2.0 $\mu g/m^3$ = $2.0 \times 4.5910 \times 10^{-4}$ = 0.00092 ≐ 0.0009 ppm

Nitrogen Dioxide.

- 24-Hour: 2.6 $\mu g/m^3$ = $2.6 \times 6.3870 \times 10^{-4}$ = 0.0017 ≐ 0.002 ppm

Appendix B

NOISE LEVEL CALCULATIONS FOR FUTURE BASELINE AND NMGS TRAFFIC IMPACTS

I. CALCULATION OF FUTURE TRAFFIC VOLUMES ON NM 371 WITHOUT NMGS

A. As projected by New Mexico Highway Department, peak level on NM 371 in 1990 will be 380 vehicles per hour:

1. 319 autos per hour
2. 61 heavy trucks per hour

B. Nonpeak traffic will be 126 vehicles per hour:

1. 103 autos per hour
2. 23 trucks per hour

C. Additional vehicles due to hypothetical mine:

1. Approximately 103 workers per million tons of coal mined (from SJRRCL EIS team)
2. Hypothetical mine size = 2.25 million tons per year (ERT 1982b)
3. Therefore, total workers associated with hypothetical mine = 230 workers

D. Haul truck traffic associated with hypothetical mine:

1. Haul truck capacity: 85 tons
2. 250 days per year

3. 8 hours per day
4. 2.25 million tons of coal mined per year
5. $$\frac{2.25 \times 10^6 \text{ tons coal}}{\text{year}} \times \frac{1 \text{ truck}}{85 \text{ tons cap.}} \times \frac{1 \text{ year}}{250 \text{ days}} \times \frac{1 \text{ day}}{8 \text{ hours}}$$

   = 13 trucks per hour
6. Because haul trucks out = haul trucks in, total trucks on road = 13 x 2 = 26 trucks per hour

E. Total traffic during peak hours:

1. Use peak flow rates:

   a. $$\frac{(319 + 230) \text{ vehicles}}{\text{hour}} = \frac{549 \text{ vehicles}}{\text{hour}}$$

   assuming maximum vehicles from hypothetical mine

   b. 319 vehicles per hour, assuming no vehicles from hypothetical mine

   c. Trucks, assume same: 61 heavy trucks per hour

2. From I.A.1 and I.C.3 above

F. Total traffic during nonpeak hours:

1. Use non-peak-hour flow rates:

   a. Auto vehicle rate, assume same: 103 vehicles per hour

   b. Trucks, add additional from mine: 23 + 26 = 49 heavy trucks per hour

2. From I.B.1 and 2, and I.D.6 above.

G. Calculate noise impacts using nomograph assuming average speed of 50 mph, and combine car and truck noise levels:

1. Peak hours, assuming maximum vehicles (230/hr) from hypothetical mine:

   a. 30 ft: trucks = 75 dB(A); cars = 68 dB(A)
   $10 \log_{10} (10^{7.5} + 10^{6.8}) = 76$ dB(A)

   b. 50 ft: trucks = 72 dB(A); cars = 64 dB(A)
   $10 \log_{10} (10^{7.2} + 10^{6.4}) = 73$ dB(A)

   c. 1/4 mi: trucks = 50 dB(A); cars = 43 dB(A)
   $10 \log_{10} (10^{5} + 10^{4.3}) = 51$ dB(A)

   d. 2000 ft: trucks = 48 dB(A); cars = 40 dB(A)
   $10 \log_{10} (10^{4.8} + 10^{4}) = 49$ dB(A)

2. With no additional vehicles from hypothetical mine, noise levels are the same, since noise levels from trucks are the dominating noise source.

3. Nonpeak hours, assuming all 26 haul trucks per hour on NM 371

   a. 30 ft: trucks = 75 dB(A); cars = 61 dB(A)
   $10 \log_{10} (10^{7.5} + 10^{6.1}) = 75$ dB(A)

   b. 50 ft: trucks = 71 dB(A); cars = 57 dB(A)
   combined: 71 dB(A)

   c. 1/4 mi: trucks = 49 dB(A); cars = ambient = 35 dB(A)
   combined: 49 dB(A)

d. 2000 ft: trucks = 47 dB(A); cars = ambient = 35 dB(A)
combined: 47 dB(A)

4. Nonpeak without 26 haul trucks per hour:

a. 30 ft = 71 dB(A)
b. 50 ft = 68 dB(A)
c. 1/4 mi = 47 dB(A)
d. 2000 ft = 45 dB(A)

II. CALCULATION OF FUTURE TRAFFIC VOLUMES ON C-15

A. Not known what percent of traffic from hypothetical mine will travel on C-15

B. Present traffic volumes are negligible (20 vehicles/day, or less than 1 vehicle/hr)

C. Baseline presented as range; lower end of range = ambient measurement of 35 dB(A)

D. Upper level equivalent to 230 vehicles per hour maximum from hypothetical mine; use nomograph to calculate levels:

1. 30 ft = 65 dB(A)
2. 50 ft = 61 dB(A)
3. 1/4 mi = 40 dB(A)
4. 2000 ft = ambient = 35 dB(A)

E. Baseline noise during nonpeak hours calculated by assuming maximum of 26 haul trucks per hour on C-15 from the hypothetical mine:

1. 30 ft = 71 dB(A)
2. 50 ft = 68 dB(A)
3. 1/4 mi = 46 dB(A)
4. 2000 ft = 41 dB(A)

III. COMBINED LEVELS WITH BLASTING

A. Blast = 119 dB(C), for 7 seconds

B. Using noise attenuation formula, noise impacts at Bisti and De-na-zin WSAs are calculated as follows:

1. Bisti WSA (2.0 miles):

$$N_{\text{Bisti}} = 119 - \frac{6 \times \log_{10}\left(\dfrac{5280 \times 2}{50}\right)}{\log_{10} 2} = 73 \text{ dB(A)}$$

2. De-na-zin WSA (3.5 miles):

$$N_{\text{De-na-zin}} = 119 - \frac{6 \times \log_{10}\left(\dfrac{5280 \times 3.5}{50}\right)}{\log_{10} 2} = 68 \text{ dB(A)}$$

C. Apply barrier attenuation of 24 dB(A) to blasting levels:

1. 73 - 24 = 49 dB(A)
2. 68 - 24 = 44 dB(A)

D. Calculate hourly L_{eq} noise levels for blast using:

$$L_{eq} = 10 \log_{10} \left(\sum_{i=1}^{n} x_i \, 10^{L_i/10} \right)$$

where the fraction of the total time that the event occurs is x_i, and L_i is the noise level for the particular event

1. Blast x_i = 7 seconds/(60 min/hr x 60 sec/min) = 0.0019

2. Blast L_i = 49 dB(A) at Bisti, 44 dB(A) at De-na-zin combined with various L_i values listed below

3. Background L_i for peak hours on NM 371:

   a. L_i = 76 dB(A) at 30 ft
   b. L_i = 73 dB(A) at 50 ft
   c. L_i = 51 dB(A) at 1/4 mi
   d. L_i = 49 dB(A) at 2000 ft

4. Combined 7-second L_{eq} values of blast plus peak-hour traffic:

   a. 30 ft: $10 \log_{10} (10^{4.9} + 10^{7.6}) = 76$ dB(A)
   b. 50 ft: $10 \log_{10} (10^{4.8} + 10^{7.3}) = 73$ dB(A)
   c. 1/4 mi: $10 \log_{10} (10^{5.1} + 10^{4.8}) = 53$ dB(A)
   d. 2000 ft: $10 \log_{10} (10^{4.8} + 10^{4.9}) = 52$ dB(A)

5. Hourly L_i values (background x_i = 1 - 0.0019 = 0.998)

   a. 30 ft: $L_{eq} = 10 \log_{10} (0.998 \times 10^{7.6} + 0.0019 \times 10^{7.6})$
   $= 76$ dB(A)
   b. 50 ft: $L_{eq} = 73$ dB(A)

c. 1/4 mi: L_{eq} = 51 dB(A)
d. 2000 ft: L_{eq} = 49 dB(A)

6. Similarly, blast combined with C-15 traffic noise results in no difference

IV. FUTURE TRAFFIC NOISE ON NM 371 WITH NMGS (peak hours)

A. Maximum employees = 1800

B. 1800 vehicles per hour over 2 shifts = 900 vehicles per hour per shift

C. Combine new traffic flows with those projected from I.E above, assuming 1990 heavy truck traffic stays the same, with NMGS traffic flows:

1. Autos: 550/hr + 900/hr = 1450/hr
2. Trucks: 61/hr

D. Calculate noise impacts using nomograph (Figure 3-8):

1. 30 ft: trucks = 75 dB(A); cars = 72 dB(A)
2. 50 ft: trucks = 72 dB(A); cars = 70 dB(A)
3. 1/4 mi: trucks = 50 dB(A); cars = 47 dB(A)
4. 2000 ft: trucks = 48 dB(A); cars = 44 dB(A)

E. Combine car and truck noise levels:

1. 30 ft = 77 dB(A)
2. 50 ft = 74 dB(A)
3. 1/4 mi = 52 dB(A)
4. 2000 ft = 49 dB(A)

V. FUTURE TRAFFIC ON C-15 WITH NMGS

A. Flows not known.

B. Using nomograph, calculate minimum traffic flows necessary to cause 9 dB(A) increase, with no trucks from hypothetical mine, and baseline level = 35 dB(A). Any increase in traffic would cause 9 dB(A) increase.

C. Assuming maximum noise levels:

1. 650 vehicles per hour: 9 dB(A) increase at boundary of De-na-zin WSA

2. 2000 vehicles per hour: 9 dB(A) increase at 1/4 mile from C-15

VI. NEW INCREASES AT BISTI WSA

A. Nonpeak hours not computed, since NMGS traffic would occur during peak hours only.

B. Increases computed:

1. 30 ft: 77 dB(A) - 76 dB(A) = 1 dB(A)
2. 50 ft: 74 dB(A) - 73 dB(A) = 1 dB(A)
3. 1/4 mi: 52 dB(A) - 51 dB(A) = 1 dB(A)
4. 2000 ft: 49 dB(A) - 49 dB(A) = 0

Appendix C

NON-POWER PLANT BASELINE DERIVATION

Non-power plant baseline concentrations are the highest levels that were measured at the project site monitoring station that cannot be attributed to the Four Corners or San Juan power plant. The methodology for selecting these values is presented in this appendix.

This methodology consisted of:

- An analysis of the frequency of occurrence of events of relatively high levels of SO_2 and NO_2 to assess which events could be judged anomalous for a rural background.

- Compiling an emission inventory for sources of SO_2 and NO_x in the San Juan Basin that would identify potential sources of SO_2 and NO_x levels that are judged anomalous for a rural background.

- Reviewing (when available) wind speed and direction, and SO_2, NO_x, and NO_2 concentrations measured at 15-minute intervals at the project site monitoring station for each day in which relatively high levels of SO_2 and NO_2 occurred.

- Examining the correlation of these relatively high occurrences with emissions from the San Juan and Four Corners power plants.

Frequency of Occurrence

The frequency of occurrence of 3-hour and 24-hour concentrations of SO_2 and 24-hour NO_x are presented in Figures B-1, B-2, and B-3. NO_x values were examined rather than NO_2, since the frequency of occurrence of 24-hour NO_2 was not tabulated by PNM. Because of the great distance between the monitor and NO_x-emitting sources, and because all NO in the atmosphere eventually converts to NO_2, NO_2 values should be similar to NO_x. Where NO_2 data are not available, NO_x data were used. Non-power plant baseline is reported as NO_2.

Relatively high concentrations of SO_2 and NO_x occur very infrequently. A review of the frequency of occurrence of 3-hour SO_2 concentrations indicates that less than 3 percent of the time are levels greater than 5 ppb and less than 0.5 percent of the time are values greater than 20 ppb. Similar frequency distributions of relatively high concentrations occur for SO_2 on a 24-hour basis: Less than 3 percent of the events are greater than 5 ppb and less than 0.5 percent of the events are greater than 10 ppb. For NO_x, less than 1 percent of the events were greater than 20 ppb and 2 percent of the events were greater than 15 ppb.

Emission Inventory

Power plants are the predominant source of SO_2 and NO_x and are the only major source of both SO_2 and NO_x in the San Juan Basin. The San Juan and Four Corners power plants account for over 80 percent of the total NO_x and over 97 percent of the total SO_2 emissions from all sources in the San Juan Basin (see Section 3.5).

San Juan and Four Corners power plants are located close to each other in approximately the same direction from the project site. The

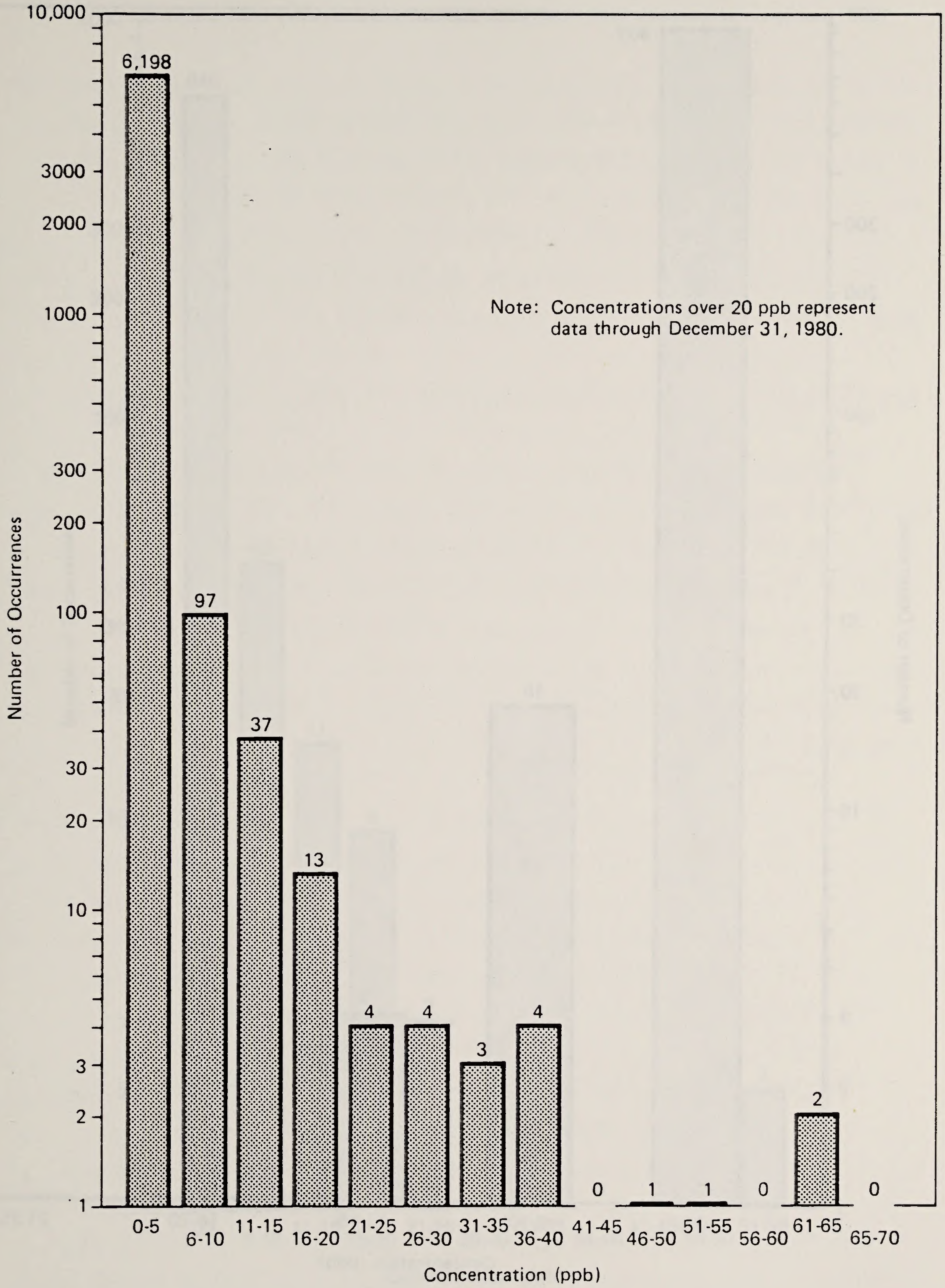


Figure C-1. FREQUENCY OF OCCURRENCE OF 3—HOUR SO_2 CONCENTRATIONS AT NMGS MONITORING SITE, NOVEMBER 1977 THOUGH OCTOBER 1980

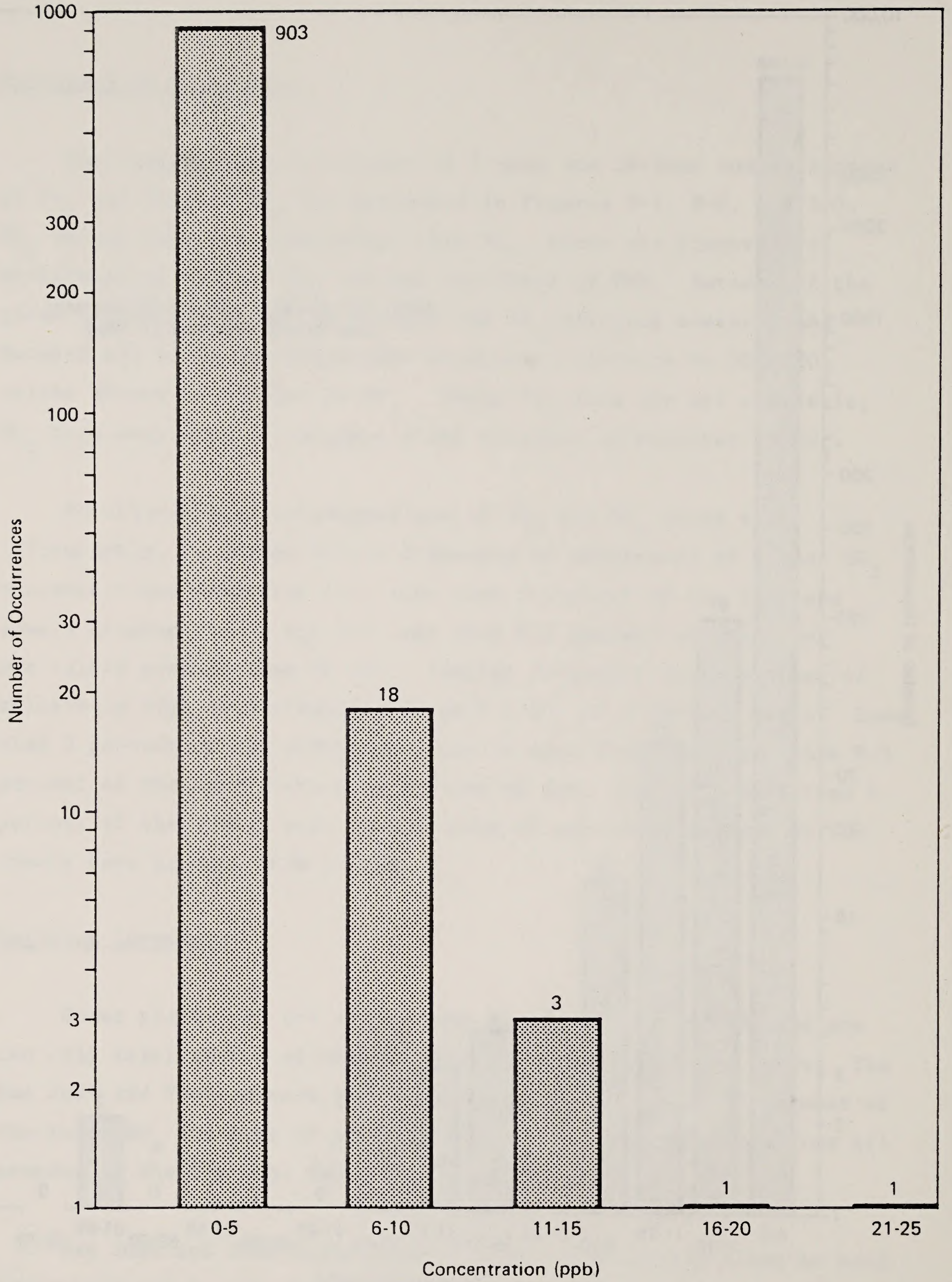


Figure C-2. FREQUENCY OF OCCURRENCE OF 24—HOUR SO_2 CONCENTRATIONS AT NMGS MONITORING SITE, NOVEMBER 1977 THOUGH OCTOBER 1980

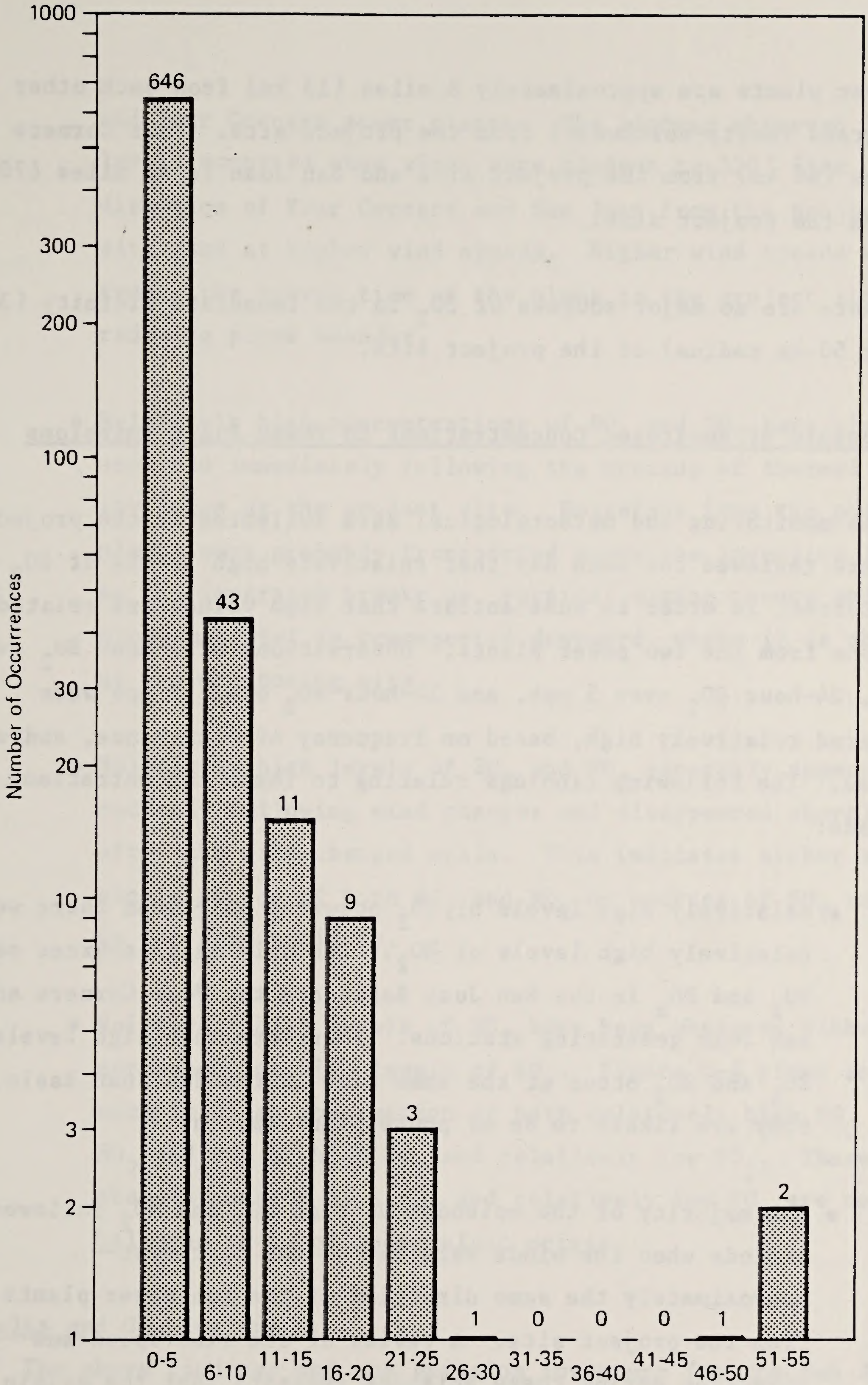


Figure C-3. FREQUENCY OF OCCURRENCE OF 24—HOUR NO_X CONCENTRATIONS AT NMGS MONITORING SITE, NOVEMBER 1977 THOUGH OCTOBER 1980 two power plants are approximately 8 miles (13 km) from each other and 330 degrees (north-northwest) from the project site. Four Corners is 37 miles (60 km) from the project site and San Juan is 43 miles (70 km) from the project site.

There are no major sources of SO_2 in the immediate vicinity (30-mile or 50-km radius) of the project site.

Relationship of Monitored Concentrations to Power Plant Emissions

The monitoring and meteorological data collected at the project site were reviewed for each day that relatively high levels of SO_2 and NO_2 occurred, in order to substantiate that high values are related to emissions from the two power plants. Observations of 3-hour SO_2 over 15 ppb, 24-hour SO_2 over 5 ppb, and 24-hour NO_2 over 15 ppb were considered relatively high, based on frequency of occurrence, and were reviewed. The following findings relating to these concentrations were made:

- Relatively high levels of SO_2 occurred only when there were relatively high levels of NO_2. The only major sources of SO_2 and NO_x in the San Juan Basin are the Four Corners and San Juan generating stations. Therefore when high levels of NO_2 and SO_2 occur at the same time in the San Juan Basin, they are likely to be of power plant origin.

- The majority of the episodes of high SO_2 and NO_2 followed periods when the winds were out of the northwest--approximately the same direction of the two power plants from the project site. A review of the wind speed and direction during these episodes suggests that the origin of the SO_2 and NO_2 is in the immediate vicinity of the San Juan and Four Corners power plants. The highest observed 3-hour levels occurred when winds were closest to 330° (the direction of Four Corners and San Juan from the project site) and at higher wind speeds. Higher wind speeds would reduce the travel time of the plume to the project site by reducing plume meander.

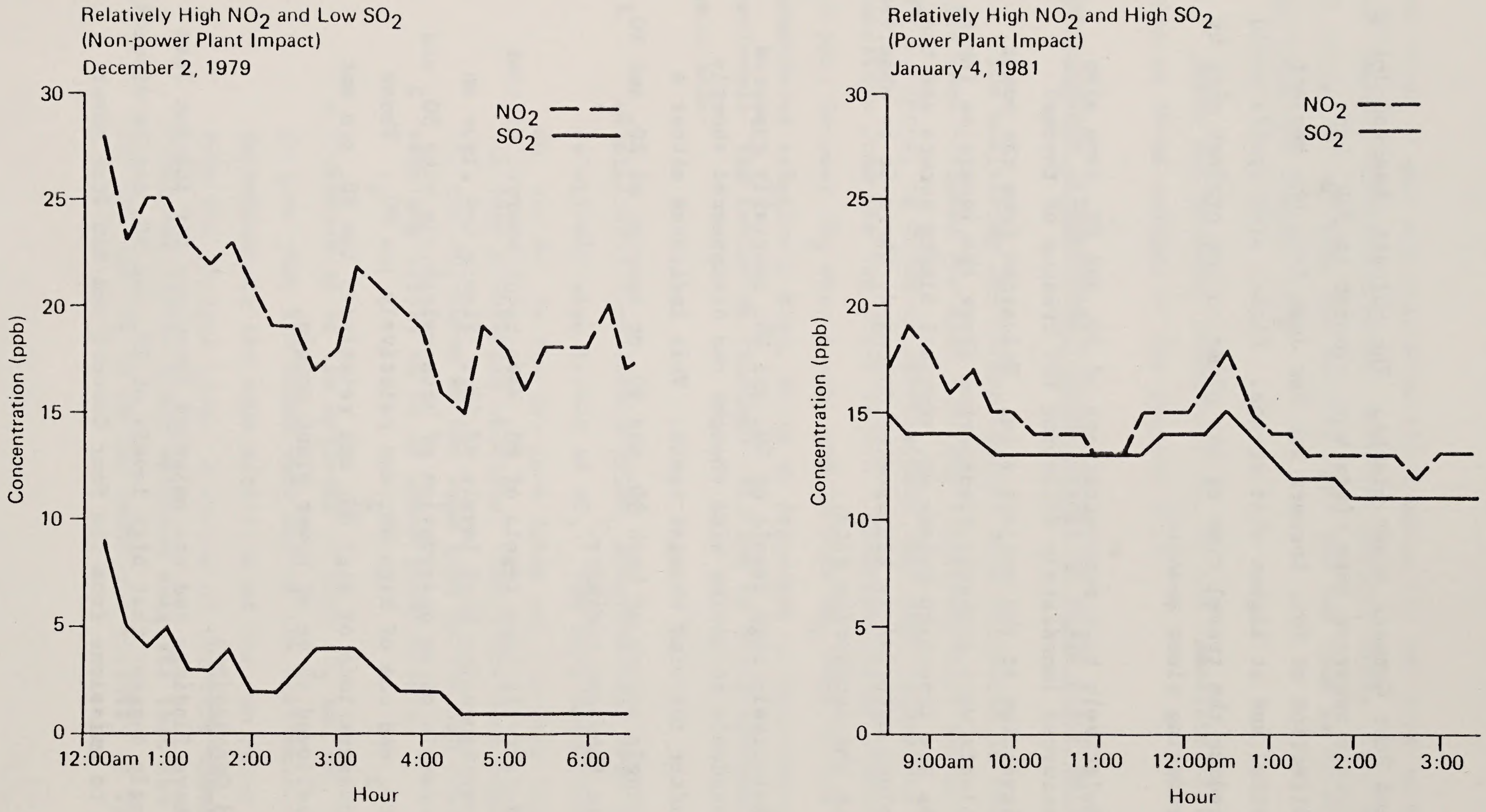
- Relatively high concentrations of SO_2 and NO_2 have also occurred immediately following the breakup of thermal inversion at the project site. Emissions from the power plants were probably transported above the inversion layer. As the inversion breaks up, vertical mixing occurs and the plume material is transported downward, where it is observed at the monitoring site.

- Relatively high levels of SO_2 and NO_2 generally appeared suddenly following wind changes and disappeared shortly after the wind changed again. This indicates either a single source of both SO_2 and NO_2 or sources of SO_2 and NO_2 in the same vicinity.

- Relatively high levels of NO_2 have been observed without corresponding high levels of SO_2. Figure C-4 gives an example of an observation of both relatively high SO_2 and NO_2 and one of high NO_2 and relatively low SO_2. Those observations of high NO_2 and relatively low SO_2 are not believed to be of power plant origin.

Results and Conclusions

The above findings and the emission inventory for the San Juan Basin strongly suggest that high levels of SO_2 and NO_2 can be directly attributed to emissions from the Four Corners and San Juan power plants.


Relatively High NO_2 and Low SO_2
(Non-power Plant Impact)
December 2, 1979

Relatively High NO_2 and High SO_2
(Power Plant Impact)
January 4, 1981

Figure C-4. COMPARISON OF 6-HOUR EMISSION PERIODS—DATA FROM NMGS MONITORING SITE

A conservative estimate of baseline SO_2 levels at the Bisti site for use in subsequent modeling is 20 ppb for the 3-hour maximum and 10 ppb for the 24-hour maximum. These values are obtained by screening out the highest levels that can be attributed to the San Juan and Four Corners generating stations. They represent, with a reasonable level of confidence, the maximum concentrations of SO_2 that would be expected--excluding power plant emissions. It must be emphasized that this approach is conservative, and it is likely that virtually all levels of SO_2 observed at the project site are of power plant origin.

An estimate of baseline NO_2 is 15 ppb for the 24-hour maximum. This value was obtained by screening all high levels of NO_2 that have occurred simultaneously with high SO_2.

Unlike sources of SO_2, there are many non-power plant sources of NO_x and NO_2 in the San Juan Basin, which account for approximately 18 percent of the total NO_2 released. Such sources consist primarily of vehicles and residential heating; other sources include refineries and natural-gas processing plants. The 15-ppb 24-hour baseline value represents, based on monitoring data, the maximum impact that any of these non-power plant NO_2 sources could reasonably be expected to have on the project site or locations outside the San Juan River valley.

It must be emphasized that this is only a correlation, although one made with a high degree of confidence. Although these levels provide a better representation of non-power plant baseline levels than the use of maximum values, care should be taken in their use in subsequent analyses. Specifically, they should not be interpreted as absolute non-power plant levels; these are probably much lower for SO_2.

Appendix D

EMISSION FACTORS AND CALCULATIONS FOR COAL- AND ASH-HANDLING FACILITIES AND HYPOTHETICAL MINE

This appendix contains descriptions of the coal- and ash-handling facilities and the hypothetical mine. It also provides information relating to the emission factors and emission calculations of fugitive particulate matter associated with these sources.

All information contained in this appendix was excerpted from the following reports:

- "EIS Analysis of Fugitive Dust Emissions from the Proposed New Mexico Generating Station" (ERT 1981c)
- "EIS Impact Analysis of Fugitive Dust Emissions from a Hypothetical Mining Operation Located Adjacent to the Proposed New Mexico Generating Station" (ERT 1982b)
- "EIS Evaluation of Fugitive Dust Emission Factors for use in the Impact Assessment of Public Service Company of New Mexico's Proposed New Mexico Generating Station and Bisti Coal Mine" (ERT 1981d)

COAL- AND ASH-HANDLING OPERATIONS (ERT 1981d)

Process Description

Within the plant area itself, coal- and ash-handling and transfer operations will utilize a covered conveyor system. Primary crushed coal will be fed by a conveyor to a secondary crusher. From the secondary crusher, coal will be conveyed to the active storage piles by transferring to branching conveyors leading to the four open storage piles. A lowering well will be used to form and maintain the active storage piles. Coal will be reclaimed from each pile through an underground vibrating grate. From the storage piles, coal will be conveyed to one of four silos located above the pulverizers at each boiler unit. After pulverization, the finely divided coal will be moved pneumatically to the boilers for combustion.

All ash produced by the coal combustion, both fly ash and bottom ash, will be collected in four enclosed storage silos. From there, as needed, the ash product will be loaded into haul trucks for transport.

So that power plant operations can continue in the event of an interruption in the coal supply, there will be an emergency storage pile containing a 3-month supply of coal. The emergency coal storage will be located as shown in Figure D-1. These emergency piles will be constructed using primary crushed coal. Reclaim from emergency storage is possible by moving coal to the nearest active storage reclaimer. Active storage reclaimers may be designed to reclaim primary crushed as well as secondary crushed coal. The reclaimed primary crushed coal will be transferred back to the secondary crushers, then crushed and conveyed to the silos. From that point, coal handling will proceed as under normal operating conditions. Chemical stabilizers will be applied to the surface of the emergency coal pile to reduce its dusting potential during inactive periods.

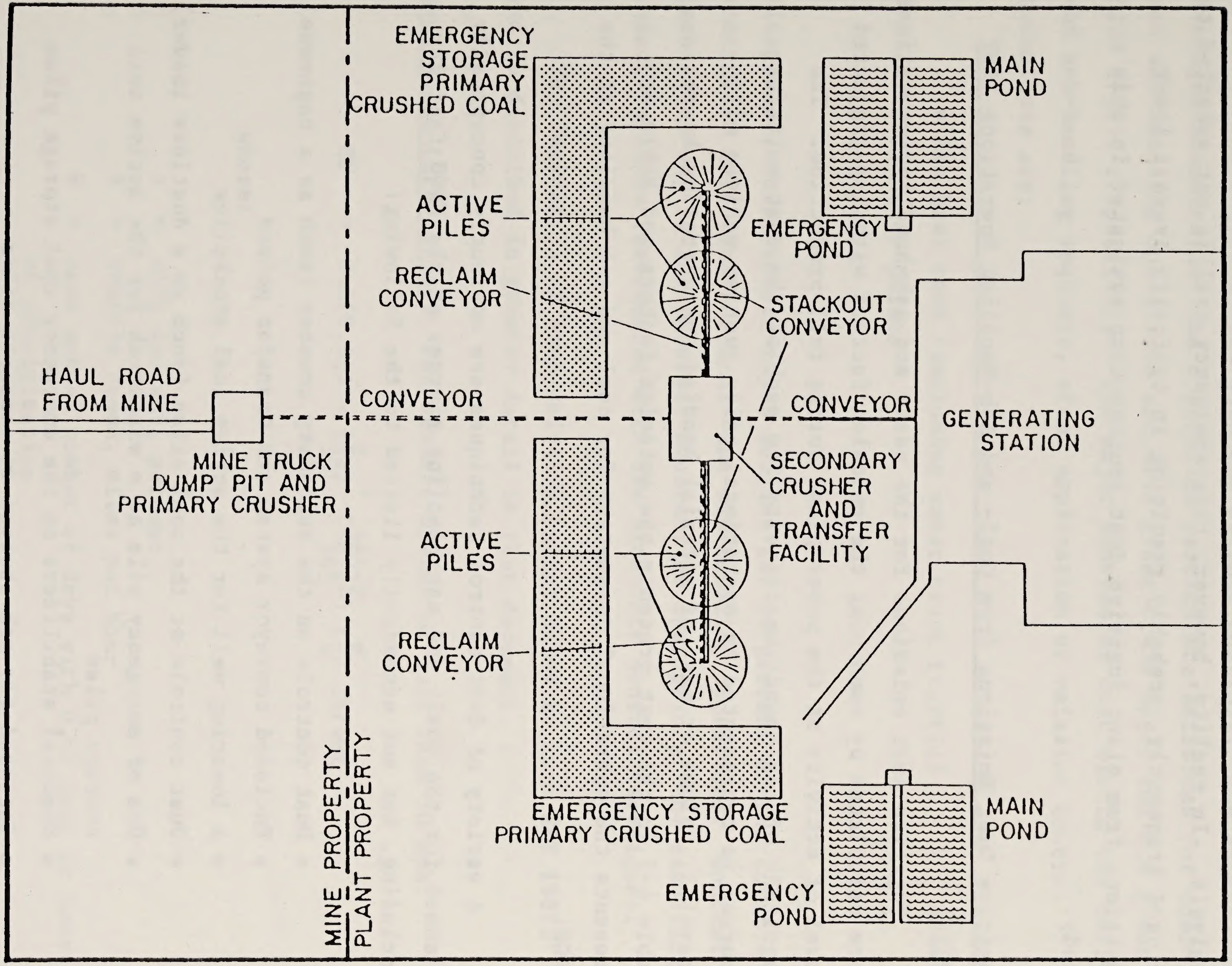


Figure D-1. PLANT PROCESSING OPERATION AT THE PROPOSED NEW MEXICO GENERATING STATION

Use of the emergency coal pile results in maximum fugitive dust emissions from NMGS and therefore was utilized in the modeling analysis. In reality, however, this emergency coal is not expected to be used frequently, probably resulting in typically overall lower emissions from plant fugitive dust sources than evaluated in this study.

Fugitive Dust Emissions from Coal- and Ash-Handling Operations (ERT 1981d)

Fugitive dust emissions for the coal- and ash-handling operations were calculated by combining the emission factors with the projected level of activity at the power plant during full production. The magnitude of coal-handling activity for each of the dust-emitting sources is represented by operational units such as vehicle miles traveled, volume or mass of material handled and operating hours. Table 4-3 in the text presents the emission factors and Table 4-4 presents the operational parameters for coal and ash handling at the NMGS.

A variety of dust control techniques are currently conceptually planned for the coal- and ash-handling sources at the NMGS facility including, but not necessarily limited to the following:

- Dust controls on the secondary crusher (such as a baghouse)
- Enclosed conveyor system and transfer points
- A lowering well for the active coal stockpiles
- Dust controls at the coal silos (such as a dustless loader)
- Use of emergency pile as a windbreak for the active coal storage piles
- Chemical stabilizers on the emergency coal storage piles
- Enclosed fly ash storage in concrete silos
- Relatively moist ash product (>10% moisture)
- Watering of the fly ash haul road

Calculated emissions for NMGS dust-producing activities are shown in Table 4-5 of the text both with and without controls. The annual averaged uncontrolled and controlled particulate emissions for coal- and ash-handling operations are 41.1 g/sec (1438 t/yr) and 6.6 g/sec (229 t/yr), respectively. The major sources of dust within the coal- and ash-handling sequence, after application of emission control techniques are:

- Ash haul road (including water truck traffic)
- Transfer points
- Conveyors

Altogether, these source types account for 89 percent of the total controlled emissions for coal- and ash-handling operations. Control techniques may be implemented; however, as appropriate, the resulting impacts will be reevaluated with the alternate control techniques.

The derivation of each emission factor below is from ERT 1981d and is described in greater detail in that document.

Haul Roads (EPA 1979b). For vehicle speeds of less than 30 mph:

$$EF = 0.6(0.81)\ s\ \left(\frac{S}{30}\right)^2 \left(\frac{365-W}{365}\right) \left(\frac{N}{4}\right)\ \text{lb/vmt}$$

where:

s = silt content, percent
S = vehicle speed, miles per hour
W = mean annual number of days with 0.01 inch or more of precipitation
N = number of wheels on vehicle
vmt = vehicle-mile traveled

For the NMGS operations the roads would be graveled, so the silt content, s, is assumed to be 12 percent (PEDCo 1976). For northwestern New Mexico, the mean number of days per year with more than 0.01 inch of precipitation is about 75 (Figure 11.2-1 in EPA 1979b). The vehicle speed and number of wheels depend on the vehicle type and use.

a. Haul Trucks (coal and fly ash)

$S = 20$ mph

$N = 10$

$$EF = 0.6(0.81)(12)\left(\frac{20}{30}\right)^{2}\left(\frac{365-75}{365}\right)\left(\frac{10}{4}\right) \text{ lb/vmt}$$

$$= 5.15 \text{ lb/vmt}$$

b. Water Trucks

$S = 10$ mph

$N = 10$

$$EF = 0.6(0.81)(12)\left(\frac{10}{30}\right)^{2}\left(\frac{365-75}{365}\right)\left(\frac{10}{4}\right) \text{ lb/vmt}$$

$$= 1.29 \text{ lb/vmt}$$

Stockpile Load-In (EPA 1981a). For load-in by front-end loader or equivalent (batch load-in):

$$EF = 0.0018 \frac{\left(\frac{s}{5}\right)\left(\frac{u}{5}\right)\left(\frac{h}{5}\right)}{\left(\frac{M}{2}\right)^{2}\left(\frac{y}{6}\right)^{1/3}} \text{ lb/ton}$$

where:

s = silt content, percent

u = mean wind speed, mph

h = drop height, feet

M = moisture content, percent

y = bucket size, cubic yards

For the NMGS operation, front-end loaders would typically work the coal stockpiles. The type of loader anticipated for use on the stockpiles would be a Caterpillar 992B or equivalent. Based on the manufacturer's specifications for this front-end loader model:

$$h = 15 \text{ ft}$$

$$y = 10 \text{ yd}^3$$

Very little is known regarding the silt and moisture characteristics of the NMGS coal supply. Other sources have shown ranges of silt content from 2.5 to 5 percent (Colorado APCD 1981) and 6 to 11 percent (PEDCo/MRI 1981). Since the coal passing through the stockpiles at NMGS would be crushed coal, the silt content is assumed to be 20 percent as a conservative estimate. The moisture content of raw coal from western coal fields has observed ranges of 7 to 38 percent and 4 to 22 percent (PEDCo/MRI 1981). A preliminary fuel supply analysis for the NMGS gives a range of moisture content from 11 to 23 percent. Since the stockpiled coal would have been crushed before being conveyed to the stockpile area, losing some moisture in the process, the moisture content is assumed to be 5 percent as a conservative estimate.

$$EF = 0.0018 \frac{(\frac{20}{5})(\frac{u}{5})(\frac{15}{5})}{(\frac{5}{2})^2 (\frac{10}{6})^{1/3}} \text{ lb/ton}$$

$$= 0.00058u \text{ lb/ton}$$

or

$$= 0.0013u \text{ lb/ton}$$

where u is in meters per second

Stockpile Load-Out (EPA 1981a).

$$EF = 0.0018 \frac{(\frac{s}{5})(\frac{u}{5})(\frac{h}{10})}{(\frac{M}{2})^2 (\frac{y}{6})} \text{ lb/ton}$$

Applying the values for these parameters developed for the stockpile load in-emission factor:

$$EF = 0.0018 \frac{\left(\frac{20}{5}\right)\left(\frac{u}{5}\right)\left(\frac{15}{5}\right)}{\left(\frac{5}{2}\right)^{2}\left(\frac{10}{6}\right)} \text{ lb/ton}$$

$$= 0.00021u \text{ lb/ton}$$

or

$$= 0.00047u \text{ lb/ton}$$

[u is in m/sec]

<u>Wind Erosion (Woodruff and Siddoway 1976, EPA 1979d)</u>. Based on the soil loss equation:

$$EF = AIKCL'V' \text{ tons/acre-year}$$

where:

A = fraction of soil loss that becomes suspended
I = soil erodibility, tons/acre-year
K = surface roughness factor
C = climatic factor
L' = field length factor
V' = vegetation cover factor

The soil erodibility and suspended fraction for soils typical of northwestern New Mexico are assumed to be represented by values for the clay-loam type:

I = 47 tons/acre-year
A = 0.025

The climatic factor is given by

$$C = 0.345 \frac{u^{3}}{PE^{2}}$$

where:

u = mean wind speed, mph

PE = Thornthwaite's precipitation-evaporation index

For northwestern New Mexico:

PE = 28

so that

$$EF = 0.345 \frac{u^3}{(28)^2} = 0.00044u^3$$

The surface roughness, field length, and vegetation cover factors range from 0 to 1, depending on local characteristics. For example, if there is no vegetation over an area, V' is 1; if there is some kind of vegetation to hold the soil, the soil loss is some fraction of the unprotected value (i.e., V' = 0.25 or 0.5 or some other fraction). For NMGS, all three factors are assumed to take on the maximum value, 1, as a conservative estimate. Thus:

$$EF = 0.025(47)(1)(0.00044u^3)(1)(1) \text{ tons/acre-year}$$

$$= 0.000517u^3 \text{ tons/acre-year}$$

or

$$= 0.0058u^3 \text{ tons/acre-year}$$

[u is in m/sec]

Stockpile Wind Erosion. Erosion characteristics of coal stockpiles are assumed to be similar to those for soil erosion; i.e., erodibility is assumed to be a function of the fine-particle fraction. This is a conservative assumption, because coal generally has a lower percentage of fine particles than most soils. Thus:

$$EF = 0.0058u^3 \text{ tons/acre-year}$$

[u is in m/sec]

Emergency Coal Transfer. Dust emitted by the movement of front-end loaders is assumed to be represented by the emission factor for vehicle travel along unpaved roads:

$$EF = 0.6(0.81)\ s \left(\frac{S}{30}\right)^2 \left(\frac{365-W}{365}\right) \left(\frac{n}{4}\right) \text{ lb/vmt}$$

where:

s = silt content, percent

S = vehicle speed, mph

W = mean annual number of days with 0.01 inch or more of precipitation

N = number of wheels on vehicle

As before:

s = 12

W = 75

For front-end loaders:

S = 10 mph

N = 4

$$EF = 0.6(0.81)(12) \left(\frac{10}{30}\right)^2 \left(\frac{365-75}{365}\right) \left(\frac{4}{4}\right) \text{ lb/vmt}$$

$$= 0.51 \text{ lb/vmt}$$

HYPOTHETICAL MINE OPERATIONS (ERT 1982b)

PNM anticipates that the large coal reserves located near the proposed NMGS site will be developed at some time to help fulfill future national energy production needs. The physiography of the area and the general nature of the coal deposits make recovery using efficient, large-scale surface mining techniques economically feasible. These reserves could be used at the NMGS or sold to other users.

Since it is likely that a mine would be located near the NMGS coal-handling facilities, Environmental Research & Technology (ERT) was retained by PNM to examine briefly the potential combined air quality impacts of the NMGS and a nearby mine. For a reasonable worst-case estimate of potential combined impacts, it was assumed that the mine would be located directly adjacent to and to the north of the plant site. This mine is referred to as the hypothetical mine.

The description of the hypothetical mine contained in ERT's report (ERT 1982b) is considered generic. The operational parameters representing coal mining activities at the hypothetical mine are based on currently available engineering information that has varying degrees of certainty. The majority of the values represent conservative assumptions and best judgment. Therefore, this mine description should not be construed as representing an engineering mine plan (such as will be provided later to the Mining and Minerals Division at the New Mexico Energy and Minerals Department), nor a definitive description of mine activities and emissions (such as that required of an Environmental Assessment for a mining operation). Accordingly, the ambient air quality impact calculations represent worst-case impact estimates. The calculations can only be used to evaluate the worst-case, combined impact of a mine and the NMGS. The calculations are not necessarily representative of air quality impacts of any specific operating mine, and may not be representative of the combined impacts of NMGS and the specific mine that may likely be located adjacent to NMGS.

This was selected to represent a realistic worst case. The NMGS would require, on the average, 7.5 million tons per year (t/yr) of coal to provide electric generation as proposed, with a maximum annual consumption rate of 9 million t/yr. Since the hypothetical mining operation may produce more than 7.5 million tons of coal (average NMGS consumption), the mine operators may seek other markets. These additional market quantities are assumed to be the difference between the maximum annual and average annual NMGS coal consumption. During those years that the plant needs to exceed 7.5 million tons and the excess mine production is committed elsewhere, the NMGS would have to obtain coal from an outside supplier. This is conservative in that the nearby mines are not assumed to supply all their coal production to NMGS; it represents a realistic worst-case. Because of the large quantity of coal (1.5 million t/yr) which will need to be transported on- and off-site, outside transport was assumed to be by rail.

The worst-case combined impacts due to both the NMGS and nearby mining operations would likely occur when a mine pit, haul roads, and mine crushing facilities are located closest to the NMGS coal handling and crushing facilities. For this study, a single mine pit with a maximum production rate of 2.25 million t/yr was assumed to be located adjacent to the northern boundary of the NMGS plant site as a worst-case scenario.

The emission calculations for the fugitive dust impact analysis are based on full-scale mining operations at the adjacent hypothetical mine with a total production of 2.25 million t/yr from a single mine pit north of the plant and an additional 6.75 million t/yr transported by truck from other pits in the area to the hypothetical mine for primary and secondary crushing. Of this 6.75 million t/yr, 2.25 million t/yr is assumed to be hauled from the area west of the NMGS site, utilizing the same haul road to the crushing facility as the hypothetical mine, and 4.5 million t/yr is assumed to be hauled from the area east of the NMGS site to the crushing facility on a separate haul road. Thus, the calculated emission inventory includes mining operations for 2.25 million t/yr and coal transport by truck and coal crushing operations for 9 million t/yr.

Of the 9 million tons of coal crushed at the mine crushing facilities, it is assumed that 7.5 million tons would be conveyed to the NMGS for use and the other 1.5 million tons would be loaded into trains for transport to other facilities as a reasonable worst case.

In a maximum operating mode, the NMGS would require a total of 9 million t/yr for electric generation. As stated above, the operating scenario adopted for the impact analysis assumes that 7.5 million t/yr will be acquired from the adjacent hypothetical mine and other nearby pits. The remainder of the coal needed by the plant, 1.5 million t/yr is assumed to be brought into the plant by train as primary-crushed coal, unloaded, and crushed at the plant secondary-crushing facilities.

Process Description

In general there are two common mining methods followed at a majority of surface mines in the Western United States. These are differentiated by their overburden removal techniques. Dragline operations remove and dispose of surface waste materials in one single motion; truck shovels use a combination of mining shovels and large haul trucks to remove, transport, and dispose of overburden materials. The hypothetical surface coal mine is assumed to utilize draglines to remove the covering layer of overburden and expose the coal seams which are then mined using a truck/shovel combination.

The conceptual plan for the hypothetical mine is based on the excavation of a narrow pit, rectangular in shape with the long axis running from east to west.

Overburden removed by dragline will be displaced from the pit into previously mined areas. Both coal and overburden will be fragmented by drilling and blasting, and coal will be removed by large coal shovels.

The dragline will move along the east-west axis of the pit, with the coal removal operations following close behind. Upon reaching the limit of the area to be mined, the dragline will turn and begin a new pit immediately to the north. Backfilled overburden will be smoothed and covered with topdressing material where appropriate.

It is assumed that the 2.25 million t/yr of coal extracted by mining operations will be hauled to the mine crushers along with 6.75 million t/yr of coal from other mine pits.

Four major steps assumed in the mining operations at the hypothetical mine are:

- Surface material removal
- Overburden removal
- Coal removal and transport
- Reclamation

Each of these assumed operations is described in detail below.

Surface Material Removal. In areas where suitable surface material is present, soils will be removed and redistributed onto regraded areas or put into stockpiles for future reclamation use. Soils which are stockpiled will be placed as necessary to control wind and water erosion. As mining progresses, soils will be removed from an area only large enough to permit overburden removal to follow in an effort to minimize the total bare acreage subject to wind erosion.

Overburden Removal. The overburden above the coal will be drilled and blasted in order to facilitate its efficient removal. An accurate estimate of the total amount of blasting needed will be made after overburden excavation has begun.

Earth-moving equipment will prepare a smooth bench on which the overburden drill will operate. Drills will be used to drill blast holes. The holes will be drilled to a predetermined depth to enable construction of optimum height shovel benches. Blasting will then be done. Overburden will be then be displaced by the dragline into previously mined areas.

Coal Removal and Transport. The coal to be mined will first be fractured by drilling and then blasted in a similar fashion to that already described for overburden. Blasted coal will be removed by a shovel and placed in dump trucks to be hauled to the coal crushing facility.

Reclamation. Following active mining, backfilled areas will be smoothed over and graded to conform to the approximate contour of the surrounding land. The regraded areas will be managed according to an approved reclamation plan.

Emissions for the Hypothetical Mine

Fugitive dust emissions for a coal mining operation are calculated by combining the uncontrolled emission factors (Table 4-3 in the text) with the projected level of activity at the mine during full production and the anticipated dust controls. The magnitude of activity for each dust-emitting source is represented by operational units such as vehicle miles traveled, volume or mass of material handled and operating hours. The estimated operational parameters for maximum projected activity at the hypothetical mine are presented in Table 4-4 in the text. Fully detailed emission calculations are presented in ERT's report (ERT 1982b).

Control of fugitive dust from mining operations is generally difficult because of the widespread nature of many of the emissions. In general, there are two types of control practices for fugitive dust from mining operations:

- Good mining practices, defined as operational practices adopted by the mining company which, although not specifically designed to control dust, result in a reduction in dust emissions (such as limiting vehicle speeds on haul roads, limiting the drop distance by shovels and draglines, and others)

- Specific control actions performed only to limit dust formation.

The effectiveness of the first of these control types is extremely difficult to quantify since most mining operations do utilize such actions, and because it is difficult to specify the uncontrolled state. For example, there are emission factors which incorporate the effect of vehicle speed on haul road emissions, and it is possible to specify a maximum vehicle speed for haul trucks, but it is difficult to state what the vehicle speed would be if no control was enforced.

From a practical standpoint, only a few of the many sources of emissions at the mine can be systematically controlled, primarily haul roads, conveyors, and crushing activities. The control technique assumed to be used for haul roads at the hypothetical mine is watering applied by a spray truck. A water spray, and an enclosure is assumed for the crushers, while an enclosure is assumed for the conveyors.

Table 4-6 in the text presents the uncontrolled and controlled emission rates for fugitive dust sources at the hypothetical mine.

Appendix E
MODEL DESCRIPTIONS

This appendix contains descriptions of the models that were used in the air quality analysis. The model descriptions were excerpted from the following reports:

"EIS Impact Areas and Low Terrain Modeling of the Proposed New Mexico Generating Station" (ERT 1981b)

"EIS Combined Impacts Modeling of the Proposed New Mexico Generating Station" (ERT 1982a)

"EIS High Terrain Modeling of the Proposed New Mexico Generating Station" (ERT 1981e)

"EIS Impact Analysis of Fugitive Dust Emissions from a Hypothetical Mining Operation Located Adjacent to the Proposed New Mexico Generating Station" (ERT 1982b)

"EIS Analysis of Fugitive Dust Emissions from the Proposed New Mexico Generating Station" (ERT 1981c)

MPTER Model

NMGS emissions were modeled using EPA's MPTER model, for low-terrain areas. This model uses hourly meteorological data to compute hourly concentrations on a receptor grid. It predicts concentrations from up to 250 point sources at up to 180 receptors. That is, for each receptor the concentration contribution from each source is summed to obtain the total concentration from all sources. This model is described in greater detail in the User's Guide to MPTER (U.S. EPA 1980e).

Plume rise is calculated using the methods of Briggs (1969, 1970, 1972). The proposed NMGS would have four stacks located near each other. Since merging of adjacent buoyant plumes is not considered, the plume rise calculations used in this study are probably conservatively low because the modeled rate of entrainment of ambient air is higher than what might actually occur.

Gradual plume rise is an optional feature of MPTER. When gradual rise is not employed, computations are made using the final effective plume height. In this study, gradual plume rise was used. However, for distances greater than about 2 km from the stacks, the use of gradual plume rise did not significantly affect modeled concentrations.

MPTER considers the difference between local ground-level elevations at the stack and at the receptor through the use of plume height adjustment factors. These factors account for terrain as a function of each of the six Pasquill-Gifford (P-G) stability classes. This treatment can be used only for terrain at or below the elevation of the stack top. Receptor elevations above the stack top are not permitted in MPTER. When the receptor elevation exceeded this height, it was set to the stack top elevation to avoid model execution problems.

Plume height adjustments were used in this study. A terrain adjustment factor of 0.5 was specified for P-G stability categories A through D. This factor is based on the analysis by Egan (1975) of a plume embedded in a potential flow approaching a hemispherically shaped terrain object, which indicated that a half-height correction to the Gaussian formula would provide an estimate of the peak ground-level concentrations expected. Use of this factor places the plume at one-half the distance above ground that it would be without the terrain.

For stable dispersion conditions, the plume was assumed to remain at a constant level in the atmosphere. This reduces the effective stack height for receptors above the stack base by the difference between the receptor and stack base elevations. Required meteorological data include wind direction, wind speed, temperature, stability class, and mixing height. Measured wind speeds are adjusted to stack height using the wind speed power law exponents (EPA 1980e), as presented in Table E-1.

COMPLEX I Model

The EPA's COMPLEX I model was used in a screening analysis to assess areas of highest concentration increases due to NMGS in high-terrain areas. A screening analysis was also performed using this model to compute combined concentrations from NMGS, Four Corners, San Juan, and the Prewitt-Escalante generating stations.

The COMPLEX I model duplicates the basic algorithms of both the MPTER model (EPA 1980e) and the VALLEY model (EPA 1977c). Further information concerning COMPLEX I is contained in the User's Guide to COMPLEX I (1980e). COMPLEX I differs from VALLEY in that it uses sequential hourly meteorological data as input and centers the 22.5° sector-averaged plume on the hourly wind direction. Concentrations can be calculated for averaging periods from one hour to one year. The Pasquill-Gifford dispersion parameters (Pasquill 1961, Gifford

Table E-1. WIND PROFILE POWER LAW EXPONENTS USED WITH PTPLU, MPTER, COMPLEX I, AND RTDM

Stability	Exponent
A	0.07
B	0.07
C	0.10
D	0.15
E	0.35
F	0.55

Source: EPA (1980e).

1960) are used in the model. Plume rise is calculated using the methods of Briggs (1969, 1970, 1972). As with the MPTER model, measured wind speeds are adjusted to stack height using the wind speed power law exponents (EPA 1980e) in Table E-1.

COMPLEX I options used included buoyancy-induced dispersion and a half-height plume clearance correction for nonstable plumes. The buoyancy-induced dispersion option probably had little or no effect on the downwind concentrations due to the relatively large distances involved. The half-height correction for neutral conditions is based on the analysis by Egan (1975) of a plume embedded in a potential flow approaching a hemispherical terrain object, which indicates that a half-height correction to the Gaussian formula will provide an estimate of the peak ground-level concentration expected. It was also applied for unstable conditions, although the technique is considered conservative for such conditions.

RTDM Model

Worst case dispersion periods in high- and complex-terrain areas were identified initially using the COMPLEX I model as described above. A refined modeling technique using the RTDM model was then used to compute concentrations in the areas identified (including Mesa Verde National Park and Chaco Culture National Historical Park).

RTDM is a Gaussian diffusion model that uses traditional Briggs plume rise formulas (1975) and ASME (1968) recommended diffusion parameters. The model incorporates the effects of enhanced diffusion due to initial buoyancy entrainment. RTDM is unique in the way it simulates plume behavior near terrain features. For stable conditions, the plume is allowed to either impinge directly on the terrain surface or flow up and over the terrain, depending on the critical dividing streamline height (DSH). These calculations are discussed in more detail below. Also, RTDM calculates a partial surface reflection factor under stable atmospheric conditions of direct impingement. Thus full doubling of ground-level concentrations due to ground reflection effects is not permitted for steep slopes in mountainous terrain. For flow over the terrain during stable conditions, full ground-level reflection is allowed. RTDM has been shown to predict measured SO_2 concentrations on Ute Mountain Mesa more accurately and with less scatter than the EPA VALLEY model (Iwanchuk et al. 1980).

The assumption in COMPLEX I of plume impingement on high terrain under stable conditions is not always a realistic approximation of true plume behavior. To determine whether direct impingement at Mesa Verde was realistic, the height of the plume was compared with the DSH for stable conditions. If the effective stack height were above the DSH, preferential flow up and over all high terrain meeting these conditions was assumed. Otherwise, direct impingement was assumed to represent the impact. The DSH is a function of the hill Froude number, which represents the ratio of the horizontal inertia of the flow to the buoyancy force that suppresses motion in the vertical. A hill Froude number less than unity implies that a fluid parcel at the bottom of the hill will not have sufficient kinetic energy to rise to the top of the hill and thus will be forced to go around it. A hill Froude number of unity or greater implies that the fluid parcel can rise to the top.

The DSH is calculated with the following equations (Hunt et al. 1978):

$$DSH = h_t (1-F_r) \qquad (1)$$

$$F_r = \frac{\bar{u}}{h_t} \; \frac{g}{T_a} \; \frac{d\theta}{dz}^{\,-1/2} \tag{2}$$

where:

F_r = hill Froude number; this nondimensional parameter is a measure of the inertia of a horizontally advecting parcel of air (or plume) as it encounters a high terrain obstacle, as compared with the buoyant forces that tend to prevent the parcel from rising

h_t = height of the terrain obstacle (m) relative to the stack base (height of the Mesa Verde receptor)

$\bar{u}$ = average wind speed (m/sec) of the advected plume (speed at plume height)

g = acceleration due to gravity = 9.8 m/sec^2

T_a = ambient temperature (°K)

$\frac{d\theta}{dz}$ = vertical potential temperature gradient (°K/m) in the layer of air from stack base to h_t

Two sources of information were available which allowed estimation of $d\theta/dz$ from actual meteorological conditions. The preferred source was the temperature profile data collected by PNM during the Bisti-McKinley minisonde program. However, since these data were collected intermittently over the 3 years modeled, the National Weather Service upper air observations from Winslow, Arizona, were used as a backup data source. Estimates of ambient temperature lapse rates were made through a layer encompassing the entire plume. Values of temperature and wind speed were taken from the hourly meteorological data. The wind speed was corrected to plume height using the power law exponents (EPA 1980e) in Table E-1.

The results of the DSH calculations were used to specify the appropriate plume path coefficients for the RTDM modeling. For plumes that were determined to flow preferentially over high terrain during stable atmospheric conditions, a plume height correction factor of 0.35 was used to adjust the plume centerline height above the terrain. This correction factor is based on the studies of Hoffnagle et al. (1977) and Slowik et al. (1977) of stable plumes impacting high-terrain objects. The following two constraints were imposed on plume behavior for this correction factor:

- For receptors where the terrain elevation is less than the effective stack height, the plume centerline height (above the high-terrain receptor) is set at 35 percent of the difference in elevation between the receptor and the NMGS stack base.

- For downwind receptors where the terrain height is greater than the effective stack height, the plume centerline height is set at 35 percent of the NMGS effective stack height.

MINE Model

The MINE model, as developed by ERT, was used to estimate particulate concentrations resulting from coal- and ash-handling activities. MINE is a Gaussian model that allows the examination of multiple sources as well as multiple meteorological conditions. It can compute average concentrations for time periods extending from an hour to a year. The capability of simulating particle deposition is a special feature of MINE and was developed exclusively for the treatment of fugitive dust sources.

The MINE model itself consists of three self-contained program units:

- MINE, which calculates concentrations at each receptor for 480 distinct meteorological conditions and 5 particle size distribution classes

- MESHER, which combines the meteorological specific concentrations calculated by MINE with sequential hourly data to produce concentrations representative of a specific period or set of conditions

- ANNUAL, which combines the meteorological specific concentrations calculated by MINE with an annual frequency distribution of wind and stability data to produce annual concentrations

The MINE model treats three types of sources common to mining operations and fugitive dust emissions in general: areas, lines, and points. In the case of a point source, a steady-state emission rate, in milligrams per second (mg/sec), is assumed for a single point of zero extent. MINE can treat both buoyant and nonbuoyant point sources of emission. For buoyant emissions, MINE uses the plume rise equations developed by Briggs (1975) to calculate the plume height above the ground. In the case of a line source, a straight line segment at constant height is assumed. The coordinates of the end points define the segment. The emission rate for a line source is specified as a mean density, i.e., in mg/m-sec. In the case of an area source, a rectangular region with axes oriented east-west and north-south is assumed. The region is assumed to be at constant height, and emissions for the source are distributed as a mean area density, i.e., in mg/m^2-sec. For the case when deposition is being used, the actual emission rate for any type of source may be a function of wind speed, and up to five emission factors for five different particle size classes may be input.

MINE uses five stability classes, corresponding to the standard Pasquill-Gifford classification: very unstable (A), unstable (B), slightly unstable (C), neutral (D), and stable (E/F). In MINE, the Pasquill-Gifford dispersion parameters, based on coefficients taken from Calder (1971), are used to determine plume spread. Up to 16 wind direction classes can be considered. Up to 6 wind speed classes are considered (with default values corresponding to National Weather Service categories). A single mixing height is specified for each stability class for the simulation of plume trapping by elevated inversions.

MINE uses a uniform 22.5° crosswind distribution to simulate plume dispersion in the horizontal or crosswind direction. In this situation, the horizontal Gaussian distribution is replaced uniformly by the average concentrations across the wind sector. To simulate vertical trapping, MINE computes vertical dispersion using a Gaussian plume reflected from both the ground and the mixing lid, as in Turner's Workbook (1970).

Particle deposition (i.e., removal from the plume) is treated in MINE using the Ermak (1977) formulation, which incorporates both gravitational settling and turbulent mixing. The initial Gaussian shape of the vertical plume profile is assumed to be altered by the deposition process. The deposition rate and consequently the non-Gaussian plume concentration distribution is derived from the continuity equation and the assumption that the rate of particle deposition due to gravitational settling and turbulent mixing is proportional to the local air concentration at ground level. The constants of proportionality are the gravitational settling velocity and the deposition velocity, both of which are a function of particle size. (The deposition velocity is also a function of parameters that define the turbulence characteristics of the local atmosphere, such as the surface roughness and the friction velocity. As used here, the term "deposition velocity" refers to the combined effects of turbulent deposition and gravitational settling.) In MINE, the total emissions from a source of particulates are divided into five particle size categories. Each size category has a particular deposition velocity, v_d, and gravitational settling velocity, v_g.

The basic difference between the two velocities acting on particles is that the gravitational settling velocity accounts for the gravitational pull on the particles, which change their average position above ground, while the deposition velocity includes the effect of turbulent mixing that causes particles to be removed from the atmosphere through the constant collisions between the particles and the underlying surface. The turbulent removal mechanism used in MINE is considered appropriate for surface releases of fugitive dust such as those common to coal-handling and mining operations, since the two mechanisms affecting particle removal are included analytically in the calculation.

The MINE model uses a self-contained routine called MESHER--a postprocessor program used to access the hourly concentration fields calculated using the MINE by "meshing" them with known hourly meteorological data. The time-specific hourly concentration values can then be averaged over a specified period of time from 1 hour to 24 hours.

MESHER requires a meteorological data file that tells the program which specific concentrations corresponding to the meteorology must be retrieved from the MINE output. For each hour desired, the meteorological data file must supply the following:

- Year
- Day of the year
- Hour of the day
- Wind speed classification
- Stability classification
- Wind direction classification

In addition, MESHER will sort the hourly concentrations so that a specified number of the highest concentrations with day and hour of occurrence can be obtained.

Annual concentrations are calculated by the MINE model using an algorithm similar to that contained in EPA's VALLEY model. To calculate annual average concentrations, meteorological data in the form of a frequency distribution for stability, wind direction, and wind speed is combined with the concentrations calculated by MINE. Based on hourly meteorological measurements, the frequency distribution is a statistical description of local air pollution meteorology using 5 stability classes, 16 wind directions, and 6 wind speeds. The 5 stability classes are those of Pasquill, ranging from very unstable to stable (Classes A through D and a combination of E and F). The 16 wind directions are the standard 16-point compass directions. The 6 wind speed classes are: 0-3 knots, 4-6 knots, 7-10 knots, 11-16 knots, 17-21 knots, and more than 21 knots. The joint frequency distribution, therefore, provides the frequency of occurrence for each of 480 distinct steady-state meteorological conditions used by MINE in the calculation of concentrations.

Appendix F
MODELING METHODOLOGY

This appendix describes the techniques used to select receptors for low-terrain, high-terrain, and combined-impacts modeling. Also discussed are the methods used to select meteorology that could be considered realistic with respect to transport of plumes long distances. Assumptions and techniques associated with fugitive dust modeling are also included below. This appendix is excerpted from the same studies conducted by ERT referenced in Appendix E.

Low-Terrain Receptor Selection

The maximum number of receptors allowed in MPTER is 180. This corresponds to a maximum of 11 downwind distances for 16 radial sectors of 22.5° each.

The 11 downwind distances were chosen by first estimating the distances to maximum concentrations with the PTPLU model (EPA 1980g). PTPLU is a Gaussian model that calculates the distance to the maximum ground-level concentration in low terrain for several wind speed categories under each of the six P-G stability categories, A through F. Plume rise is calculated by the method of Briggs (1969). Scaling of the wind speed to the height of the top of the stack was accomplished with the wind speed power law exponents (EPA 1980e) specified in Table E-1. The closest radial for MPTER modeling was placed at about 2.5 km, corresponding to the distance from the NMGS stacks to the corners of the plant property boundary. Additional receptors were placed at about 4.5, 6.5, 8.5, 12.5, and 15 km downwind. These distances are associated with worst-case dispersion for unstable and slightly unstable conditions, and also for neutral stability with moderate to strong wind speeds. Receptor radials were also located at about 27, 30, 40, 50, and 75 km. Receptors at 27, 30, and 40 km reflect the distances at which modeled maximum concentrations will occur during low-wind-speed neutral conditions and slightly stable conditions. The 50-km radial is associated with the greatest distance that steady-state Gaussian models are generally applied as a screening tool. The last radial was placed at 75 km to determine what the model calculates at large distances in low terrain under stable conditions.

Once the downwind distances were chosen, receptors were placed at the location in each of the arcs where the terrain elevation was highest, according to the EPA regional workshops summary (EPA 1981b). If this elevation was higher than the NMGS stack height, the elevation input to the model was specified as the stack height.

High-Terrain and Combined-Impacts Receptor Selection

Highest concentrations calculated by COMPLEX I and RTDM during stable conditions occur at terrain heights equivalent to the centerline height of the plume. Model receptor selection therefore requires estimates of the plume rise under stable (F) and slightly stable (E) dispersion conditions.

Calculations were performed with the PTPLU model (EPA 1980g) for a range of wind speeds associated with each of the six P-G stability categories, A through F, for NMGS and the Four Corners, San Juan, and Prewitt-Escalante generating stations. Receptors were then located in high-terrain areas at the elevations associated with the calculated range of effective stack heights.

The effective stack height for different emission sources varies under identical meteorological conditions. The degree of variance is a function of the magnitude of the differences between the stack volumetric flow rates and exhaust temperatures. In addition, differences in stack base elevation and stack heights for separate sources lead to varying plume centerline elevations. NMGS and Prewitt-Escalante modeled plume heights are at a much higher level than the predicted San Juan and Four Corners plumes. The higher stack base elevations of NMGS and Prewitt-Escalante are the primary reason for this difference. Predicted stable plume heights from the NMGS range from almost 6700 to 6950 feet elevation, mean sea level (msl); Prewitt-Escalante stable plume heights range from 7600 to 7800 feet msl; San Juan stable plume heights range from 6000 to 6400 feet msl; and Four Corners plumes during stable conditions range from heights of 5850 to 6550 feet msl. In areas of high terrain surrounding each facility, receptor elevations were specified within the ranges stated above. For example, receptor elevations surrounding the Prewitt-Escalante plant were concentrated in the range of stable plume heights for that source. Where two or more facilities were aligned with a particular receptor location, receptors were located at different elevations within the range of plume centerlines for those sources. Near the Four Corners and San Juan facilities, for example, high-terrain receptors were located throughout the range of stable plume elevations for those sources.

The geographic location of the maximum combined impact was determined using a two-phase approach. An initial coarse-resolution receptor package was developed from USGS 1:250,000 maps to define the general geographic area of maximum combined impacts. For those areas found to be potential areas of maximum combined impact, a fine-resolution receptor grid was developed from USGS 1:24,000 maps. The 1:24,000 maps allowed more precise spatial definition of receptors at the critical elevations identified earlier. Additional receptors were located in potential areas of impact surrounding the San Juan, Four Corners, and Prewitt-Escalante facilities, and within sectors of potential plume interaction between NMGS and those sources. Emphasis was placed on locating receptors in areas that align NMGS with the other facilities modeled. Receptors in other areas such as Mesa Verde National Park, the San Pedro Parks Wilderness Area, and the Chaco Culture National Historical Park were also included. Several high-terrain receptors around the proposed NMGS site were included to ensure full geographic coverage of the area. The high terrain evaluated included one or more receptors at each of the following areas:

- Unnamed high terrain 20 to 25 km northeast of Bisti
- Chuska Mountains to the southwest, west, and northwest
- Huerfano Mountain and the nearby mesa to the northeast
- Huerfanito Peak
- San Mateo Mesa

Fugitive Dust Receptor Selection

Maximum concentrations of particulate matter associated with the hypothetical mine and coal- and ash-handling facilities occur very close to these sources. This is because the emissions are at ground level and are nonbuoyant. The receptors were chosen to provide information regarding pollutant concentrations at the plant and mine boundaries. For the coal- and ash-handling facilities, receptors were spaced 500 meters or less along all boundaries separating the plant area from publicly accessible lands. Receptors selected for the hypothetical mine are shown in Figure F-1.

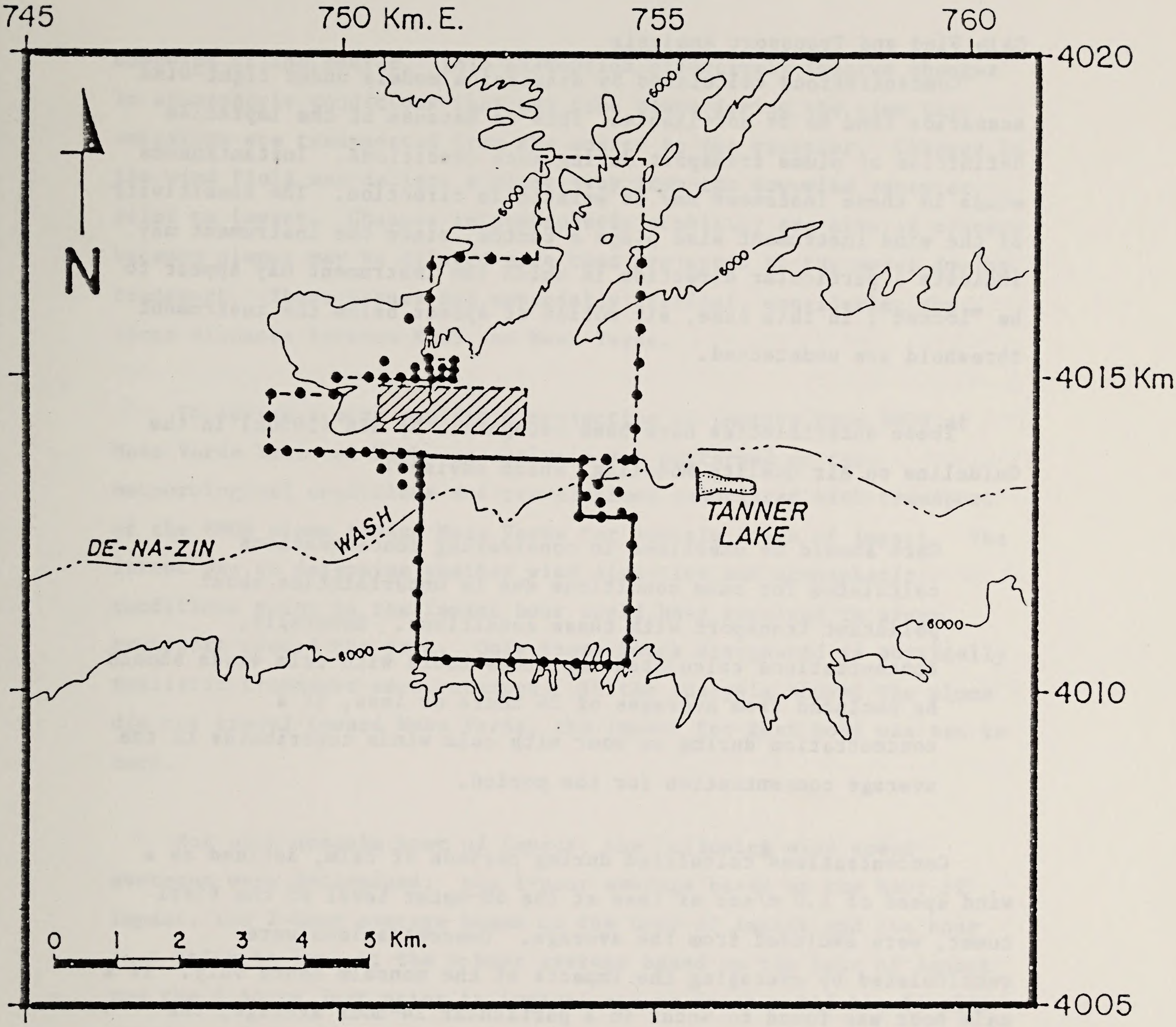


Figure F-1. RECEPTOR GRID USED IN MODELING FUGITIVE DUST EMISSIONS FROM NMGS AND THE HYPOTHETICAL MINE

Calm Wind and Transport Analysis

Concentrations calculated by dispersion models under light-wind scenarios tend to be unreliable. This is because of the imprecise definition of plume transport during such conditions. Instantaneous winds in these instances may be erratic in direction. The sensitivity of the wind instrument also plays a factor, since the instrument may indicate a particular direction in which the instrument may appear to be "locked"; in this case, air motion at speeds below the instrument threshold are undetected.

These uncertainties have been recognized by EPA (1980h) in the Guideline on Air Quality Modeling, which advises:

> Care should be exercised in considering concentrations calculated for calm conditions due to uncertainties about pollutant transport with these conditions. Generally, concentrations calculated for those hours with calm winds should be excluded from averages of 24 hours or less, if a concentration during an hour with calm winds contributes to the average concentration for the period.

Concentrations calculated during periods of calm, defined as a wind speed of 1.0 m/sec or less at the 60-meter level of the Bisti tower, were excluded from the average. Concentrations were recalculated by averaging the impacts of the noncalm hours only. If a calm hour was found to occur in a particular 24-hour average, the revised concentration was determined from the average of the remaining 23 hours only (e.g., the sum of 23 hourly concentrations divided by 23).

Another conservative aspect of steady-state Gaussian diffusion models is the assumption of instantaneous impacts at all receptors downwind of the source. This assumption effectively ignores changes in atmospheric conditions that may take place during the time that emissions are transported from the source to the receptor. Changes in the wind field may deflect a plume away from the downwind receptor prior to impact. Changes in atmospheric stability are also of concern because plumes may be diluted more than projected by the model during transport. These issues are especially critical, considering the large distance between NMGS and Mesa Verde.

To derive a more realistic projection of impacts from NMGS at Mesa Verde National Park, an analysis was performed of the meteorological conditions and travel times associated with transport of the NMGS plume toward Mesa Verde for noncalm hours of impact. The intent was to determine whether wind direction and atmospheric conditions prior to the impact hour could have resulted in plume transport toward the park. Only those hours designated as physically realistic transport were retained. If the analysis showed the plume did not travel toward Mesa Verde, the impact for that hour was set to zero.

For each noncalm hour of impact, the following wind speed averages were determined: the 1-hour average based on the hour of impact; the 2-hour average based on the hour of impact and the hour just prior to impact; the 3-hour average based on the hour of impact and the 2 hours just prior to impact; and so forth. All hourly wind speeds used in these calculations were adjusted to plume height from the 60-meter values. After calculation of each cumulative average, the "plume advection distance" (i.e., the distance the plume traveled for that period) was calculated as the product of the average wind speed and the hours it represented. These sequential calculations were performed until the plume advection distance appproximately equaled the distance from the project site to Mesa Verde (70 miles, or 110 km).

Once the necessary travel time to the park was calculated, the vector resultant wind for that time period was determined. This resultant wind was used to evaluate whether or not plume transport toward Mesa Verde occurred prior to the hour of impact. If the resultant wind direction was within ±11° of the angle subtended from NMGS to the east and west borders of Mesa Verde, then it was assumed the plume was transported toward the park and the impact was probable. The choice of ± 11° was made to be consistent with the 22.5° sector used in COMPLEX I. A plume, 22.5° wide and centered on any wind direction within 11° of the park, will pass over portions of the park. A resultant wind direction between 150° and 182° was assumed to indicate plume transport to Mesa Verde.

Meteorological Scenarios

The meteorological input used in all modeling analyses consists of a 3-year set of hourly averaged data for the period of November 1, 1977, to October 31, 1980. A more complete discussion of the preparation of the hourly meteorological data set is contained in a separate report (ERT 1981a).

The required meteorological data included hourly values of wind direction, wind speed, temperature, stability class, and mixing heights. Wind speed is reported at anemometer height and then extrapolated to stack height, using power law wind speed profiles dependent on stability class as discussed in the model descriptions.

The wind speed and wind direction data were taken primarily from the 60-meter level of the instrumented tower at the project site. The ambient temperature data were taken from the 10-meter level of that tower.

Hourly average mixing heights were determined using the Benkley-Schulman (1979) Mixing Height Program. The surface temperature and wind speed data used by this program were taken from the 10-meter level at the project site. Upper air data were taken from the National Weather Service station at Winslow, Arizona.

The P-G stability categories were generated from hourly average vertical wind fluctuation values (σ_{ϕ}) measured at the 60-meter level. When the σ_{ϕ} data were unavailable, P-G stabilities estimated according to Turner (1964) were substituted, using cloud cover and ceiling height data from the National Weather Service station at Farmington and wind speed from the 10-meter on-site measurements.

Appendix G
RADIONUCLIDE CALCULATIONS

This appendix defines the terms and equations, presents the assumptions, and reports the calculations used in estimating radionuclide emissions from the New Mexico Generating Station.

DEFINITION OF TERMS AND EQUATIONS

Unit of Decay

Curie (Ci) = 3.7×10^{10} disintegrations per second (dis/sec)
Picocurie (pCi) = 3.7×10^{-2} disintegrations per second (dis/sec)

Rate of Decay

N = atoms present at a given instant
dN = atoms which decay in the time interval dt
λ = radioactive decay constant

$$\frac{dN}{N} = -\lambda dt$$

Integration from time = o, when $N = N_o$, to time t, when $N = N_t$ gives

$$\log \frac{N_t}{N_o} = -\lambda t$$

$$N_t = N_o e^{-\lambda t}$$

$$\log_{10} \frac{N_t}{N_o} = -0.4343 \lambda t_{1/2}$$

Half-life

$t_{1/2}$ = time required for half of the original number of atoms present to decay

$$\log_{10} \frac{0.5}{1} = -0.4343 \lambda t_{1/2}$$

$$\log_{10} 2 = +0.434 \lambda t_{1/2}$$

$$\lambda = \frac{0.693}{t_{1/2}}$$

Specific Activity = disintegration per unit time per unit mass

= λN where N is number of atoms in unit mass

$$= \frac{0.693}{t_{1/2}} \times \frac{6.03 \times 10^{23}}{A} \text{ dis/sec/g}$$ (where A is the mass number)

Secular Equilibrium - half-life of the parent (x) is very much greater than that of the daughter (y), and an equilibrium is established between x and y in which the number of y atoms decaying per unit time is equal to the number of x atoms decaying per unit time

Case where x decays to y decays to z:

$$x \xrightarrow{\lambda x} y \xrightarrow{\lambda y} z$$

Number of atoms of y decaying = $N_y \lambda_y$

Number of atoms of y forming = $N_x \lambda_x$

at equilibrium = $N_y \lambda_y = N_x \lambda_x$

since $\lambda = \frac{0.693}{t_{1/2}}$

therefore

$$\frac{N_y}{N_x} = \frac{t_{1/2^x}}{t_{1/2^x}}$$

ASSUMPTIONS FOR CALCULATIONS

The following assumptions were used in the calculations:

- Elemental content of coal is

  U = 6 ppm

  Th = 14 ppm

- Coal Ash content is 19.03 percent.

- All of the U and Th in coal is found only in the ash and is therefore present in the following concentrations:

  $$U = \frac{6 \text{ ppm}}{0.1903} = 32 \text{ ppm}$$

  $$Th = \frac{14 \text{ ppm}}{0.1903} = 74 \text{ ppm}$$

- The concentration of U and Th in the ash is the same as in all particulate material released through the stack during combustion.

- All radon contained in the coal will be released during combustion.

- U and Th are in secular equilibrium with all their daughter products.

- Annual stack emission rate of TSP from NMGS is 2329 tons/yr or 2.11 x 10^9 grams/year.

- Maximum 24-hour TSP concentration is 5.7 g/m^3.

- Maximum annual concentration of TSP is 0.3 g/m^3.

- Except for Rn^{222}, radionuclides with half-lives less than several minutes are omitted.

- There is instantaneous release and impact of material after combustion.

- U^{238} is in secular equilibrium with Th^{234}, Pa^{234m}, U^{234}, Th^{230}, Ra^{226}, Po^{218}, Pb^{214}, Bi^{214}, Po^{214}, Pb^{210}, Bi^{210}, Po^{210} and the total activity from the U^{238} chain is therefore equal to 13 times the activity of U^{238}.

- U^{235} is in secular equilibrium with Th^{231}, Pa^{231}, Ac^{227}, Th^{227}, Ra^{223}, Pb^{211}, Bi^{211} and the total activity from the U-235 chain is therefore equal to 8 times the activity of U^{235}.

- Th^{232} is in secular equilibrium with Ra^{228}, Ac^{228}, Th^{228}, Ra^{224}, Pb^{212}, Bi^{212} and the total activity from the Th^{232} chain is therefore equal to 7 times the activity of Th^{232}.

- Half-life U^{238} = 4.51 x 10^9 years.

- Half-life U^{235} = 7.13 x 10^8 years.

- Half-life Th^{227} = 1.39 x 10^{10} years.

DISPERSION CALCULATIONS

The short- and long-term dispersion rate of stack effluents was calculated from the ratio of the stack concentration of particulate to the maximum modeled concentrations.

Short-Term

$$\text{Stack Concentration} = \frac{84\ \text{g/sec}}{1286\ \text{m}^3/\text{sec}} = \frac{6.53 \times 10^{-2}\ \text{gram}}{\text{m}^3}$$

$$\begin{array}{r}\text{Maximum 24 Hour}\\ \text{Modeled Concentration}\end{array} = \frac{5.7 \times 10^{-6}\ \text{gram}}{\text{m}^3}$$

$$\text{Dispersion Rate} = \frac{\text{Max 24 Hour Modeled Concentration}}{\text{Stack Concentration}} = 8.73 \times 10^{-5}$$

$$= \frac{1}{1.15 \times 10^{4}}$$

Long-Term

$$\text{Stack Concentration} = \frac{6.53 \times 10^{-2}\ \text{gram}}{\text{m}^3}$$

$$\begin{array}{r}\text{Maximum Annual}\\ \text{Modeled Concentration}\end{array} = \frac{3.0 \times 10^{-7}\ \text{gram}}{\text{m}^3}$$

$$\text{Dispersion Rate} = \frac{\text{Max Annual Modeled Concentration}}{\text{Stack Concentration}} = 4.59 \times 10^{-6}$$

$$= \frac{1}{2.18 \times 10^{5}}$$

CALCULATION OF RADIOISOTOPE EMISSION AND CONCENTRATIONS

Thorium 232

$$\lambda = \frac{0.693}{t_{1/2}}$$

$$t_{1/2} = 1.39 \times 10^{10} \text{ years}$$

$$\text{Activity per Gram Th}^{232} = \frac{0.693}{1.39 \times 10^{10}} \times \frac{\text{yr}}{3.15 \times 10^{7} \text{ sec}} \times \frac{6.03 \times 10^{23}}{232}$$

$$= 4114 \text{ dis/sec/gram of Th}^{232}$$

Activity in Ash

$= (\text{Activity of Th}^{232})(\text{Conc. of Th}^{232} \text{ in Ash})(\% \text{ Abun. of Th}^{232} \text{ in Th})$

$(4114 \text{ dis/sec/gram})(74 \times 10^{-6} \text{ g Th/g Ash}) (1.00 \text{ Th}^{232}\text{/Th})$

$= 0.304 \text{ dis/sec/gram Ash}$

pCi Th^{232} per gram Ash

$= (0.304 \text{ dis/sec/gram Ash})[1/(3.7 \times 10^{-2}) \text{ pCi/dis/sec/gram}]$

$= 8.22 \text{ pCi/gram of Ash}$

Annual Emission of Thorium 232

$$= \frac{8.22 \text{ pCi}}{\text{gram}} \times \frac{2.11 \times 10^{9} \text{ gram}}{\text{year}} = \frac{1.73 \times 10^{10} \text{ pCi}}{\text{year}}$$

Annual Emission of Thorium 232 Chain

$$= \frac{1.74 \times 10^{10} \text{ pCi}}{\text{year}} \times 7 = \frac{1.21\ 10^{11} \text{ pCi}}{\text{year}} = \boldsymbol{\frac{1.21 \times 10^{-1} \text{ Ci}}{\text{year}}}$$

Maximum 24 hour Activity from Thorium 232

$$= \frac{8.22\ \text{pCi}}{\text{gram}} \times \frac{5.7 \times 10^{-6}\ \text{gram}}{\text{m}^3} \times \frac{1\ \text{m}^3}{1000\ \text{liters}} = \frac{4.69 \times 10^{-8}\ \text{pCi}}{\text{liter}}$$

Maximum 24 hour Activity from Thorium 232 Chain

$$= \frac{4.69 \times 10^{-8}\ \text{pCi}}{\text{liter}} \times 7 = \frac{\mathbf{3.28 \times 10^{-7}\ pCi}}{\mathbf{liter}}$$

Maximum Annual Activity from Thorium 232

$$= \frac{8.22\ \text{pCi}}{\text{gram}} \times \frac{3.0 \times 10^{-7}\ \text{gram}}{\text{m}^3} \times \frac{1\ \text{m}^3}{1000\ \text{liter}} = \frac{2.47 \times 10^{-9}\ \text{pCi}}{\text{liter}}$$

Maximum Annual Activity from Thorium 232 Chain

$$= \frac{2.47 \times 10^{-9}\ \text{pCi}}{\text{liter}} \times 7 = \frac{\mathbf{1.73 \times 10^{-8}\ pCi}}{\mathbf{liter}}$$

Uranium 235

$$\lambda = \frac{0.693}{t_{1/2}}$$

$$t_{1/2} = 7.13 \times 10^{8}\ \text{years}$$

$$\text{Activity per gram } U^{235} = \frac{0.693}{7.13 \times 10^{8}} \times \frac{\text{yr}}{3.15 \times 10^{7}\ \text{sec}} \times \frac{6.03 \times 10^{23}}{235}$$

$$= 79{,}200\ \text{dis/sec/gram of } U^{235}$$

Activity in Ash

$= (\text{Activity of } U^{235})(\text{Concen. of U in Ash})(\%\ \text{Abun. of } U^{235} \text{ in U})$

$(79{,}200\ \text{dis/sec/g})(32 \times 10^{-6}\ \text{g U/g Ash})(0.007\ U^{235}/U)$

$= 0.018\ \text{dis/sec/gram Ash}$

pCi U^{235} per gram of Ash

$$= (0.018 \text{ dis/sec/gram Ash})[1/(3.7 \times 10^{-2}) \text{ pCi/dis/sec/gram}]$$

$$= 0.486 \text{ pCi/gram of Ash}$$

Annual Emission of U^{235}

$$= \frac{0.486 \text{ pCi}}{\text{gram}} \times \frac{2.11 \times 10^{9} \text{ gram}}{\text{year}} = \frac{1.03 \times 10^{9} \text{ pCi}}{\text{year}}$$

Annual Emission of U^{235} Chain

$$= \frac{1.03 \times 10^{9} \text{ pCi}}{\text{year}} \times 8 = \frac{8.24\ 10^{9} \text{ pCi}}{\text{year}} = \frac{\mathbf{8.24 \times 10^{-3}\ Ci}}{\mathbf{year}}$$

Maximum 24 hour Activity from U^{235}

$$= \frac{0.486 \text{ pCi}}{\text{gram}} \times \frac{5.7 \times 10^{-6} \text{ gram}}{\text{m}^{3}} \times \frac{1 \text{ m}^{3}}{1000 \text{ liters}} = \frac{2.77 \times 10^{-9} \text{ pCi}}{\text{liter}}$$

Maximum 24 hour Activity from U^{235} Chain

$$= \frac{2.77 \times 10^{-9} \text{ pCi}}{\text{liter}} \times 8 = \frac{\mathbf{2.22 \times 10^{-8}\ pCi}}{\mathbf{liter}}$$

Maximum Annual Activity from U^{235}

$$= \frac{0.486 \text{ pCi}}{\text{gram}} \times \frac{3.0 \times 10^{-7} \text{ gram}}{\text{m}^{3}} \times \frac{1 \text{ m}^{3}}{1000 \text{ liters}} = \frac{1.46 \times 10^{-10} \text{ pCi}}{\text{liter}}$$

Maximum Annual Activity from U^{235} Chain

$$= \frac{1.46 \times 10^{-10} \text{ pCi}}{\text{liter}} \times 8 = \frac{\mathbf{1.17 \times 10^{-9}\ pCi}}{\mathbf{liter}}$$

Uranium 238

$$\lambda = \frac{0.693}{t_{1/2}}$$

$$t_{1/2} = 4.51 \times 10^{9} \text{ years}$$

$$\text{Activity per gram } U^{238} = \frac{0.693}{4.51 \times 10^{9} \text{ yr}} \times \frac{\text{yr}}{3.15 \times 10^{7} \text{ sec}} \times \frac{6.03 \times 10^{23}}{238}$$

$$= 12{,}400 \text{ dis/sec/gram of } U^{238}$$

Activity in Ash

$= (\text{Activity of } U^{238})(\text{Concen. of U in Ash})(\text{\% Abun. of } U^{238} \text{ in U})$

$= (12{,}400 \text{ dis/sec/g})(32 \times 10^{-6} \text{ g U/g Ash})(0.993\ U^{238}/U)$

$= 0.39$ dis/sec/gram Ash

pCi U^{238} per gram of Ash

$(0.39 \text{ dis/sec/gram Ash})(1/3.7 \times 10^{-2} \text{ pCi/dis/sec/gram})$

$= 10.5$ pCi/gram of Ash

Annual Emission of U^{238}

$$= \frac{10.5 \text{ pCi}}{\text{gram}} \times \frac{2.11 \times 10^{9} \text{ gram}}{\text{year}} = \frac{2.22 \times 10^{10} \text{ pCi}}{\text{year}}$$

Annual Emission of U^{238} Chain

$$= \frac{2.22 \times 10^{10} \text{ pCi}}{\text{year}} \times 13 = \frac{2.89\ 10^{11} \text{ pCi}}{\text{year}} = \frac{\mathbf{2.89 \times 10^{-1} \text{ Ci}}}{\mathbf{year}}$$

Maximum 24 hour Activity from U^{238}

$$= \frac{10.5 \text{ pCi}}{\text{gram}} \times \frac{5.7 \times 10^{-6} \text{ gram}}{m^{3}} \times \frac{1 \text{ m}^{3}}{1000 \text{ liters}} = \frac{6.0 \times 10^{-8} \text{ pCi}}{\text{liter}}$$

Maximum 24 hour Activity from U^{238} Chain

$$= \frac{6.0 \times 10^{-8}\ \text{pCi}}{\text{liter}} \times 13 = \frac{\mathbf{7.8 \times 10^{-7}\ pCi}}{\mathbf{liter}}$$

Maximum Annual Activity from U^{238}

$$= \frac{10.5\ \text{pCi}}{\text{gram}} \times \frac{3.0 \times 10^{-7}\ \text{gram}}{\text{m}^3} \times \frac{1\ \text{m}^3}{1000\ \text{liters}} = \frac{3.15 \times 10^{-9}\ \text{pCi}}{\text{liter}}$$

Maximum Annual Activity from U^{238} Chain

$$= \frac{3.15 \times 10^{-9}\ \text{pCi}}{\text{liter}} \times 13 = \frac{\mathbf{4.10 \times 10^{-8}\ pCi}}{\mathbf{liter}}$$

Radon 220

Activity of Rn^{220} = Activity of Th^{232}

Activity of Th^{232} in Coal = Activity in Ash times percent of Ash in Coal

= 8.23 pCi/gram x 0.1903

= 1.57 pCi/gram of coal

$$\text{Coal Combustion} = \frac{6.81 \times 10^{12}\ \text{gram}}{\text{yr}} \text{ or } \frac{2.16 \times 10^{5}\ \text{gram}}{\text{sec}}$$

$$\text{Annual Emission} = \frac{1.57\ \text{pCi}}{\text{gram}} \times \frac{6.8 \times 10^{12}\ \text{gram}}{\text{yr}}$$

$$= \frac{1.07 \times 10^{13}\ \text{pCi}}{\text{yr}} = \mathbf{11\ Ci/yr}$$

$$\text{Stack Exhaust Concentration} = \text{Coal activity (pCi/g)} \times \text{flow rate (sec/m}^3) \times \text{combustion rate (g/sec)}$$

$$= \frac{1.57 \text{ pCi}}{\text{gram}} \times \frac{1 \text{ sec}}{1029 \text{ m}^3} \times \frac{2.16 \times 10^5 \text{ gram}}{\text{sec}}$$

$$= 3.30 \times 10^2 \text{ pCi/m}^3$$

Maximum 24 Hour:

(Stack Concentration)(Dispersion Rate)

$$\frac{3.30 \times 10^2 \text{ pCi}}{\text{m}^3} \quad \frac{1}{1.15 \times 10^4} = \mathbf{\frac{2.87 \times 10^{-2} \text{ pCi}}{m^3}}$$

Maximum Annual:

(Stack Concentration)(Dispersion Rate)

$$\frac{3.30 \times 10^2 \text{ pCi}}{\text{m}^3} \quad \frac{1}{2.18 \times 10^5} = \mathbf{\frac{1.51 \times 10^{-3} \text{ pCi}}{m^3}}$$

<u>Radon 222</u>

$$\text{Activity of Rn}^{222} = \text{Activity of U}^{238}$$

$$\text{Activity of U}^{238} \text{ in coal} = \text{Activity in ash} \times \text{percent ash in coal}$$

$$= 10.6 \text{ pCi/gram ash} \times 0.1903$$

$$= 2.02 \text{ pCi/gram coal}$$

$$\text{Annual Emission} = \text{Activity in Coal} \times \text{Annual Coal Combustion}$$

$$\frac{2.02 \text{ pCi}}{\text{gram of coal}} \times \frac{6.8 \times 10^{12} \text{ grams}}{\text{yr}}$$

$$= \frac{1.37 \times 10^{13} \text{ pCi}}{\text{yr}} = \mathbf{14 \text{ Ci/yr}}$$

Stack Exhaust Concentration = Coal activity (pCi/g) x flow rate (sec/m^3) x combustion rate (g/sec)

$$= \frac{2.02 \text{ pCi}}{\text{gram}} \times \frac{1 \text{ sec}}{1029 \text{ m}^3} \times \frac{2.16 \times 10^5 \text{ grams}}{\text{sec}}$$

$$= \frac{4.24 \times 10^2 \text{ pCi}}{\text{m}^3}$$

Maximum 24 Hour:

(Stack Concentration)(Dispersion Rate)

$$\left(\frac{4.24 \times 10^2 \text{ pCi}}{\text{m}^3}\right)\left(\frac{1}{1.15 \times 10^4}\right) = \frac{\mathbf{3.68 \times 10^{-2} \text{ pCi}}}{\mathbf{m^3}}$$

Maximum Annual:

(Stack Concentration)(Dispersion Rate)

$$\left(\frac{4.24 \times 10^2 \text{ pCi}}{\text{m}^3}\right)\left(\frac{1}{2.18 \times 10^5}\right) = \frac{\mathbf{1.94 \times 10^{-3} \text{ pCi}}}{\mathbf{m^3}}$$

Acid precipitation - refers to precipitation with pH lower than 5.6. Precipitation is naturally somewhat acidic (with a pH of about 5.6) because of the dissolution of atmospheric carbon dioxide to form carbonic acid. Precipitation with a pH lower than 5.6 is indicative of substances other than CO_2 causing the acidity. Sulfuric, nitric and to a lesser extent, hydrochloric acid contribute to the lower pH values of acid precipitation. It is generally recognized that fossil fuel combustion forms precursors to acid precipitation, although its importance is not clear.

Air basin - a region which experiences the same general wind and temperature patterns due to its terrain and geographical location.

Air chemistry monitoring - the measurement of airborne chemicals (e.g., SO_2, NO_x and NO_2) using continuous monitors.

Alkaline - of, relating to, or having the properties of an alkali; especially having a pH of more than 7.

Ambient - actual conditions of P (pressure) = 633 mm mercury and T (temperature) = 298.15 K (25°C). Used in reference to modeled or monitored concentrations, that are reported at actual or ambient conditions.

Ambient air - the portion of the atmosphere, external to buildings, to which the general public has access. Pollutant concentrations that are predicted as a result of NMGS are reported in those areas that are "ambient air."

Anthropogenic source of emissions - a human-caused source of emissions, including vehicle exhaust, industrial sources, and construction emissions. A nonanthropogenic source refers to naturally occurring emissions such as forest fires.

Area source - emissions from other than a stationary stack or vent (e.g., vehicle emissions).

Attainment - a designation issued by the EPA to indicate an area's compliance with all applicable National Ambient Air Quality Standards (NAAQS). An area that is in compliance with the particulate matter standard, for example, is termed "attainment" for this pollutant. An area that is shown by monitoring or modeling to exceed a standard is designated "non-attainment" for the particular pollutant(s).

Attenuation - a lessening or weakening of severity. Used in reference to noise; noise levels decrease or "attenuate" with distance from the noise source.

Baseline air quality - data obtained from a monitoring station at a project site to determine concentrations of possible air contaminants before any changes are made to the site.

Best available control technology (BACT) - an emission limit or control technology that represents the maximum degree of reduction with respect to a particular source and pollutant, taking into account energy, environmental, and economic impacts, and other costs. BACT is required under the PSD regulations for each pollutant regulated under the Clean Air Act that exceeds applicable emission criteria (see Prevention of Significant Deterioration, PSD).

Bisti Wilderness Study Area - a 3520-acre badlands area located in northwestern New Mexico on T23N, R13W, and T24N, R13W. It is approximately 32 miles south of Farmington on Highway 371. The proposed NMGS would be located about 3 miles southeast of the Bisti WSA, and two of the proposed water pipelines would parallel its western boundary.

Class I areas - land areas defined in the Clean Air Act as follows:

1) all international parks;
2) all national wilderness areas which exceed 5,000 acres in size;
3) all national memorial parks which exceed 5,000 acres in size;
4) all national parks which exceed 6,000 acres in size

Such areas are given additional air quality protection under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act.

Clean Air Act - the Clean Air Act is the primary legislative tool for improving and monitoring air quality in the United States. Many requirements of the Act mandate the U.S. Environmental Protection Agency to promulgate regulations relating to emission limitations and permitting requirements. Some requirements of the Act also apply to Bureau of Land Management activities.

Clean Air Act Amendments of 1977 - the latest in a series of expanding regulatory requirements designed to protect the air quality resource in the United States. The Amendments of 1977 introduced several new concepts including the Prevention of Significant Deterioration (PSD), the use of Best Available Control Technology, and the protection of ambient visibility levels.

Concentration - used in reference to air pollutants; means the amount of such pollutant (in terms of weight or volume) with respect to the volume of air containing it. Pollutant concentrations are expressed in units of parts per million (ppm) or g/m^3. Pollutant concentration values are representative of the degree of such pollutant in the atmosphere. A concentration value answers the question: "How much of this substance is contained in a given volume of air?"

Criteria Pollutants - pollutants for which the EPA has established ambient air quality standards: sulfur dioxide, nitrogen dioxide, total suspended particulate matter, carbon monoxide, non-methane hydrocarbons, ozone, and lead.

Decibel - a unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average pain level.

De-na-zin Wilderness Study Area - the topography of this 19,000-acre area is 3/4 badland to 1/4 rolling grassland. This WSA is located in T24N, R12W, and R11W. The De-na-zin is accessible from Farmington by taking Highway 371 or 44 and connecting with County Road 15.

Dispersion - used in reference to air pollutants; refers to the mixing or diffusion of pollutants in the atmosphere.

Emissions - air contaminants from any source, expressed in terms of weight per unit of time (e.g., pounds per hour, tons per year).

Fugitive dust - particulate matter composed of soil which is uncontaminated by pollutants resulting from industrial activity.

Fugitive particulate matter - refers to emissions of dust particulates that are not vented through a stack, chimney or vent. Examples of fugitive dust emissions include wind-blown particulate matter from product storage piles.

Gaussian dispersion model - see Modeling.

Hydrocarbon - a gaseous air contaminant expressed as methane equivalents.

Insolation - solar radiation that is received; also in reference to measurement it means the rate of delivery of all direct solar energy per unit of horizontal surface.

Hypothetical mine - a mine included in the Baseline 1 and 2 inventories that would be located near the NMGS coal- and ash-handling facilities.

Increment - the maximum allowable increase in a specific pollutant concentration over and above existing "baseline concentrations" as specified in Section 163 of the Clean Air Act, and in EPA's PSD regulations (40 CFR 52.21).

Isotope - any of two or more species of atoms of a chemical element with the same atomic number and position in the periodic table and nearly identical chemical behavior but with differing atomic mass or mass number and different physical properties.

Lead - a heavy metallic element which can be released during combustion of lead-containing material and can be poisonous in certain quantities.

Mesa Verde Plateau - high plateau region north of San Juan and Four Corners power plants designated as nonattainment for SO_2. Area also referred to as "Ute Mountain Mesa" in ERT reports.

Modeling - a computer analysis of air quality which predicts future concentration levels resulting from a source of air pollution. Also referred to as computer simulation modeling or computer dispersion modeling. Computer models which base dispersion on Gaussian statistical principles are termed Gaussian dispersion models.

National Ambient Air Quality Standards (NAAQS) - pollutant concentration limits established by the EPA for sulfur dioxide, nitrogen dioxide, total suspended particulates, carbon monoxide, non-methane hydrocarbons, ozone, and lead. These limits represent levels that the EPA feels are necessary to protect the public health with an adequate margin of safety, and to protect the general welfare. The EPA is mandated to establish such standards under Section 109 of the Clean Air Act.

New Mexico Ambient Air Quality Standards - pollutant concentration limits established by the New Mexico Environmental Improvement Division (NMEID) for sulfur dioxide, hydrogen sulfide, nitrogen dioxide, total suspended particulates, carbon monoxide, non-methane hydrocarbons, total reduced sulfur, and photochemical oxidants. These limits represent levels that the NMEID feels will preserve the air resource.

Nitric oxide (NO) - a colorless, odorless gas containing one molecule of nitrogen and one of oxygen. It is the major oxide of nitrogen formed during high temperature combustion.

Nitrogen dioxide (NO_2) - a chemical compound containing one atom of nitrogen and two of oxygen. New Mexico state standards include in their definition of NO_2, other oxides of nitrogen (e.g., nitric oxide, which may test as nitrogen dioxide).

Nitrogen oxides (NO_x) - class of oxides formed by the combination of nitrogen and oxygen. Generally refers to only nitric oxide (NO) and nitrogen dioxide (NO_2), but can also include nitrous oxide (N_2O), nitrogen trioxide (NO_3), dinitrogen trioxide (N_2O_3), dinitrogen tetroxide (N_2O_4), and dinitrogen pentoxide (N_2O_5).

Non-power plant baseline - highest background concentrations in the project area that have been measured at the project site and that cannot be attributed to either Four Corners or San Juan power plants.

Opacity - the degree to which emissions reduce the transmission of light and obscure the view of an object in the background.

Ozone - a triatomic oxygen molecule which is a bluish irritating gas with a pungent odor. Formed naturally by the reaction of solar ultraviolet radiation with oxygen. It is also formed by electrical discharges and by reactions of pollutants (i.e., smog).

Particulate matter - any airborne material except uncombined water. It consists of particles in the atmosphere resulting from many kinds of dust and fume-producing industrial and agricultural operations, from combustion products, including automobile exhaust, and from atmospheric photochemical reactions.

PNM monitoring site - a 60-meter meteorological tower installed 1 km southeast of the proposed project site and operated by PNM.

Point source - a stationary source of emissions (i.e., emissions that originate from either a stack or vent).

Pollutant - a substance that contaminates the natural environment--usually from human activity. Used in reference to the atmosphere it means gaseous or particulate matter that contaminates the atmospheric environment.

Prevention of Significant Deterioration (PSD) - specific requirements contained in the Clean Air Act Amendments of 1977, and in the subsequent PSD regulations promulgated by the EPA. The requirements and regulations are designed to protect the air quality resource in regions of the country where present pollutant levels are below the national ambient air quality standards. The PSD regulations require an air quality analysis for proposed sources of air pollution. The analysis examines air quality "increments" (see "increment"). The regulations also require application of the Best Available Control Technology (see Best Available Control Technology).

Project site - the New Mexico Generating Station (NMGS), a proposed coal-fired power plant to be located in northwestern New Mexico in the San Juan Basin, 37 miles south of Farmington, New Mexico and 12 miles northwest of Chaco Culture National Historical Park.

Radionuclide - an element such as uranium, which spontaneously emits energy without the absorption of energy.

San Juan Basin - the region bounded by the Chuska Mountains on the west side, Mesa Verde National Park on the north side, and the continental divide on the south and east sides.

San Juan River valley - the region surrounding the Animas and San Juan rivers between Highways 44 and 666, including the towns of Aztec, Bloomfield, Farmington and Shiprock.

Stationary source - a nonmoving source of emissions.

Sulfur dioxide (SO_2) - the chemical compound containing one atom of sulfur and two of oxygen. Colorless gas characterized by an unpleasant egg-like odor.

Synoptic - used with respect to meteorology and refers to meteorological conditions that exist simultaneously over a broad area such as an air basin (see "air basin").

Threshold of detection - lowest recordable level of a monitoring instrument.

Total suspended particulate - airborne particulate matter that exists in the atmosphere, as opposed to particulate matter in a stack, or in the process of being emitted.

Ute Mountain Mesa - see Mesa Verde Plateau.

Volatile organic compounds (VOC) - nonmethane hydrocarbon compounds which are precursors to the formation of ozone in the atmosphere.

Wilderness Study Area - a geophysical area identified for study by the BLM as having particular natural or ecological characteristics of such quality as to be set aside and managed for the purposes of preservation and for historical, scientific, scenic, educational, or unconfined and primitive recreational use by the public. After the study period, Congress considers BLM's recommendation on whether the area should be included in the National Wilderness Preservation System. Such areas addressed in the Technical Report include the Bisti and De-na-zin WSAs.

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