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OPERATIONAL ENVIRONMENTAL MONITORING PLAN FOR THE WASTE ISOLATION PILOT PLANT

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
AIBS	American Institute of Biological Scientists
ALARA	As Low As Reasonably Achievable
AMAD	Activity Median Aerodynamic Diameter
AMS	Aerial Measurement Survey
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BR	Breathing Rate
CAM	Continuous Air Monitor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	Concentration Guide
CH	Contact-Handled Waste
CMS	Central Monitoring Station
DBA	Design Basis Accident
DCF	Dose Conversion Factor
DCG	Dose Concentration Guide
DOE	Department of Energy
DOE/AL	DOE Albuquerque Operations Office
DOT	Department of Transportation
EC	Electrical Conductivity
EEG	Environmental Evaluation Group, State of New Mexico
EIS	Effluent Information System
EMP	Ecological Monitoring Program
EPA	Environmental Protection Agency
FAS	Fixed Air Sampler
FDA	Fluorescein Diacetate
FEIS	Final Environmental Impact Statement
FSAR	Final Safety Analysis Report
HEPA	High Efficiency Particulate Air Filter
HPIC	High Pressure Ionization Chamber
HiVol	High Volume Air Sampler
ICRP	International Commission on Radiological Protection

LIST OF ACRONYMS
(CONTINUED)

ING	Ingestion Rate of Drinking Water
LD	Limit of Detection
LoVol	Low Volume Air Sampler
MCL	Maximum Contaminant Level
NBS	National Bureau of Standards
NCRP	National Commission on Radiation Protection and Measurements
NES	Nonradiological Environmental Surveillance
NRC	Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act
ODIS	Onsite Discharge Information System
OEMP	Operational Environmental Monitoring Plan
PCB	Polychlorinated Biphenyl
QA/QC	Quality Assurance/Quality Control
RBP	Radiological Baseline Program
RCRA	Resource Conservation and Recovery Act
RES	Radiological Environmental Surveillance
RH	Remote-Handled Waste
RPS	Radiation Protection Standards
SAR	Safety Analysis Report
SES	Storage Exhaust Shaft
SNK	Student-Newman-Keuls test for homogenous mean
SNLA	Sandia National Laboratories, Albuquerque
TLD	Thermoluminescent Dosimeter
TRU	Transuranic Waste
TRUPACT	TRansUranic PACkage Transporters
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
USBM	United States Bureau of Mines
USGS	United States Geological Survey
WAESD	Westinghouse Advance Energy Systems Division
WEC	Westinghouse Electric Corporation
WFF	WIPP Far Field
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant
WQSP	Water Quality Sampling Program

1.0 INTRODUCTION

U.S. Department of Energy (DOE) Order 5400.1 (1988d) requires each DOE site to prepare an Operational Environmental Monitoring Plan (OEMP). This document is the OEMP for the Waste Isolation Pilot Plant (WIPP), which is located in southeastern New Mexico, and is prepared in accordance with the guidance contained in DOE Order 5400.1 (DOE, 1988d) and draft Order 5400.3 (DOE, 1988e). The WIPP project is operated by Westinghouse Electric Corporation (WEC) for the DOE.

This plan defines the scope and extent of the WIPP effluent and environmental monitoring programs during the facility's operational life. It also discusses the quality assurance/quality control programs which ensure that samples collected and the resulting analytical data are representative of actual conditions at the WIPP site.

This plan provides a comprehensive description of environmental activities at WIPP, including:

- A summary of environmental program information, including an update of the status of environmental permits and compliance activities (Section 1.0);
- A description of the WIPP project and its mission (Section 2.0);
- A description of the local environment, including demographics (Section 3.0);
- A summary of applicable standards and regulatory requirements and brief discussions of potential exposure pathways, routine and accidental releases, and their consequences (Section 4.0);
- A summary of the preoperational environmental monitoring and assessment activities (Section 5.0); and
- Responses to the requirements (Appendix A) and guidelines (Appendix B) presented in the "Radiological Effluent Monitoring and Environmental Surveillance for U.S. DOE Operations," DOE Order 5400.xy (DOE, 1988f).

The WIPP operational effluent and environmental sampling program is presented in Section 6.0. Sampling activities include collection of liquid and airborne effluent samples to determine radioactive material releases; measurement of meteorological parameters for modeling potential releases; collection and analysis of environmental samples; and ecosystem sampling for assessment of WIPP operational impacts. Sections 7.0 through 9.0 discuss the identification and management of samples, data analyses, and methodologies for calculating radiation doses to the public and to workers at the site. Program reporting requirements are described in Section 10.0. Quality assurance and quality control activities for the program are described in Section 11.0.

This document extensively references DOE orders and other federal and state regulations affecting effluent and environmental monitoring programs at the site. WIPP procedures, which implement the requirements of this program plan, are also referenced.

DOE regulates its own activities for radiation protection of the public under the authority of the Atomic Energy Act of 1954, as amended. The effluent and environmental monitoring activities prescribed by DOE Order 5400.xy are designed to ensure DOE facilities collect the information required to estimate potential and actual radiation doses to site personnel and the surrounding population.

In addition, other federal agencies, such as the U.S. Environmental Protection Agency (EPA) and the U.S. Nuclear Regulatory Commission (NRC), are empowered through specific legislation to regulate certain aspects of DOE activities potentially affecting public health and safety or the environment. Presidential Executive Order 12088, "Federal Compliance with Pollution Control Standards," further requires the heads of executive agencies to ensure that all federal facilities and activities comply with applicable pollution control standards and to take all necessary actions for the prevention, control, and abatement of environmental pollution.

In addition to statutory obligations, the DOE has established a general environmental protection policy. The "Environmental Policy Statement" issued by Secretary Herrington on January 8, 1986, and extended on January 7, 1987, describes the DOE's commitment to national environmental protection goals by conducting operations "in an environmentally safe and sound manner . . . in compliance with the letter and spirit of applicable environmental statutes, regulations, and standards" (DOE, 1986a). This Environmental Policy Statement also states DOE's commitment to "good environmental management in all of its programs and at all of its facilities in order to correct existing environmental problems, to minimize risks to the environment or public health, and to anticipate and address potential environmental problems before they pose a threat to the quality of the environment or public welfare." Additionally, "it is DOE's policy that efforts to meet environmental obligations be carried out consistently across all operations and among all field organizations and programs" (DOE, 1986a).

Environmental activities at the WIPP project generally fall into three categories: (1) the performance of analyses and preparation of documents to address DOE requirements, as well as applicable regulations of the EPA and other federal and state agencies having jurisdiction over construction sites in general and the WIPP project in particular; (2) the conduct of studies to monitor site impacts; and (3) the occasional implementation of measures to mitigate potentially significant adverse impacts.

Compliance with terms of the Agreement for Consultation and Cooperation established in 1981 with the State of New Mexico is very important at WIPP. This agreement, required by the federal legislation which authorized the WIPP project (Public Law 96-164, 1980), specifies that DOE notify the State of New Mexico prior to commencement of key events. The Supplemental Stipulated Agreement requires DOE to provide the State with sufficient information to conduct an independent review of WIPP activities. This review, performed by the New Mexico Environmental Evaluation Group (EEG), may include an independent radiological surveillance program.

A number of provisions, taken to mitigate potential environmental impacts, appear in Statements of Work issued to all contractors involved in the construction of WIPP facilities. These include:

- Protection of environmental resources, including the avoidance of unnecessary damage to vegetation, wildlife, and soil by controlling traffic, minimizing disturbance zones, and cleaning up spills.

- Protection of air resources, including the control of hydrocarbon emissions by using proper fuels, the suppression of dust by spraying with water, and the monitoring and control of noise.

- Protection of water resources, including the use of retention ponds for controlling suspended materials, solutes, and other pollutants.

- Preservation and recovery of historical, archaeological, and cultural resources, including the interruption of construction activities as necessary to investigate and mitigate any finds of unusual or potentially valuable items.

- Post-construction cleanup, including the obliteration of temporary construction facilities such as haul roads, stockpiles, and work areas, as well as the restoration of all damaged landscape features outside the limits of approved work areas.

WIPP must also comply with specified permitting and approval requirements of several federal and state regulating agencies. A record is maintained of required permits, notices, and approvals which apply to the WIPP project. This record enables environmental personnel to anticipate commitments such as renewal dates, fee payments, and reclamation requirements. A preoperational environmental permit compliance plan has been developed for WIPP (Louderbough, 1986). Table 1-1 lists permits which are currently active, as well as approvals granted and notices filed during 1988. Table 1-2 lists inactive permits for which close-out activities (i.e., filing of final reports, reclamation) were performed.

TABLE 1-1
ACTIVE ENVIRONMENTAL PERMITS

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
Department of the Interior, Bureau of Land Management	Land Use Permit for placement of raptor platforms	NM-060-LUP-235	9/12/86	9/12/89	NA		
As above	Right-of-Way for water pipeline	NM53809	8/24/83	NA	NA		Right-of-way extended in perpetuity
As above	Right-of-Way for north access road	NM55676	8/24/83	NA	NA		Right-of-way extended in perpetuity
As above	Land Use Permit to Dispose of Contruction Debris	NM-067-LUP-237	2/9/87	2/9/90			Landfill has been cleaned up and procedure WP 02-503 issued
As above	Right-of-Way for railroad	NM55699	9/27/83	NA	NA		Right-of-way extended in perpetuity
As above	Right-of-Way for dosimetry and aerosol sampling sites	NM63136	7/3/86	NA	NA		

TABLE 1-1
ACTIVE ENVIRONMENTAL PERMITS
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
As above	Right-of-Way for seven subsidence monuments	NM65801	11/7/86	NA	NA		
As above	Approval to drill 2 new test wells on existing pads at P-1 and P-2	NA	9/18/86	NA	NA		
New Mexico Environmental Improvement Division	Open Burning Permit to train fire control crews	NA (initial)	2/24/88 (extension)	2/24/89	NA		
As above	Food or Drink Purveyor Permit for cafeteria	4CA08CARRS184A	10/10/86	NA	NA		
New Mexico Department of Game and Fish	Permit to collect bio-logical samples	1775	1/14/88	12/31/88	Limit of 20 scaled quail and catfish		Permit renewal requested; 1988 Annual Report submitted 01/89

TABLE 1-1
ACTIVE ENVIRONMENTAL PERMITS
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
As above	Concurrence that construction of WIPP will have no significant adverse impact upon threatened or endangered species	NA	4/7/80	NA	NA		
New Mexico Commissioner of Public Lands	Right-of-way for high volume air sampler	RW-22789	10/3/85	10/3/2020	$500 annual fee		
New Mexico Department of Finance and Administration, Planning Division, Historic Preservation Bureau	Concurrence that the archaeological resources protection plan prepared by the DOE is adequate to mitigate any adverse impacts upon cultural resources resulting from construction of the full WIPP facility	NA	7/25/83	NA	NA	NA	

TABLE 1-1
ACTIVE ENVIRONMENTAL PERMITS
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
U.S. Environmental Protection Agency	Notification of presence of 2 underground fuel storage tanks at WIPP	NA	4/15/86	NA	NA	Compliance with 40 CFR 280	$56 annual fee submitted 9/1/88
As above	Acknowledgement of Notification of Hazardous Waste Activity	NMD982283566	10/87	NA		Compliance with 40 CFR 262 and NMHWMR	Biennial report submitted 5/88
As above	Acknowledgement of Notification of Hazardous Waste Activity (WIPP)	NMD982285488	1/88	NA		Compliance with 40 CFR 262 and NMHWMR	Revisions to Notification submitted 7/88

TABLE 1-2
INACTIVE ENVIRONMENTAL PERMITS

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
Department of the Interior, Bureau of Land Management	Free Use Permit to excavate sand and caliche on federal land administered by the BLM	NM-060-MP1-076	4/30/81	7/31/81	Maximum excavation of 1,100 yd^3	Pit must be graded and seeded	Pit not yet graded and seeded
As above	As above	NM-060-MP3-7094	4/15/83	4/15/84	Maximum excavation of 7,000 yd^3	As above	Pit not yet graded and seeded
As above	As above	NM-060-MP3-7105	5/18/83	5/31/83	Maximum excavation of 1,500 yd^3	As above	Pit not yet graded and seeded
As above	As above	NM-060-MP4-7002	10/4/83	10/4/84	Maximum excavation of 50,000 yd^3	As above	Pit not yet graded and seeded
As above	As above	NM-060-MP4-7009	10/21/83	10/21/84	Maximum excavation of 12,000 yd^3	As above	Pit graded and seeded
As above	As above	NM-060-MP4-7010	10/21/83	10/21/84	Maximum excavation of 279,000 yd^3	As above	Pit graded and seeded

TABLE 1-2
INACTIVE ENVIRONMENTAL PERMITS
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
As above	As above	NM-060-MP4-7087	1/9/84	1/9/85	Maximum excavation of 10,000 yd^3	As above	Pit graded and seeded
As above	As above	NM-060-MP4-7088	1/9/84	1/9/85	Maximum excavation of 15,000 yd^3	As above	Pit not yet graded and seeded
As above	As above	NM-060-MP4-7089	1/9/84	1/9/85	Maximum excavation of 15,000 yd^3	As above	Pit graded and seeded
As above	As above	NM-060-MP4-7094	4/15/83	4/15/84	Maximum excavation of 53,000 yd^3	As above	Pit graded and seeded
As above	As above	NM-060-MP5-7013	11/2/84	11/2/85	Maximum excavation of 12,000 yd^3	As above	Pit graded and seeded
As above	As above	NM-060-MP4-7015	11/21/83	11/21/84		As above	Pit not yet graded and seeded

TABLE 1-2
INACTIVE ENVIRONMENTAL PERMITS
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
As above	Land use permit for north access road construction	NM-060-LUP-212	10/1/83	4/30/85		Additional reclamation required	Initial seeding. unsuccessful in places
As above	Land use permit for water-pipe line construction	NM-060-LUP-214	2/9/84	2/9/85		Reclamation required	
As above	Free Use Permit to excavate sand and caliche on federal land administered by the BLM	NM-060-MP5-7080	5/22/85	1/1/88	Maximum excavation of 70,000 yd^3	Report of quantity of material excavated required within 30 days of expiration; upon completion of excavation, pit must be graded and seeded	Report filed; this location has been converted to a construction landfill
As above	Land Use Permit to dispose of construction debris in open soil/caliche pit	NM-060-LUP-219	1/14/85 (initial) 1/14/86 (extension)	1/14/88	Only construction waste may be disposed; monthly BLM inspections	Upon completion of construction, trash must be covered and area graded and seeded	Pit has been filled and covered. Reseeding is pending appropriate season

TABLE 1-2
INACTIVE ENVIRONMENTAL PERMITS
(CONTINUED)

GRANTING AGENCY	TYPE OF PERMIT/ APPROVAL	PERMIT NUMBER	DATE GRANTED	DATE EXPIRATION	PERMIT CONDITIONS	ACTION REQUIRED	COMMENTS
As above	Free Use Permit for excavation of Caliche from existing borrow pit	NM-060-FUP-7018	5/10/88	01/01/89	Excav pit to be rehab by backfill with spoils soil and covering w/ stockpiled top soil to depth of two ft or reduce side slopes & dress slopes and pit with stock-piles soil depth of two ft.		Caliche Use Report submitted 01/89
New Mexico Commissioner of Public Lands	Right-of-way for con-struction of brine evapora-tion ponds	RW-21487	1/29/82	1/29/87	NA	Reclamation required upon completion of activities	Site has been regraded. Reseeding is pending appropriate season

2.0 PROJECT DESCRIPTION

The purpose of WIPP is to provide a research and development facility to demonstrate the safe disposal of transuranic (TRU) wastes generated by the defense activities of the U.S. Government. The preoperational radiological and ecological environmental monitoring programs were detailed in earlier documents entitled: "Radiological Baseline Program for the Waste Isolation Pilot Plant" (Reith and Daer, 1985) and "Ecological Monitoring Program for the Waste Isolation Pilot Plant, Semi-annual Report" (Reith et al., 1985). A summary of those programs is presented in Section 5.0 of this document. The operational environmental monitoring program continues, as appropriate, the preoperational environmental monitoring efforts and adds monitoring of the airborne and liquid effluent discharges.

Figure 2-1 is a schematic diagram of the repository, including surface facilities. Figure 2-2 is an oblique aerial view of the WIPP site (looking northwest) in December 1988. Details regarding the design and operation of the WIPP project are in the Final Safety Analysis Report (FSAR) (DOE, 1988a). Except for possible experiments with some high-level wastes, the waste received by the WIPP will be transuranic (TRU) waste, i.e., waste that is contaminated with alpha-emitting radionuclides having atomic numbers larger than 92 and half-lives longer than 20 years in concentrations greater than 100 nanocuries per gram. Waste containers will be classed as "contact handled" (CH) or "remote handled" (RH) based on whether surface dose rates are less than or greater than 200 mrem/hr. The waste inside the containers will be in a variety of forms such as concrete stabilized sludges, decommissioned machine tools, glove boxes, etc. All wastes received by the WIPP will be restricted according to specific Waste Acceptance Criteria (WEC, 1985) which prohibit free liquids, pressurized gases, explosives, and security classified materials. Table 4-4 lists the types of radionuclides which may be present in the incoming wastes. General criteria defining the various categories of radioactive waste, including TRU waste appear in DOE Order 5820.2A (DOE, 1988g) and DOE/AL Order 5820.2 (DOE, 1985a). Isotopes of plutonium, americium, and curium will be the predominant radionuclides contaminating TRU waste.

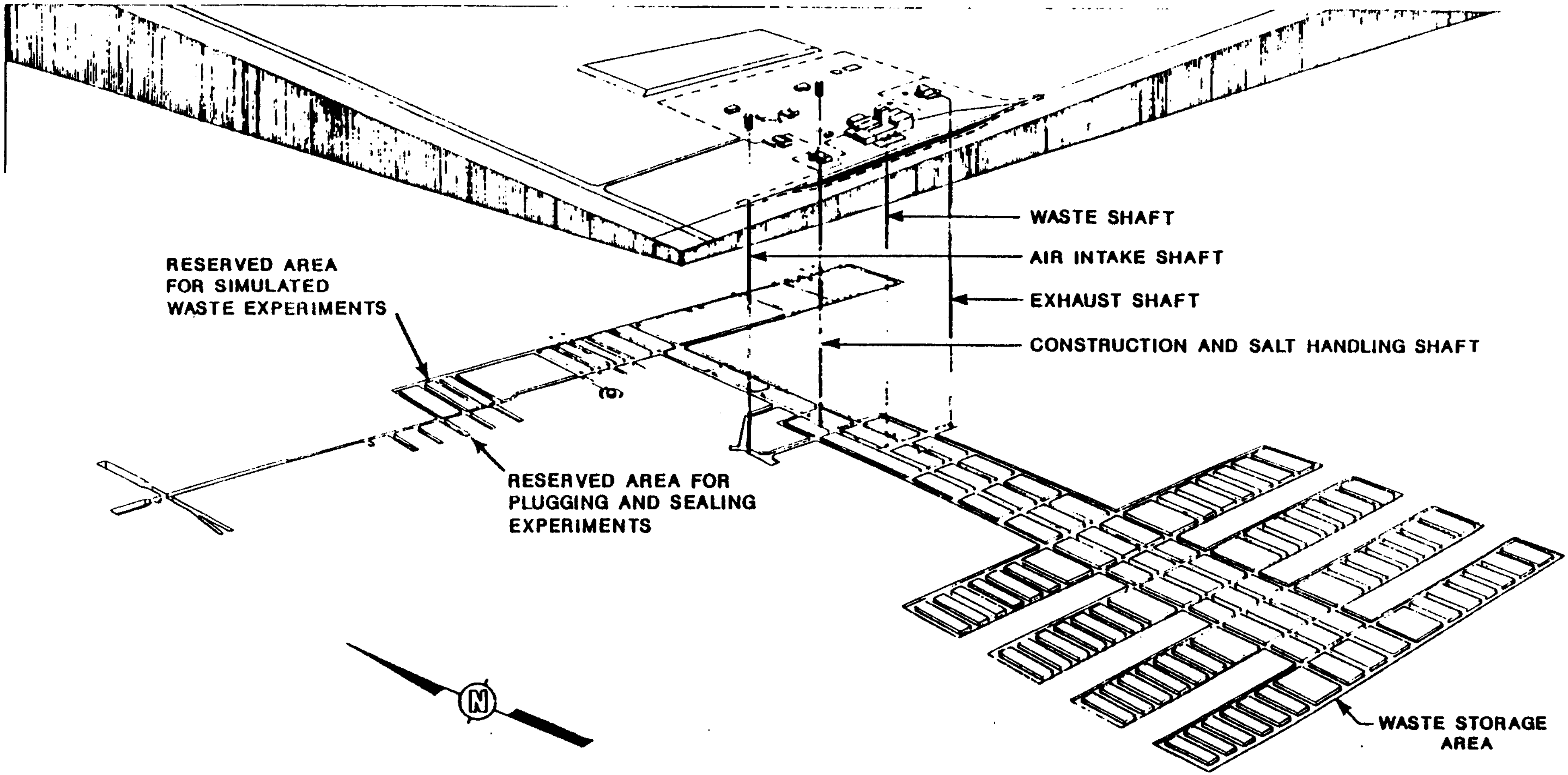

FIGURE 2-1 SCHEMATIC OF THE WIPP REPOSITORY

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TRU waste will be delivered to the WIPP waste-handling building via trucks and rail cars. Contact-handled transuranic (CH TRU) wastes will arrive in shipping containers known as TRUPACT II's (TRansUranic PACkage Transporters). TRUPACT II's are durable, Type B, Department of Transportation (DOT) transport containers, accommodating drums and other waste containers. Remote-handled transuranic (RH TRU) wastes will be packaged in waste canisters and shipped to WIPP in special transportation casks.

Once in the waste-handling building, waste containers will be removed from their shipping container, placed on the waste-handling hoist, and lowered to the emplacement horizon at a depth of 655 m (2,150 feet). Waste containers will then be removed from the hoist and emplaced in excavated storage rooms in the Salado Formation, a thick sequence of salt beds deposited approximately 250 million years ago (Permian age). Eventually, specially designed seals and plugs will be placed in the excavated drifts and in the shafts. Geologic pressures and the plasticity of the salt will result in the excavation's gradual closure due to creepage. This closure will encapsulate and isolate any waste within the Salado. The first five years of WIPP operations will be a demonstration period, during which wastes will be emplaced so as to be easily retrievable.

Once operational, the underground area will be ventilated by air entering via the Construction and Salt Handling and Air Intake Shafts and exiting through the Exhaust Shaft (Figure 2-1). In the event of an accident underground, air from the Exhaust Shaft will be directed, at a reduced flow rate, through the Exhaust Filter Building containing banks of high efficiency particulate air (HEPA) filters in order to remove potentially contaminated particulates. Exhaust ventilation from the Waste Handling Building is continuously HEPA filtered, and is not expected to represent a significant release point.

3.0 SITE CHARACTERISTICS

3.1 GEOGRAPHY

The WIPP site is located in Eddy County in southeastern New Mexico (Figure 3-1). The site is approximately 40 km (25 miles) east-southeast of Carlsbad in an area known as Los Medanos (the dunes), which is a relatively flat, sparsely inhabited plateau with little water and limited land uses. Most of the land is owned by the Federal Government or the State of New Mexico and is used for grazing. Other land uses in the general area include potash mining and oil-and-gas exploration and/or development.

The WIPP site (Figure 3-2) consists of 14 sections of federal land and two sections of state land in Township 22 South, Range 31 East. The 14 sections of federal land are withdrawn from the application of public land laws by Public Land Order 6403, which authorizes the land to be used for the construction of the WIPP facility. The two sections of state land have been withdrawn voluntarily from public use. Except for the 2.75 km^2 (1 $mile^2$) area encompassing the facility (known as the DOE Exclusive Use Area), surface land uses remain largely unchanged. Mining and drilling for purposes other than support of the WIPP project are restricted within this 16 section area.

The WIPP site is divided into zones as represented in Figure 3-1. Zone I, surrounded by a chain-link fence, includes all major surface facilities. The Secured Area Boundary, bounded by a barbed wire fence, includes other facilities associated with construction. Zone II indicates the maximum extent of underground development. The WIPP Site boundary extends at least 1.6 km (1 mile) beyond any underground development and is defined on the surface by the 16 section land withdrawal area. This boundary provides a functional barrier of intact salt between the underground region defined by Zone II and the accessible environment.

3.2 GEOLOGY

Los Medanos soils are sandy and well drained, with a well developed caliche layer occurring below one meter. There are no integrated natural surface drainage features at the site. Scattered throughout the local area are numerous livestock watering ponds (tanks) and seasonally wet, shallow lakes (playas).

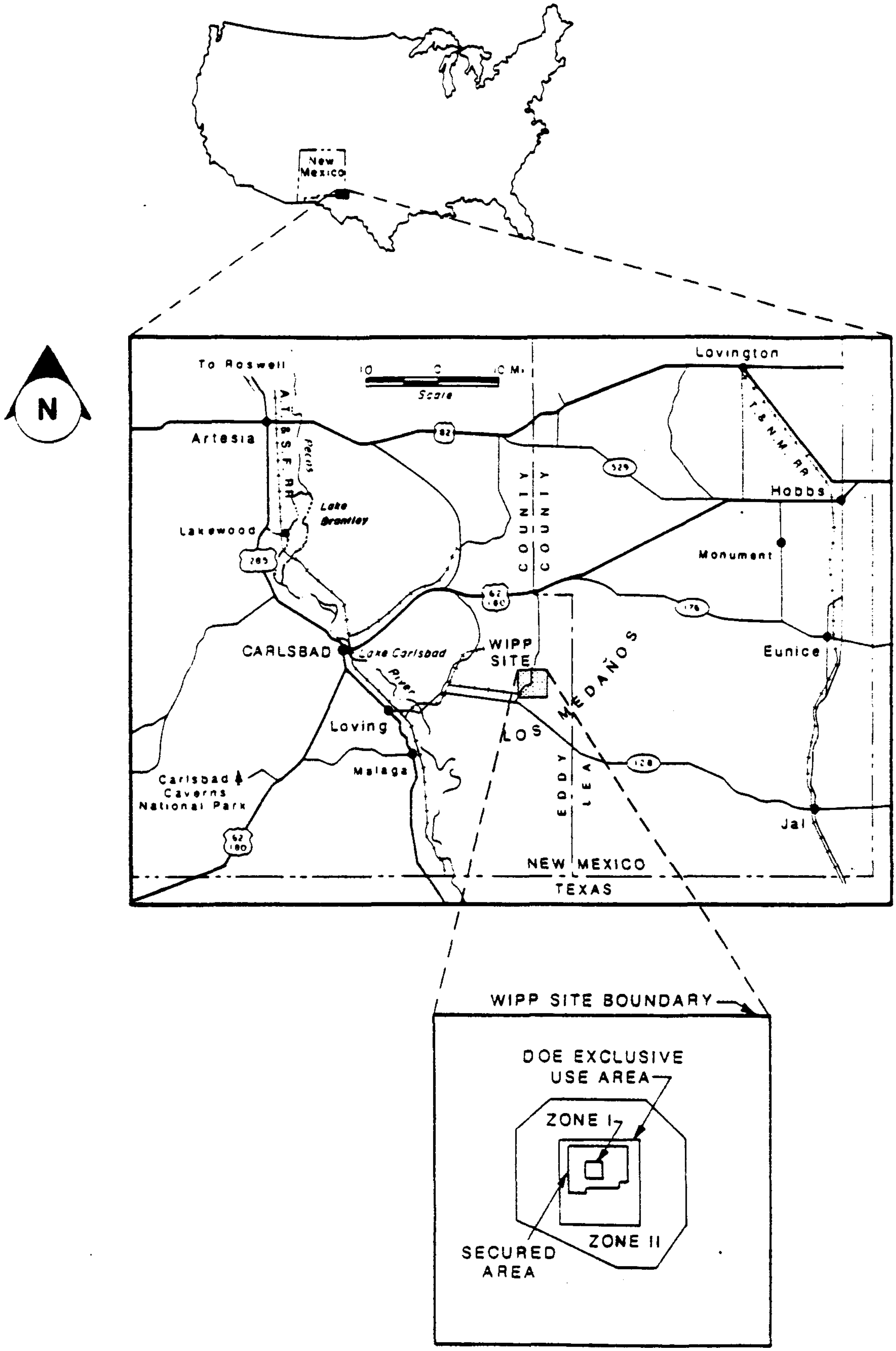

FIGURE 3-1 LOCATION OF THE WIPP SITE

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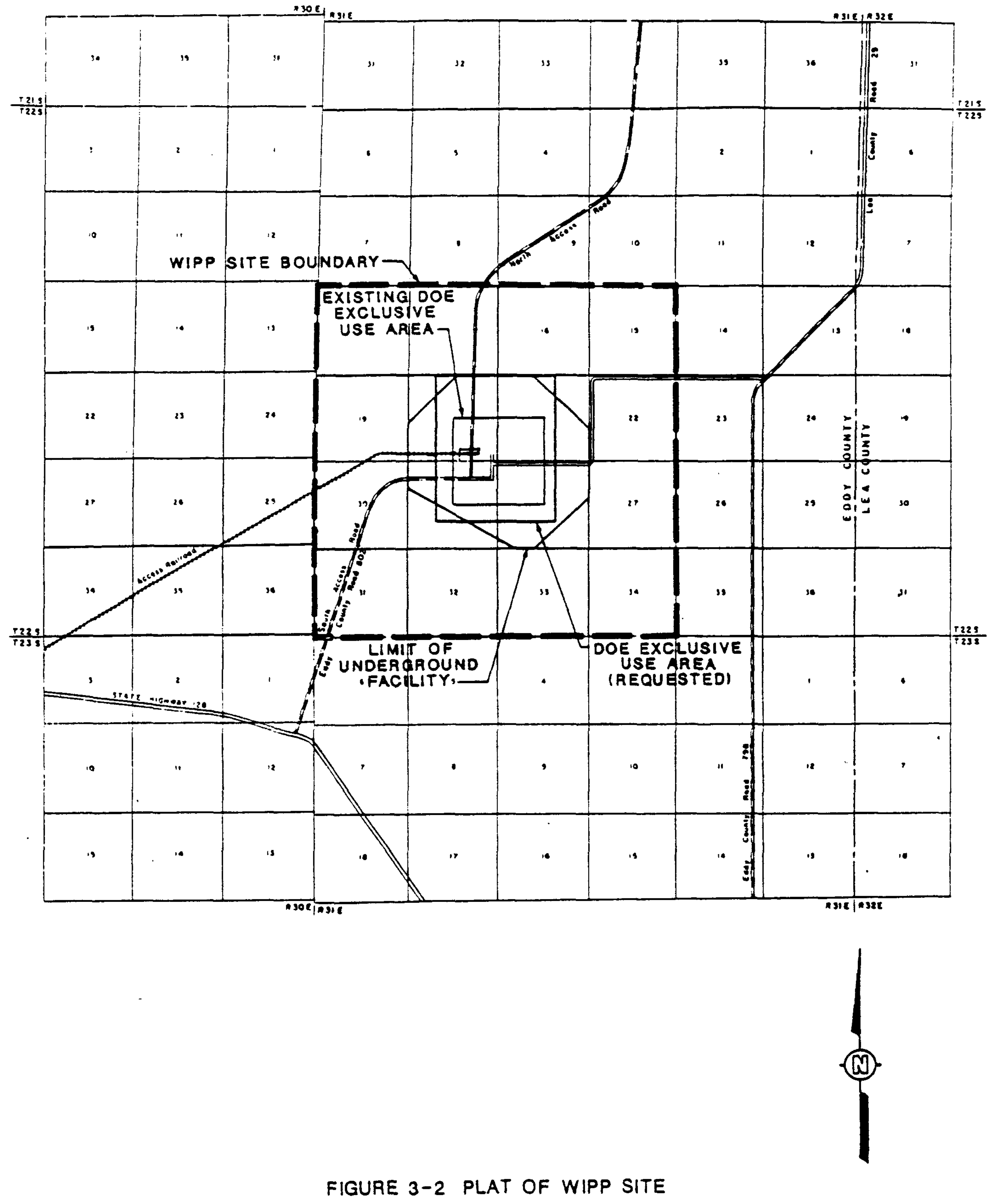

FIGURE 3-2 PLAT OF WIPP SITE

The WIPP site is located within the Pecos Valley section of the southern Great Plains physiographic province (Powers et al., 1978). Geologically, the site is located in the northern portion of the Delaware Basin, one of the westernmost sedimentary basins collectively known as the Permian Basin. Approximately 3,960 meters (13,000 feet) of strata are present in the Delaware Basin (Bachman, 1984), including hundreds of meters of evaporite sequences composed in part of halite, anhydrite, and gypsum. Figure 3-3 illustrates the local stratigraphy.

3.3 CLIMATOLOGY

Regional and WIPP site climate is semi-arid with generally warm temperatures. Approximately half the average annual precipitation (about 12 inches) is received from summer thunderstorms during June through September. Daytime summer temperatures consistently exceed 32°C (90°F) and occasionally rise above 38°C (100°F). Winter temperatures often rise as high as 21°C (70°F) during the afternoon. Nighttime lows during winter average near -5°C (23°F), occasionally dipping below -10°C (14°F). Prevailing winds are from the southeast, however, strong winds are frequent (especially in spring) and can blow from any direction creating potentially violent windstorms which carry large volumes of dust and sand. Figure 3-4 summarizes wind data for 1988. Detailed compilations of climatic data have appeared in the Ecological Monitoring Reports (Fischer et al., 1985; Fischer, 1987 and 1988). Additional climatic information appears in the Final Environmental Impact Statement (FEIS) (DOE, 1980) and WIPP Final Safety Analysis Report (FSAR) (DOE, 1988a).

3.4 HYDROLOGY

There are several water-bearing zones with enough ground water flow to be of hydrologic significance in the vicinity of the WIPP site. The most significant of these are the Culebra and Magenta Dolomite Members of the Rustler Formation and the Dewey Lake Formation. Other water-bearing zones that have been evaluated as part of site characterization include the Rustler-Salado contact residuum, brine pockets in the Castile Formation, and the Bell Canyon Formation (DOE, 1988a).

The Rustler Formation consists of interbedded anhydrite, dolomite, siltstone, and halitic claystone. The Culebra and Magenta Dolomite members are both six

301001 88 65 05 A8

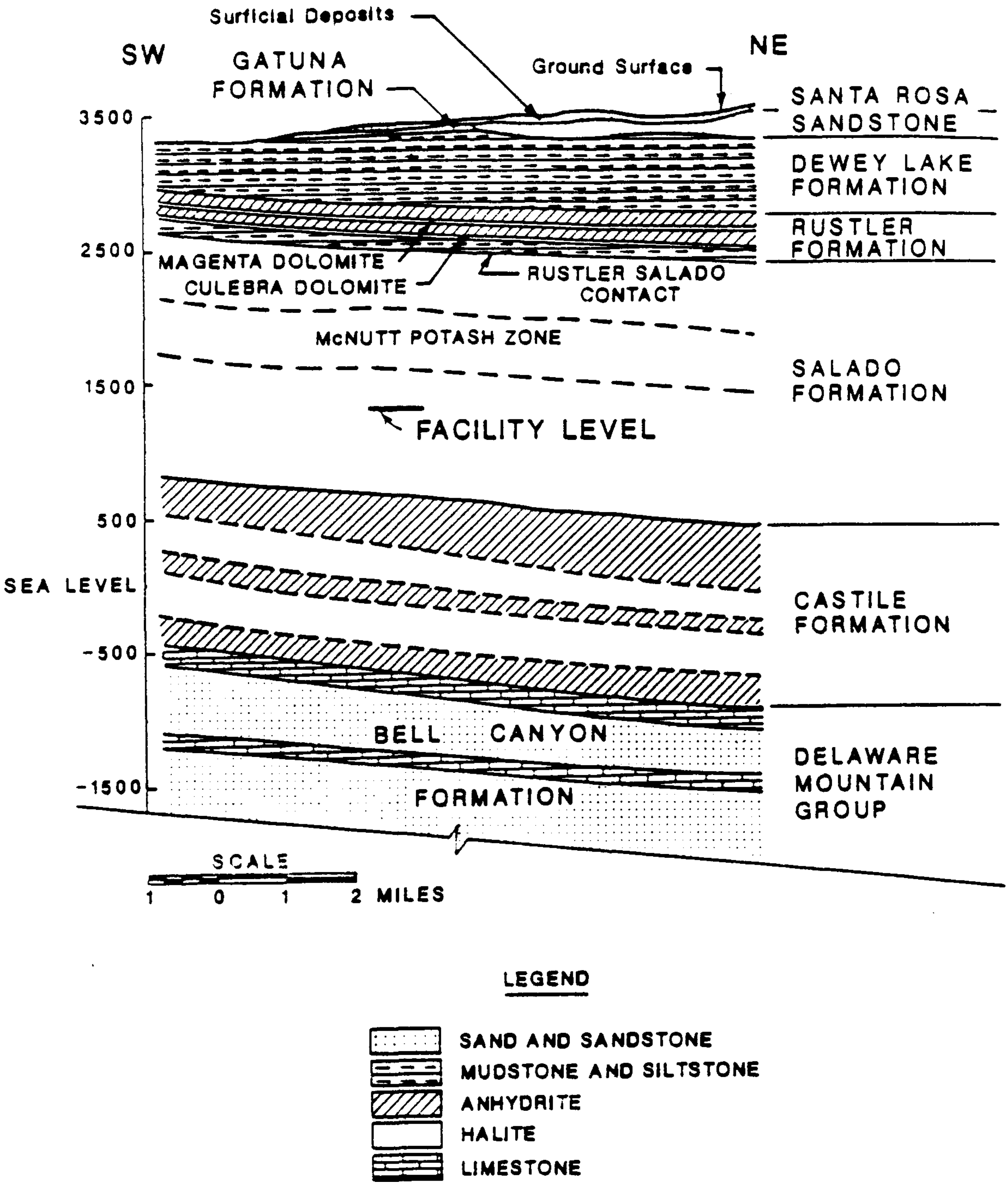

FIGURE 3-3 GENERALIZED STRATIGRAPHY OF THE WIPP SITE

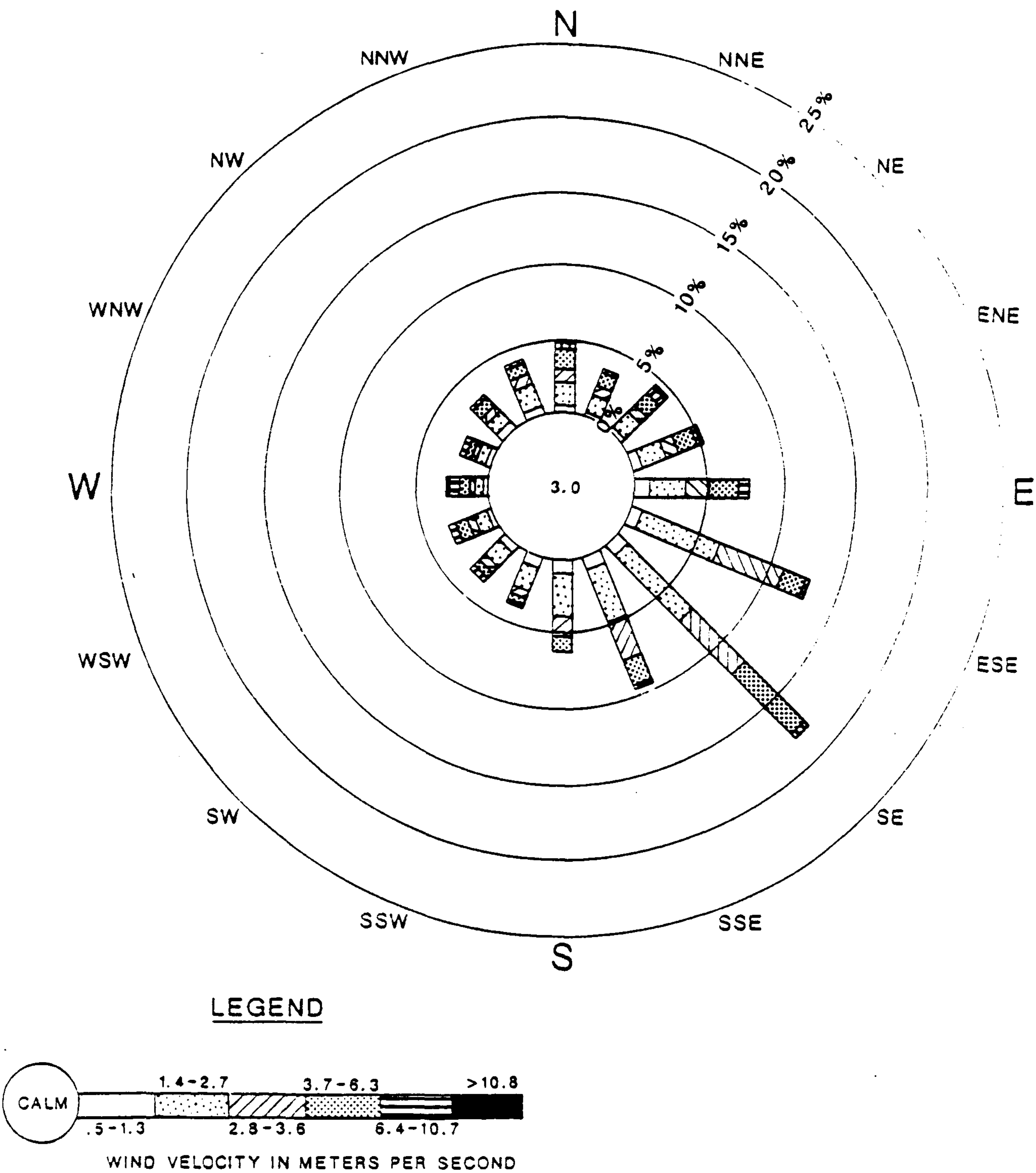

FIGURE 3-4 1988 ANNUAL WINDROSE, WIPP SITE to nine meters (19.5 to 30 feet) thick, are areally extensive and are significant water-bearing zones (DOE, 1988a).

The Dewey Lake Formation is comprised of alternating thin, even beds of siltstone and mudstone with lenticular interbeds of fine-grained sandstone. Exploratory drilling during site hydrogeologic evaluation did not identify a continuous zone of saturation within the Dewey Lake. The few Dewey Lake wells yielding water for domestic and stock purposes are believed to be completed in the thin, discontinuous lenticular sands where favorable ground water recharge occurs (Mercer, 1983). A more complete discussion of both the regional and site-specific ground water hydrology is contained in the WIPP FSAR (DOE, 1988a).

3.5 ECOLOGY

The Los Medanos Ecosystem is characterized in documents produced by the WIPP Biology Program. A brief summary of the ecological baseline surveys appears in Appendix H of the FEIS (DOE, 1980).

In general, the biota of Los Medanos represent a transition between the northern Chihuahuan Desert and the southern Great Plains and is dominated by shinnery oak (*Quercus havardii*), mesquite (*Prosopis glandulosa*), sand sage (*Artemisia filifolia*) and perennial grasses. Soils are sandy and form stabilized coppice dunes interspersed with swales. A caliche layer occurs below a depth of one meter. The potential for soil erosion is high due to the aridity and strong winds, but the extensive root systems of the dominant vegetation tends to support stable dunes.

3.6 DEMOGRAPHY

The approximate distribution of the local 1985 population within 50 miles of the WIPP site is provided in Figure 9-1. The nearest residents to the site include eight individuals living at the Mills Ranch, 5.8 km (3.5 miles) south-southwest of the site, and 13 individuals living at the Smith Ranch, 10 km (6 miles) west-northwest of the site. Both neighboring ranches have been and will continue to be monitored as part of WIPP's environmental surveillance program. Detailed demographic summaries and projections are in the WIPP FEIS (DOE, 1980) and FSAR (DOE, 1988a).

4.0 PATHWAY ANALYSIS

Pathway analysis is a component of risk assessment. Risk assessment is the process used to estimate risks associated with potential radiation exposures from an operation or activity. DOE orders require that such exposures not exceed specific limits. The assessment determines the radioactive materials available for release to the environment from facility activities. At WIPP, routine releases of radioactive materials are not anticipated, but potential releases have been estimated for each step in the waste handling process. These activities include receipt of waste on site, unloading of CH or RH waste, transfer of waste containers underground, and emplacement of waste.

4.1 APPLICABLE STANDARDS

This plan is primarily based on Draft DOE Order 5400.3 (DOE, 1988e), which adopts and implements dose standards consistent with the recommendations of the International Commission on Radiological Protection (ICRP). In 1977, ICRP recommended a system of dose limitations (ICRP, 1977) which has been adopted and implemented by most countries with nuclear programs. The ICRP system consists of three main features:

1. No practice shall be adopted unless its introduction produces a positive net benefit;

2. All exposures shall be kept as low as reasonably achievable, considering economic and social factors; and,

3. The dose equivalent to individuals shall not exceed the limits recommended for the appropriate circumstances by the Commission.

The ICRP system of dose limitations provides a scientific basis for health protection and selection of dose limits. The system also reflects current information on health risks, dosimetry, and radiation practices, and promotes a uniform and consistent application of radiation protection among diverse activities. The ICRP system is based on sophisticated analytical models, and although the system is precise, the terminology is complex.

In 1985, DOE adopted interim limits (DOE, 1985b) that lowered its Radiation Protection Standard (RPS) for members of the general public. The revised RPSs and the interim DOE radiation standards were based on recommendations of the

ICRP and the National Commission on Radiation Protection and Measurements (NCRP). The revised DOE primary standard of 100 mrem effective committed dose equivalent in a year to the public was lower than the 500 mrem limit in DOE Order 5480.11, (DOE, 1988h), and was adopted in recognition of the ICRP recommendation to limit the long-term average dose to 100 mrem per year (DOE, 1985b). A higher dose limit may be authorized for unusual operation conditions, not to exceed the 500 mrem annual limit recommended by ICRP.

At the same time, DOE (1985b) adopted the air emission standards of EPA's 40 Code of Federal Regulations (CFR) Part 61, Subpart H (EPA, 1985b). This established effective dose equivalent from DOE facility emissions, for the air pathway only, of 25 mrem/year for the whole body and 75 mrem/year for any organ of the maximum exposed individual. WIPP is subject to the more stringent requirements of 40 CFR Part 191 (EPA, 1985a) instead of the 40 CFR Part 61 regulations. Although exempt, WIPP will voluntarily comply with the reporting requirements of 40 CFR Part 61, Subpart H.

Draft DOE orders 6430.1A (DOE, 1988b) and 5400.3 (DOE, 1988e) specifically require that WIPP comply with the provisions of 40 CFR Part 191, Subpart A. This requires that the combined annual dose equivalent to any member of the public in the general environment resulting from discharges of radioactive material and direct radiation from normal WIPP operations not exceed 25 mrem to the whole body or 75 mrem to any critical organ.

DOE is also committed to maintaining radiation exposure to the public to levels which are "as low as reasonable achievable" (ALARA). DOE's ALARA policy is consistent with the features of the ICRP system described above. Accordingly, DOE Order 5400.3 requires that ALARA be considered in planning and carrying out all DOE activities. Consideration of societal, technological, and economic factors is required when choosing among alternative methods to achieve the DOE ALARA objectives.

Thus, there are four criteria which are used by WIPP in controlling off-site radiation exposures, i.e., a radiation protection limit of 100 mrem/year, a limit for the air pathway of 25 mrem/year to the whole body and 75 mrem/year to any organ, a limit for all pathways of 25 mrem/year to the whole body and

75 mrem/year to any organ, and a requirement to conduct all operations such that exposures are ALARA. Meeting the numerical exposure limits does not ensure an ALARA operation.

DOE also requires that the annual effective dose equivalent from both internal and external sources received in any year by occupationally exposed personnel (radiation workers) be limited to 5 rem or less. In addition, for individual organs and tissue, the dose equivalent received in any year by an occupational worker is limited to 15 rem to the lens of the eye or 50 rem to any other organ, tissue (including the skin of the whole body), or extremity of the body (DOE, 1988h). The above principle of ALARA also applies to radiation workers (see Table 4-1).

The DOE regulates radiation exposure to the public and the worker by limiting the radiation dose that can be received. Because some radionuclides remain in the body and result in exposure long after intake, DOE requires consideration of the dose commitment caused by inhalation, ingestion, or absorption of such radionuclides. This involves integrating the dose received from radionuclides over a standard period of time. The dose models adopted by DOE are based on the recommendations of Publication 30 of the International Commission on Radiological Protection (ICRP, 1979).

Concentrations of radionuclides are compared with DOE's Dose Concentration Guides (DCGs) for Uncontrolled Areas (DOE, 1988e). These DCGs (Table 4-2) represent concentrations of radionuclides in water or air which, if taken in continuously for a period of 50 years, will deliver an annual effective dose equivalent to a member of the public equal to the RPS of 100 mrem.

Thus, DCG for airborne radioactivity is the concentration that, if inhaled continuously, will result in an effective dose equivalent to an individual equal to the DOE's RPS of 100 mrem per year for all air pathways. The effective dose equivalent is the hypothetical whole body dose to an individual that would result in the same risk of radiation-induced cancer or genetic disorder as a given organ exposure. The effective dose is the sum of the individual organ doses weighted to account for the sensitivity of each organ to radiation-induced damage. The weighting factors are taken from the recommendations

TABLE 4-1

DOE RADIATION PROTECTION STANDARDS

EXPOSURE OF ANY MEMBER OF THE PUBLIC[1]

1. All Pathways

	Annual Effective Dose Equivalent[2] at Point of Maximum Probable Exposure
Occasional Annual Exposure	500 mrem
Prolonged Annual[3] Exposure	100 mrem
No individual tissue shall receive an annual dose equivalent in excess of 5,000 mrem	

2. Air Pathway Only[4]

	Annual Dose Equivalent at Point of Maximum Probable Exposure
Whole Body	25 mrem
Any Organ	75 mrem

3. All Pathways from WIPP Operations[5]

Whole Body	25 mrem
Any Organ	75 mrem

4. All Pathways - Design Basis Accident (DBA)[6]

	Annual Dose Equivalent at Point of Maximum Probable Exposure[7]
Whole Body	25 rem
Thyroid or Bone Surface	300 rem
Lung or Any Other Organ	75 rem

TABLE 4-1

DOE RADIATION PROTECTION STANDARDS
(CONTINUED)

OCCUPATIONAL EXPOSURES[1]

TYPE OF EXPOSURE	EXPOSURE PERIOD	DOSE EQUIVALENT
Effective dose equivalent	Year	5,000 mrem
Lens of the eye	Year	15,000 mrem
Other organs, tissue (including skin of the whole body), or extremity	Year	50,000 mrem

(1) In keeping with DOE policy, exposures shall be limited to as small a fraction of the respective annual dose limits as practicable. Except as noted, these Radiation Protection Standards apply to exposures from routine operations, excluding contributions from cosmic, terrestrial, global fallout, self-irradiation, and medical diagnostic sources of radiation. Routine operation means normal, planned operation and does not include actual or potential accidental or unplanned releases. Exposure limits for any member of the general public are taken from DOE (1988e). Limits for occupational exposure are taken from DOE Order 5480.11 (DOE, 1988h).

(2) As used by DOE, effective dose equivalent includes both the effective dose equivalent from external radiation and the committed effective dose equivalent to individual tissues from ingestion and inhalation during the calendar year.

(3) For the purposes of DOE's Radiation Protection Standard, a prolonged exposure will be one that lasts, or is predicated to last, longer than five years.

(4) These levels are from EPA's regulations promulgated under the Clean Air Act (40 CFR Part 61, Subpart H) (EPA, 1985b).

(5) For WIPP, radiation exposure to the public for all pathways is restricted by the provisions of 40 CFR Part 191 (EPA, 1985a).

(6) DOE Order 6430.1A (DOE, 1988b) requires that nonreactor nuclear facilities be designed and sited such that for each DBA, the calculated dose to the off-site individual receiving the maximum exposure would not exceed the criteria provided.

(7) For the purpose of analysis, the off-site individual receiving maximum exposure shall be assumed to be located at the point of highest concentration (or highest exposure rate) on the boundary controlled by the site (Secured Area Boundary).

TABLE 4-2

DOE'S DERIVED CONCENTRATION GUIDES (DCG) FOR UNCONTROLLED AREAS AND CONCENTRATION GUIDES (CG) FOR CONTROLLED AREAS (μCi/ml)[1]

	DCGs FOR UNCONTROLLED AREAS		CGs FOR CONTROLLED AREAS	
NUCLIDE	AIR	WATER	AIR	WATER
^{3}H	1E-07	2E-03	5E-06	1E-01
^{7}Be	4E-08	1E-03	1E-06	5E-02
^{89}Sr	3E-10	2E-05	3E-08	3E-04
^{90}Sr (2)	9E-12	1E-06	1E-09	1E-05
^{137}Cs	4E-10	3E-06	1E-08	4E-04
^{234}U	9E-14	5E-07	1E-10	1E-04
^{235}U	1E-13	6E-07	1E-10	1E-04
^{238}U	1E-13	6E-07	7E-11	2E-05
^{238}Pu	3E-14	4E-08	2E-12	1E-04
^{239}Pu (2)	2E-14	3E-08	2E-12	1E-04
^{240}Pu	2E-14	3E-08	2E-12	1E-04
^{241}Am	2E-14	3E-08	6E-12	1E-04

(1) Guides for uncontrolled areas are based upon DOE's Radiation Protection Standard (RPS) for the general public (DOE, 1988e); those for controlled areas are based upon occupational RPSs from DOE Order 5480.11 (DOE, 1988h). Guides apply to concentrations in excess of that occurring naturally or due to fallout.

(2) Guides for ^{239}Pu and ^{90}Sr are the most appropriate to use for gross alpha and gross beta, respectively.

of the ICRP. The effective dose equivalent includes dose from both internal and external exposure. For each airborne radionuclide, the DCG is calculated by

$$DCG = RPS/(BR \cdot DCF)$$

where

RPS = 0.1 rem/year, the DOE Radiation Protection Standard

BR = 8.400 E+09 ml/year, the breathing rate for the standard man, and

DCF = Dose conversion factor giving the effective dose in rem/uCi inhaled.

Similarly, the DCGs for water-borne radioactivity are the concentrations that will result in an effective dose equivalent of 100 mrem per year if ingested continuously. They are calculated using

$$DCG = RPS/(ING \cdot DCF)$$

where

RPS = 0.1 rem/year, the DOE Radiation Protection Standard

ING = 7.3 E+05 ml/year, the rate of ingestion of drinking water for the standard man, and

DCF = Dose conversion factor giving the effective dose in rem per uCi ingested.

The DOE Radiation Protection Standard is based on consideration of the potential risk of radiation-induced fatal cancers, i.e., the ICRP risk-based system. However, a number of other radiation standards applicable to DOE are based upon a judgment of what has been found to be "as low as is reasonably achievable." Examples of these are 40 CFR Parts 61 (EPA, 1985b), 190 (EPA, 1977a), and 191 (EPA, 1985a). These "ALARA" standards are generally focused on a selected specific radiation source or exposure pathway and all are below the DOE standard.

Demonstration of compliance with requirements of DOE Order 5400.3 (DOE, 1988e) for routine releases will generally be based upon calculations which make use of information obtained from monitoring and surveillance programs. WIPP will also rely on in-place effluent monitoring, monitoring of environmental transport and diffusion conditions, and its emergency monitoring capabilities to detect, quantify, and adequately respond to unplanned releases of radioactive material to the environment. It is the intent of DOE that the monitoring and surveillance programs for DOE activities, facilities, and locations be of the highest quality.

Radioactivity in drinking water is regulated by EPA regulations contained in 40 CFR Part 141 (EPA, 1976). These regulations limit gross alpha activity (including Ra-226, but excluding radon and uranium) to 15 E-09 µCi/ml and combined Ra-226 and Ra-228 activities to 5 E-09 µCi/ml. The regulations further require that the average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem/year.

Standards have been developed to protect the environment against avoidable contamination by radioactive materials and to provide criteria for limiting doses. The capability to detect and assess unplanned releases of radioactive material and the resulting radiological consequences is also required. However, specific standards for concentrations of radioactive and chemical contaminants in soils, sediments, and foodstuffs are not available.

For chemical pollutants in drinking water, standards have been promulgated by the Environmental Protection Agency and adopted by the New Mexico Environmental Improvement Division (Table 4-3). The EPA's primary Maximum Contaminant Level (MCL) is the maximum permissible level of a contaminant in water delivered to the outlet of the ultimate user of a public water system. The EPA's secondary water standards control drinking water contaminants that primarily affect esthetic qualities associated with public acceptance of drinking water.

4.2 EXPOSURE PATHWAYS

The Final Safety Analysis Report (FSAR) (DOE, 1988a) discusses off-site doses resulting from routine operations and accidental discharges to the environment from WIPP. Estimated doses from the normal operation of WIPP were calculated

TABLE 4-3

MAXIMUM CONTAMINANT LEVELS (MCL) IN WATER SUPPLY FOR INORGANIC CHEMICALS AND RADIOCHEMICALS[1]

INORGANIC CHEMICAL CONTAMINANT	MCL (mg/l)	RADIOCHEMICAL CONTAMINANT	MCL (μCi/ml)
Primary Standard			
Ag	0.05		
As	0.05	Gross alpha[2]	15E-09
Ba	1.0	^{3}H	20E-06
Cd	0.010		
Cr	0.05		
F	4.0		
Hg	0.002		
NO_3	10		
Pb	0.05		
Se	0.01		
Secondary Standards			
Cl	250		
Cu	1.0		
Fe	0.3		
Mn	0.05		
SO_4	250		
Zn	5.0		
TDS	500		
pH	6.5 - 8.5		

(1) Source: EPA, 1976 and EPA, 1979.
(2) See text for discussion of application of gross alpha MCL and gross alpha screening level of 5E-09 μCi/ml.

using the AIRDOS-EPA computer code, for a maximally exposed hypothetical individual living at the WIPP site boundary location where the received exposure would be higher than for any other member of the general population. The WIPP site boundary is at the edge of the 16-section land withdrawal area (Figure 3-2). Doses resulting from normal operations are also estimated for the total population within an 80-kilometer (48 mile) radius of WIPP. Specific pathways by which the radioactivity can reach the population are discussed in Sections 4.3 and 4.4.

The effluent and environmental monitoring programs (Sections 5.0 and 6.0) evaluate both radiological and nonradiological parameters near effluent release points on site and at specific off-site locations. This monitoring, in conjunction with meteorological measurements, assists in establishing the relationships between radioactive effluent emissions and projected radiation doses to individuals off site via potential exposure pathways.

The WIPP facility receives and stores radioactive waste in containers, some of which may be contaminated externally. This waste and external contamination, if any, are the major sources of radioactivity that are available for release. In addition to these wastes, small quantities of solid and liquid wastes are generated on site as a result of waste handling operations. Liquid wastes are collected, solidified, and disposed of as solid wastes. Site-generated solid wastes (including solidified liquids) which meet the WIPP Waste Acceptance Criteria (WEC, 1985) are emplaced at WIPP in the same manner as wastes received from off site. Wastes will not contain significant quantities of gaseous radionuclides, such as krypton, xenon, or halogens.

Pathways from the potential source to the outside environment must exist for radioactive materials ultimately to reach man. These pathways may involve direct exposure to radioactive materials in the air or deposited on the ground. Exposure to internal organs can occur by the ingestion of intermediary organisms or water, or by inhalation of contaminated air. The facility design limits the amount of radioactivity or hazardous chemicals that could potentially reach the environment. The mechanism for transporting radionuclides through the potential pathways depends on the mobility of their chemical forms in the environment. For example, some radionuclides deposited on the soil move from the soil through microbial populations to plant roots and concentrate in edible leaves. Other radionuclides may concentrate in the organs of animals which eat the plants and in soil clinging to the roots. The effluent and environmental monitoring programs sample media from pathways that are potential routes of exposure and form a basis for the off-site dose assessment.

The potential pathways for human exposure from WIPP activities are summarized in Figure 4-1 and form a basis for selection of environmental media to be monitored and the analytical methods used in the environmental monitoring program. The pathways involve both internal and external exposure mechanisms. The most important pathway is via releases to the air. Direct releases to the soil and/or aquifers were evaluated and determined to be insignificant or not credible. Two of the air pathways, air immersion and soil deposition, can result in direct (whole body) exposure. The other pathways result in internal dose as a result of radioactive materials being taken into the body. Other pathways are more complex and involve the ingestion of intermediary organisms like beef or vegetables.

The release pathways are characterized by five parameters:

1. Physical properties of the released material,
2. Radionuclide content of the released material,
3. Location of the release,
4. Process by which the release occurs, and
5. Depletion of the released radioactivity before it enters the biosphere.

Determination of environmental impact (particularly human exposure) requires, in addition to pathway descriptions, estimates of the amount of materials released. To estimate release quantities requires consideration of container design, quality control, handling procedures, transfer procedures, and storage methods. Estimates of dose consequences from routine operations and potential accident scenarios may then be examined to verify the suitability and extent of the operational monitoring program.

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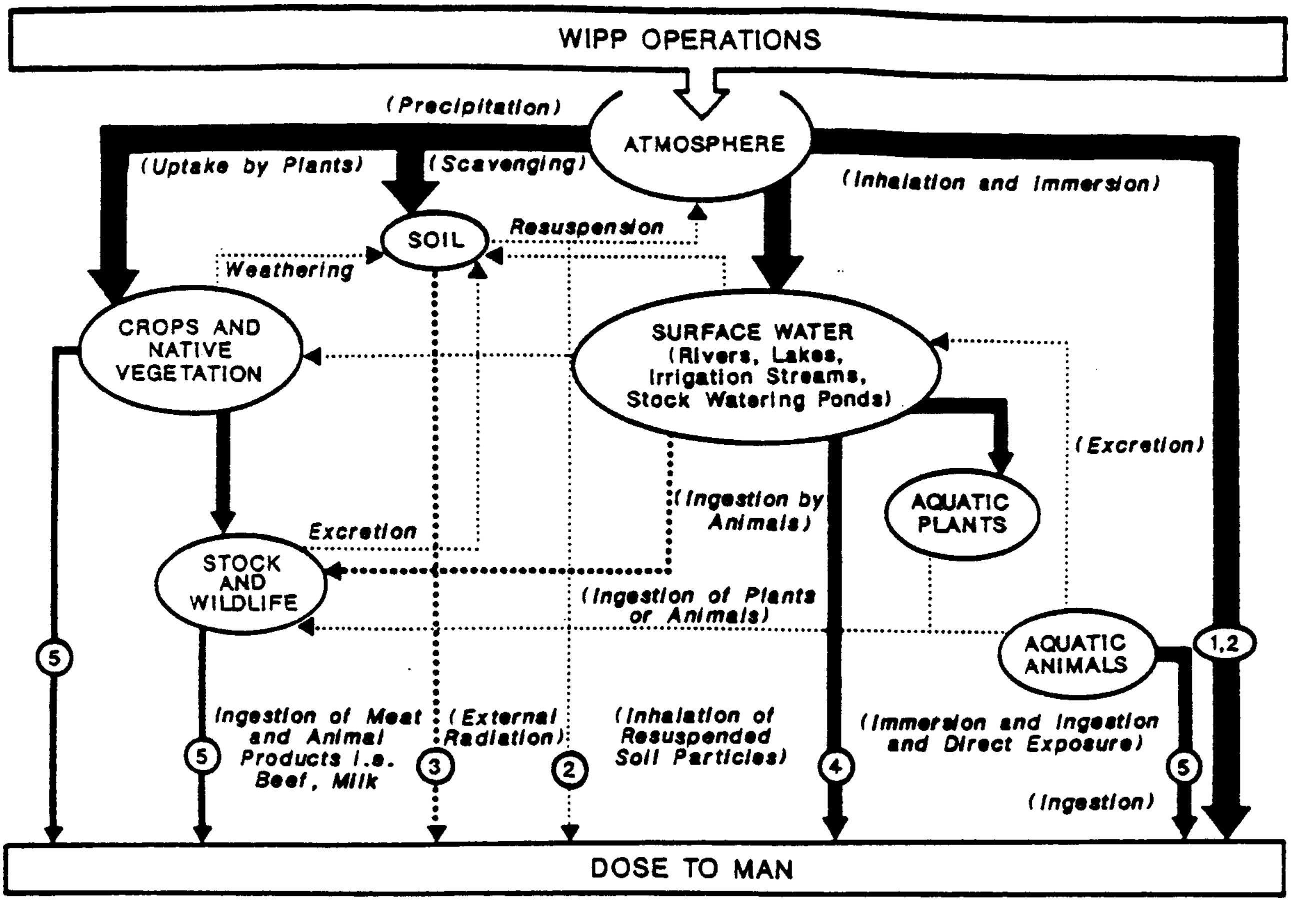


POSSIBLE RADIONUCLIDE PATHWAYS LEADING FROM THE WIPP SITE TO MAN:

THE WIDTH OF EACH LINE IS PROPORTIONAL TO THE IMPORTANCE OF THE PATHWAY IN THE LOS MEDANOS ECOSYSTEM. THE NUMBERS IN THE PATHWAYS LEADING TO MAN INDICATE WHICH MONITORING PROGRAMS WILL INTERCEPT THAT PATHWAY.

1. EXTERNAL RADIATION MONITORING
2. AIRBORNE PARTICULATE AND EFFLUENT MONITORING
3. SOIL AND SEDIMENT SAMPLING
4. SURFACE WATER AND GROUNDWATER MONITORING
5. VEGETATION, BEEF, GAME ANIMAL AND AQUATIC FOODSTUFFS SAMPLING

FIGURE 4-1 PRIMARY EXPOSURE PATHWAYS

4.3 ANTICIPATED ROUTINE RELEASES AND DOSE CONSEQUENCES

Table 4-4 summarizes the radionuclide content of the wastes which will be emplaced at the WIPP. During normal handling and storage operations at WIPP, very small amounts of radioactivity may be released. The locations where potentially contaminated air is discharged from the WIPP facilities are the Waste Handling Building (WHB) exhaust and the exhaust shaft from the underground storage area (SES). The WHB exhaust is continuously filtered through two stages of HEPA filters. The SES exhaust flows through HEPA filters only when air monitors in the storage area or the shaft detect airborne radioactivity in excess of preset limits. When the air monitors detect sufficient activity, automatic valves force the exhaust through the HEPA filter banks.

The FSAR (DOE, 1988a) discusses the development of radioactivity release quantities from normal operations. The AIRDOS-EPA computer code was then used to estimate the radiation dose to man resulting from the atmospheric releases of radionuclides from the WIPP facility. Site-specific meteorological data typical of annual average conditions were used in the above calculations. The dose calculation methodology employed by the code is further discussed in Section 9.0 of this document.

The FSAR conservatively estimates the Adult Maximum Individual Dose resulting from normal operations to be 4.8 E-05 rem/year effective dose equivalent (50 year dose commitment). The population dose was calculated to be 6.7 E-02 person-rem/year (50-year dose commitment). These doses are far below the limits established by DOE (1988e) and EPA (1985b), Table 4-1.

4.4 POTENTIAL ACCIDENT RELEASES AND DOSE CONSEQUENCES

Accident scenarios for WIPP were developed in the FSAR (DOE, 1988a) by following the course of a typical waste container from the initial receiving area to final underground storage and by reviewing the waste handling procedures. The normal operation of waste handling equipment such as forklifts and hoists were studied to determine how equipment misuse or failure could result in breaching the waste containers. The FSAR discusses postulated accident scenarios and their frequency classification for CH and RH TRU waste.

TABLE 4-4

RADIONUCLIDE CONTENT OF WIPP WASTES

RADIONUCLIDES IN WIPP WASTES	TOTAL ACTIVITY DRUMS (Ci)	TOTAL ACTIVITY BOXES (Ci)	TOTAL ACTIVITY (Ci)	TOTAL MASS DRUMS (gm)	TOTAL MASS BOXES (gm)	TOTAL MASS (gm)	PERCENT TOTAL ACTIVITY	PERCENT TOTAL MASS
Th-232	2.43E-01	3.06E-02	2.74E-01	2.23E+06	2.81E+05	2.51E+06	0.00	15.89
U-233	6.24E+03	1.48E+03	7.72E+03	6.58E+05	1.56E+05	8.14E+05	0.08	5.15
U-235	3.23E-01	4.72E-02	3.70E-01	1.51E+05	2.21E+04	1.73E+05	0.00	1.10
U-238	1.28E+00	1.89E-01	1.47E+00	3.84E+06	5.68E+05	4.41E+06	0.00	27.91
Np-237	8.01E+00	7.11E-03	8.02E+00	1.14E+04	1.01E+01	1.14E+04	0.00	0.07
Pu-238	3.87E+06	1.65E+04	3.89E+06	2.22E+05	9.48E+02	2.23E+05	42.51	1.41
Pu-239	3.13E+05	1.12E+05	4.25E+05	5.11E+06	1.83E+06	6.94E+06	4.65	43.92
Pu-240	7.12E+04	3.40E+04	1.05E+05	3.14E+05	1.50E+05	4.64E+05	1.15	2.94
Pu-241	2.51E+06	1.57E+06	4.08E+06	2.24E+04	1.40E+04	3.64E+04	44.59	0.23
Pu-242	1.13E+01	6.68E+00	1.80E+01	2.90E+03	1.71E+03	4.61E+03	0.00	0.03
Am-241	6.20E+05	1.66E+04	6.32E+05	1.91E+05	5.12E+03	1.96E+05	6.96	1.24
Cm-244	1.25E+04	1.58E+02	1.27E+04	1.50E+02	1.90E+00	1.52E+02	0.14	0.00
Cf-252	2.00E+03	2.53E+01	2.03E+03	3.72E+00	4.71E-02	3.77E+00	0.02	0.00
			9.15E+06			1.58E+07		

TOTAL NUMBER OF DRUMS 3.69E+05

TOTAL NUMBER OF BOXES 2.28E+04

As discussed previously, conservative assumptions were used to estimate quantities of radioactivity released for the various accident scenarios. The radiation dose to man was estimated using the AIRDOS-EPA computer code. Results of the dose commitment calculations from the various scenarios are provided in the FSAR. The results of the dose estimates indicate the WIPP facility complies with DOE Order 6430.1A (1988b) siting criteria noted in Table 4-1.

5.0 WIPP PREOPERATIONAL ENVIRONMENTAL CHARACTERIZATION

Since its inception, the WIPP project has included a comprehensive set of environmental programs. The efforts to establish environmental baseline conditions in the site area before the arrival of radioactive waste have been extensive and thorough. The purpose of these studies has been to characterize the local environment and to quantify environmental impacts of WIPP construction activities.

The information acquired through site characterization studies and from other research projects in the vicinity (i.e., Project Gnome) was use to develop the Radiation Baseline Program (RBP) to measure environmental background radiation levels prior to waste emplacement, and the Ecological Monitoring Program to monitor changes in ecosystem activity attributable to construction or salt-handling activities.

The two preoperational monitoring programs, completed in 1988, have been replaced by the Operational Environmental Monitoring Program (Section 6.0). Other programs especially important in the development of the OEMP are the Water Quality Sampling Program and the Cooperative Raptor Research Program.

5.1 SITE CHARACTERIZATION

Site characterization studies were initiated at the site to begin evaluating the adequacy of the site as a long-term repository and to obtain information necessary for modeling. The earlier studies which impact current WIPP environmental monitoring efforts are described below.

5.1.1 WIPP Site Characterization Program

Sandia National Laboratories, Albuquerque (SNLA) instituted a program in 1976 (Pocalujka et al., 1979, 1980a, 1980b, 1980c, 1981a, and 1981b) to monitor air quality and background radiation levels at the proposed WIPP site. The program's purpose was to characterize ambient background radiation and airborne radionuclides, and to collect data for NEPA regulatory compliance. SNLA's program included installation of a meteorological tower, establishment of seven thermoluminescent dosimeter (TLD) stations in the area, and collection of High Pressure Ionization Chamber (HPIC) and high volume air sampler (HiVol) data at the site. Soil samples were taken at the TLD locations (Brewer and Metcalf, 1977).

The FEIS (DOE, 1980) for WIPP cites a National Council on Radiation Protection and Measurement (NCRP) report (NCRP, 1975) on national background radiation. The report states that, based on aerial surveys taken between 1958 and 1963, the annual external whole-body dose rate from terrestrial sources, cosmic rays, and global fallout is estimated to be 64 mrad per year for the WIPP area. A second fly-over in 1977 confirmed the earlier aerial survey data and the surface measurements made by SNLA (DOE, 1980).

5.1.2 WIPP Biology Program

The WIPP Biology Program (Best, 1980) began in August, 1975, with baseline studies of climate, soils, vegetation, arthropods, and vertebrates. The program was expanded in late 1977 to include studies of floristics, primary productivity, plant succession, microbial biogeochemistry, and the aquatic ecosystem of the lower Pecos River. The major objectives were: 1) to acquire baseline data on the WIPP environment, including information for environmental documentation; 2) to provide data useful in the determination of possible radionuclide pathways between the WIPP facility and humans; and 3) to aid in the establishment of a long-term ecological monitoring program.

In 1980, the program was re-oriented to emphasize studies that would help predict specific environmental impacts associated with construction and operations. Soils were experimentally treated with salt and plants were trampled and grazed in order to make quantitative predictions of the effects of these potential impacts. The effects of salt on populations of arthropods and decomposition of leaf litter were also studied, because of the relatively high sensitivity of these ecosystem components and processes as possible indicators of chemical impacts. In 1984, the WIPP Biology Program was succeeded by the Ecological Monitoring Program.

5.1.3 United States Geological Survey (USGS) Studies

Before the WIPP project was proposed, the region was studied intensively by the USGS because of its potential potash (USBM, 1977; AIM, 1979) and oil and gas (Keesey, 1979) resources. At the request of DOE, the USGS has conducted investigations of the geohydrology of the WIPP area. Their research documented naturally occurring radionuclide levels in subsurface water of the three major members of the Rustler Formation. Data on gross alpha, gross beta, radium, and uranium levels in each member from a total of 20 well locations were obtained (USGS, 1983). Also, the USGS maintains a routine surface sampling program on the Pecos River (USGS, 1978-1984). Summaries of the USGS mineral, petroleum and geohydrology studies are presented in the WIPP FEIS (DOE, 1980).

Additionally, Columbia University personnel under NRC contract performed a study of radionuclide mobility in the highly saline groundwaters of the Delaware Basin, which is the area underlying the WIPP (Simpson et al., 1985). This study documented radium, uranium, thorium, and plutonium levels in groundwater and surface waters of the Delaware Basin. A summary of the data from the Columbia University study is presented in Bradshaw and Louderbough (1987).

5.1.4 Project Gnome

Although not a part of the WIPP studies, Project Gnome is also of interest when considering environmental monitoring at WIPP and the radiological history of southeastern New Mexico. In December, 1961, as part of the Plowshare Program sponsored by the Atomic Energy Commission (AEC), a three-kiloton nuclear device was detonated underground approximately 12 km (7.5 miles) southwest of the present WIPP Site (USAEC, 1962a; Lantz and Berry, 1978). The detonation and subsequent activities released some radionuclides into the surrounding environment. An aerial radiological survey of the area in 1981 indicated that the AEC's post-shot decontamination efforts had reduced radioactivity to background levels (DOE, 1981b). Radiological monitoring of air, water, and biological media was conducted by the AEC before and after the Gnome detonation (USAEC, 1962a, b, c, d).

In 1963, the AEC initiated a study of the mobility of radionuclides in the Salado Formation. As part of this study, two wells at the Gnome Site were intentionally contaminated with H-3, I-131, Sr-90, and Cs-137. The EPA annually samples these wells and others in the area of Project Gnome. Tritium values in the two wells (USGS Wells 4 and 8) are still elevated, as are levels of Strontium-90 and Cesium-137 (USAEC, 1973).

The EPA established a program in 1972 to monitor radionuclide levels in surface water and groundwater in the area potentially affected by the Project Gnome activities. Included in the program are several USGS wells, municipal water supplies for Carlsbad and Loving, New Mexico, and the Pecos River. Other wells in the area show radionuclide levels consistent with normal background activity. Results are published in EPA's "Off-Site Environmental Monitoring Reports for Nuclear Test Areas Around the United States" (EPA, 1984 and 1985c).

5.2 RADIOLOGICAL BASELINE PROGRAM (RBP)

The RBP was the successor to the WIPP Site Characterization Program described above. The primary goal of the RBP was to establish a statistically sound data base of radiological data against which operational radiation measurements will be assessed. The RBP consisted of five subprograms:

1) Atmospheric Radiation Baseline, which included eight low-volume air sampling stations where airborne particulates were continuously collected and analyzed for radioactivity and seven high-volume air sampling stations where airborne particulates were collected intermittently;

2) Ambient Radiation Baseline, which included 44 stations with thermoluminescent dosimeters and one station with a high-pressure ionization chamber to monitor penetrating radiation;

3) Terrestrial Radiation Baseline, which included 28 stations where soil samples were collected;

4) Hydrologic Radiation Baseline, which included 10 stations where surface water was collected (bottom sediments were also collected at five of these stations) and 23 wells where groundwater was collected; and

5) Biotic Baseline, which included the sampling of vegetation, rabbits, quail, beef, and fish.

As required by DOE/EP-0023 (Corley et al., 1981), the RBP radiochemical analyses included not only those nuclides expected to be released, but also the typical fallout nuclides and natural radioactivity. All major environmental media potentially affected by WIPP activities, not just those in the critical pathways, were sampled.

Data acquisition for the RBP began on June 30, 1985, in accordance with the RBP program plan (Reith and Daer, 1985). All materials (airborne particulates, water, sediments, soils, and biota) collected were analyzed for activities of naturally occurring and transuranic radionuclides by a contract analytical laboratory.

Results of the RBP are discussed in the annual WIPP Environmental Monitoring Reports (Reith et al., 1986; Banz et al., 1987; Flynn, 1988). A final compilation and assessment of the baseline radiological results will be prepared after initial receipt of waste. That report will characterize the distribution and variability of existing (both natural and man-made) radioactivity in the WIPP environs prior to receipt of waste. To date, RBP results are within expected ranges of environmental radioactivity as predicted by national consensus organizations such as the NCRP (1975, 1976) and federal agencies (DOE, 1980; EPA, 1977b).

The principal basis for the RBP sampling strategy is the pathway analysis described in the WIPP FSAR (DOE, 1988a) and summarized in Section 4.0 of this plan. Critical pathways identified in the FSAR were characterized by the five RBP subprograms (Figure 4-1). The general RBP sampling schedule and analytical array were presented in Tables 5-1 and 5-2, respectively. Sampling and related activities (logging, packaging, and shipping) were conducted as described in the Environmental Procedures Manual (WP-02-03). As appropriate, sample splits were made available to the New Mexico Environmental Evaluation Group (EEG) and were archived.

5.2.1 Atmospheric Radiation Baseline

Low volume continuous airborne particulate (LoVol) samples were taken at the eight locations shown in Figure 5-1: three inside the secured area boundary in different directions from the exhaust shaft; one at the WIPP Far Field (WFF) Site northwest of the site; one each at the K. Smith Ranch, approximately 10 kilometers (6 miles) northwest of the site, and the J. C. Mills Ranch 5.8 kilometers (3.5 miles) south of the site; and one each in Carlsbad and Eunice.

TABLE 5-1

RBP SAMPLING SCHEDULE

TYPE OF SAMPLE	SAMPLING LOCATIONS	SAMPLING FREQUENCY
Liquid Influent	1	Once
Liquid Effluent	1	Once
Aerial Gamma Survey	1	Once
Thermoluminescent Dosimeters	44	Quarterly
Exposure Rate Meter	1	Continuous
Atmospheric Particulate (LoVol)	8	Weekly
Atmospheric Particulate (HiVol)	7	Monthly
Vegetation-Radioanalysis	3	Annual
Beef	2	Once
Game Birds	1	Twice
Rabbits	1	Twice
Soil-Radioanalysis	28 (3 depths)(1)	Twice
Surface Water	10	Annual
Groundwater	23	Twice
Fish	1	Twice
Sediment	5	Annual

(1)Surface soil samples were analyzed. Soils collected at depth were archived.

TABLE 5-2

RBP ANALYTICAL ARRAY

TYPE OF SAMPLE	ANALYSIS
Liquid Influent	Specific Radionuclides
Liquid Effluent	Specific Radionuclides
Aerial Gamma Survey	Penetrating Radiation
Thermoluminescent Dosimeters	Penetrating Radiation
Exposure Rate Meter	Penetrating Radiation
Atmospheric Particulate	Gross α, Gross β, TSP, Specific Radionuclides
Vegetation Radioanalysis	Specific Radionuclides
Beef	Specific Radionuclides
Game Birds	Specific Radionuclides
Rabbits	Specific Radionuclides
Soil Radioanalysis	Specific Radionuclides
Surface Water	^{3}H, Specific Radionuclides
Groundwater	^{3}H, Specific Radionuclides
Fish	Specific Radionuclides
Sediment	Specific Radionuclides

TSP = Total Suspended Particulates

Specific Radionulides = ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{233}U, ^{241}Am, ^{243}Am, ^{232}Th, ^{244}Cm, ^{237}Np, ^{226}Ra, ^{137}Cs, ^{90}Sr, ^{40}K, ^{60}Co, U_{nat}, Th_{nat}

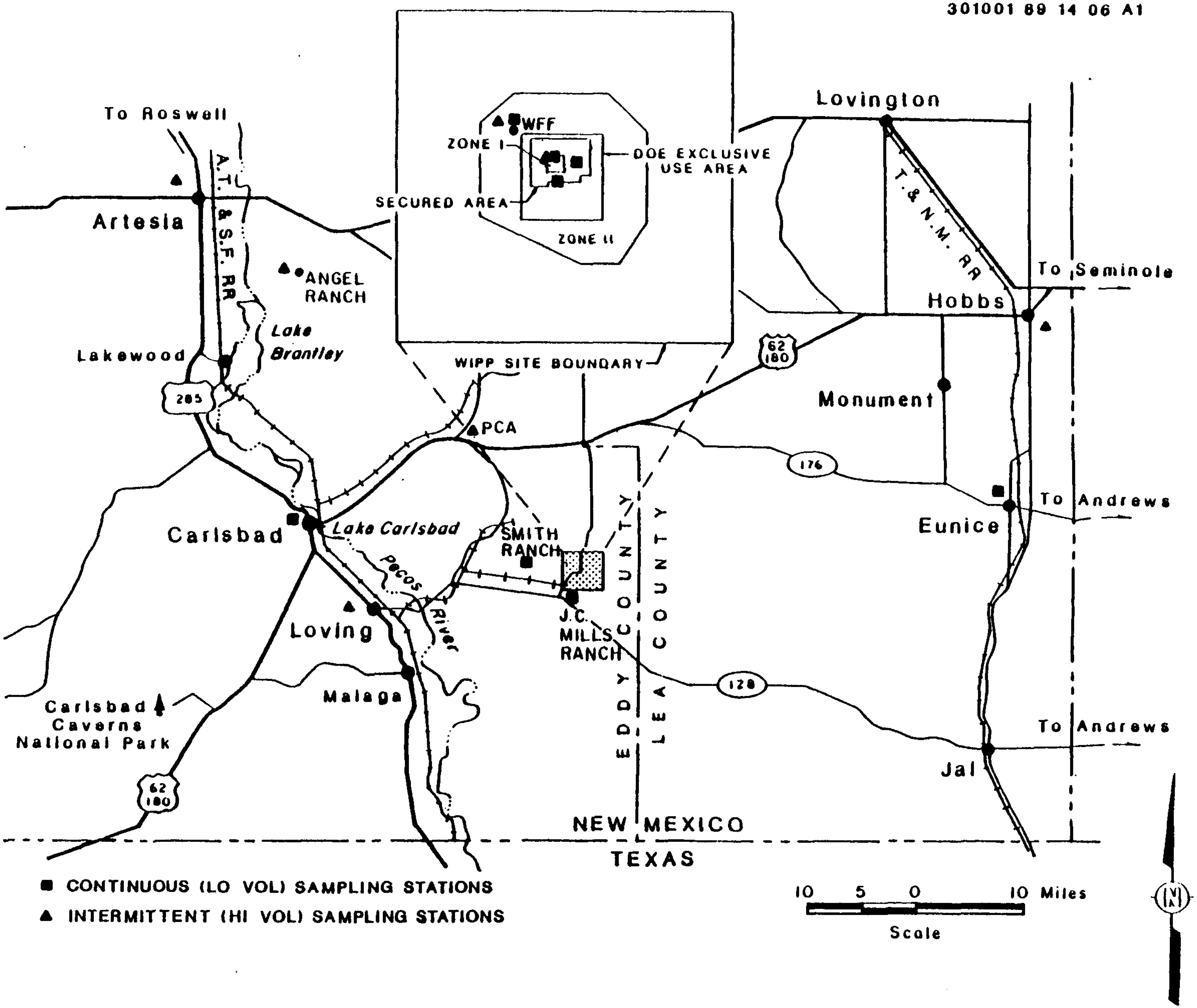


FIGURE 5-1 RBP AIRBORNE PARTICULATE SAMPLING STATIONS

Filters were collected weekly and shipped to an off-site analytical laboratory for a gross alpha and gross beta count. Quarterly composites from each location were analyzed by gamma spectroscopy. The filter composites then underwent destructive radiochemical analysis for the specific alpha and beta emitters indicated in Table 5-2.

Gross alpha and beta measurements are used for screening purposes only. Gross alpha activity has shown little variation through 1987 and has consistently been in the range of 1 to 3 E-15 uCi/ml. The WIPP northwest site, located just inside the perimeter fence next to the parking lot, shows somewhat greater fluctuations, probably as a result of variable particulate loading from road dust. Gross beta activity has fluctuated throughout the year at all locations, typically within the range of 1 to 4 E-15 uCi/ml (a peak of 3.8 E-13 was observed after the Chernobyl accident). Results of the gamma spectrometry and radiochemical analyses have indicated that transuranic radionuclide concentrations are not significantly different from the analytical lower limit of detection. Other radionuclide activities are within expected environmental ranges. Air sampling data are summarized in the WIPP annual environmental monitoring reports (Reith et al., 1986; Banz et al., 1987; Flynn, 1988).

Figure 5-1 also indicates seven locations where aerosols have been sampled intermittently with high volume air samplers (HiVols). Initially, 24-hour HiVol samples were collected weekly at all seven locations. After about a year of data collection, the sampling frequency was reduced to monthly.

5.2.2 Ambient Radiation Baseline

TLD packages were used to measure penetrating (gamma) radiation levels at numerous locations in and around the WIPP site (Figure 5-2). TLD packages were collected quarterly and evaluated by the TMA/Eberline Corporation in Albuquerque, New Mexico. TLD data are summarized in the site annual environmental monitoring reports (Reith et al., 1986; Banz et al., 1987; Flynn, 1988).

The RBP included a network of 44 TLD locations (Figure 5-2). Seven of these dosimeters were at locations also monitored by SNLA in order to determine the correlation between the SNLA and RBP dosimetry data. The remaining 37 TLDs

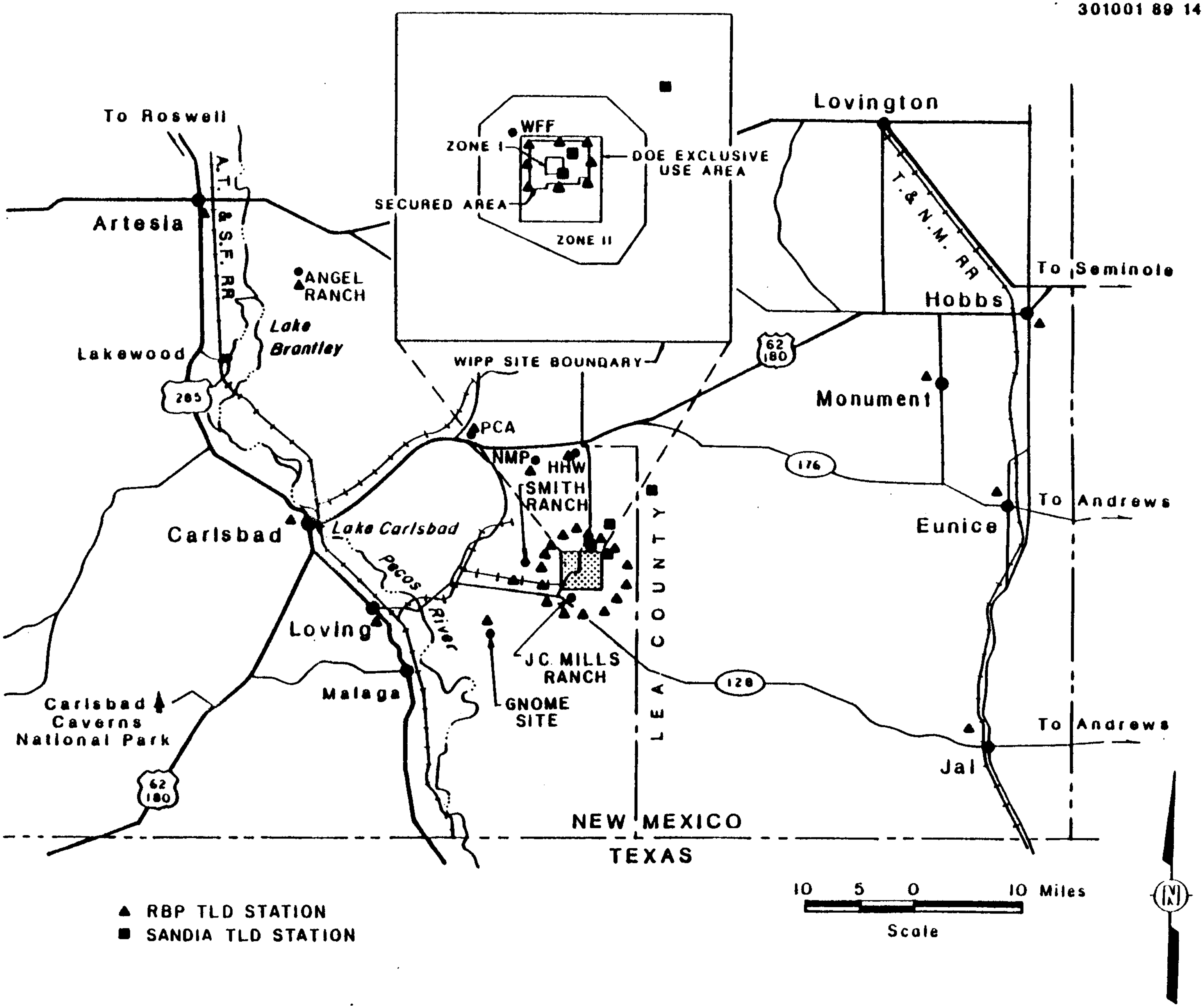


FIGURE 5-2 RBP THERMOLUMINESCENT DOSIMETER (TLD) LOCATIONS

were located at: the Gnome site; in the principal downwind direction; at the eight principal compass points at the security fence boundary; at the 16 major points of the compass at a distance of about eight kilometers (five miles) from the site; near the major population centers around the site; at private ranches near the site; and where specifically requested by local citizens. The rationale for location of the TLD sampling stations is presented in Reith and Daer (1985). The estimated annual averages of the TLD data, about 36 mrem, have been consistently lower than other data for the area.

A continuous exposure rate meter, designed to monitor low levels of gamma radiation in the environment, operated between 1986 and 1988 at the northwest corner of Zone I. The data (summarized in Banz et al., 1987, and Flynn, 1988) average about 7.5 uR/h, indicating an estimated annual gamma exposure of approximately 66 mrem. These data are consistent with the SNLA TLD and Project Gnome data, but are significantly higher than the annual exposure estimated from the RBP TLD data.

As recommended in DOE/EP-0023 (Corley et al., 1981), an Aerial Measurement Survey (AMS) has been conducted as part of the WIPP baseline program. The AMS provided gamma radiation mapping of the WIPP site, the transportation corridors and the Project Gnome site.

5.2.3 Terrestrial Radiation Baseline

Soil samples have been collected at 28 dosimeter stations on three occasions during the RBP (Figure 5-3). Samples were collected at three depths at each location (0 to 2, 2 to 5, and 5 to 10 cm). Radionuclide concentrations in RBP soil samples fell within expected ranges (NCRP, 1976) and did not indicate unexpected environmental radioactivity. Soil sample data are presented in the site annual environmental monitoring reports (Reith et al., 1986; Banz et al., 1987; Flynn, 1988).

5.2.4 Hydrologic Radiation Baseline

This subprogram was designed to determine baseline radiation levels in surface bodies of water, bottom sediments, and groundwater. Surface water and sediments were sampled annually at the locations indicated in Figure 5-4. Data from surface water sampling did not show unusual levels of environmental

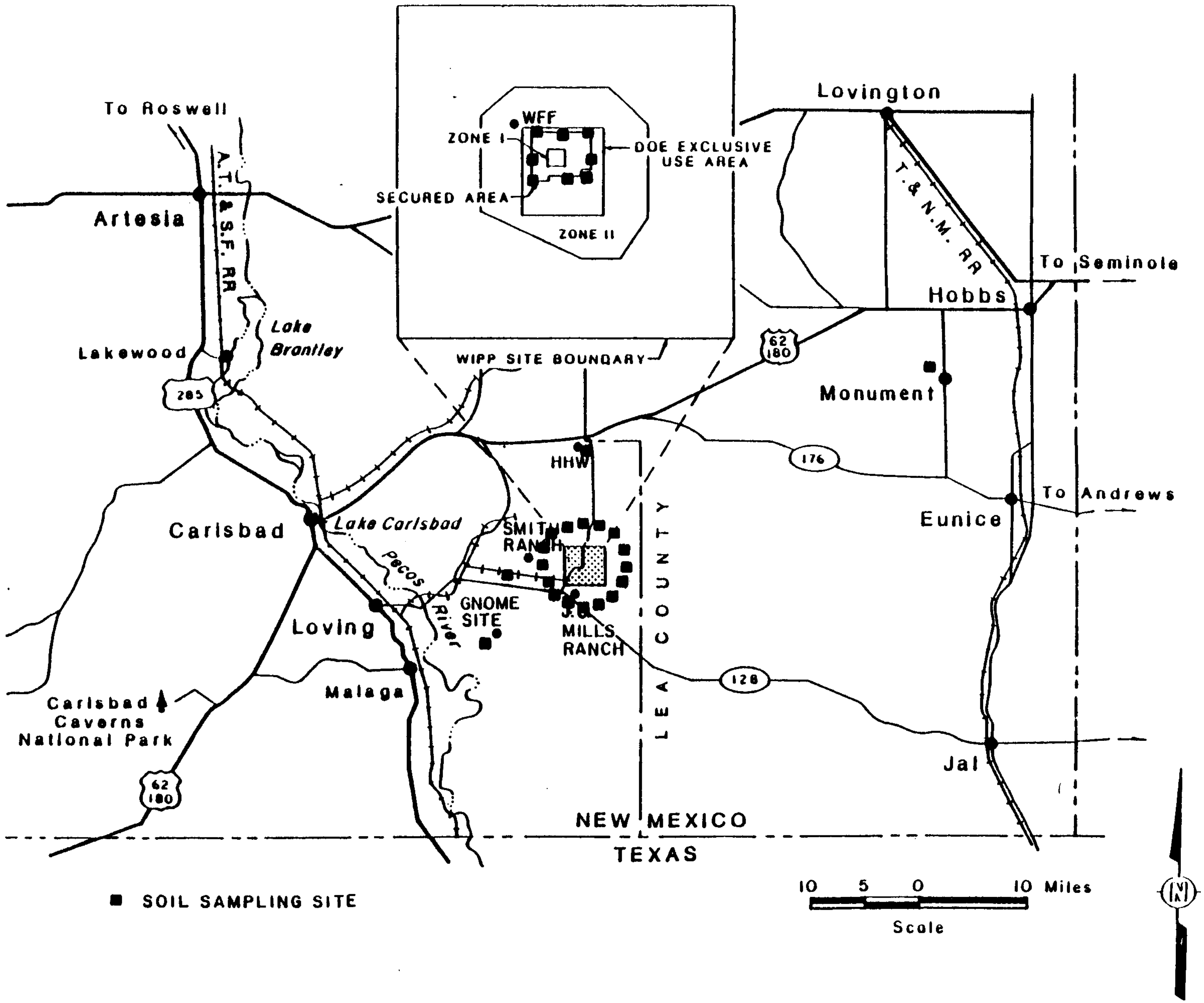


FIGURE 5-3 RBP SOIL SAMPLING LOCATIONS

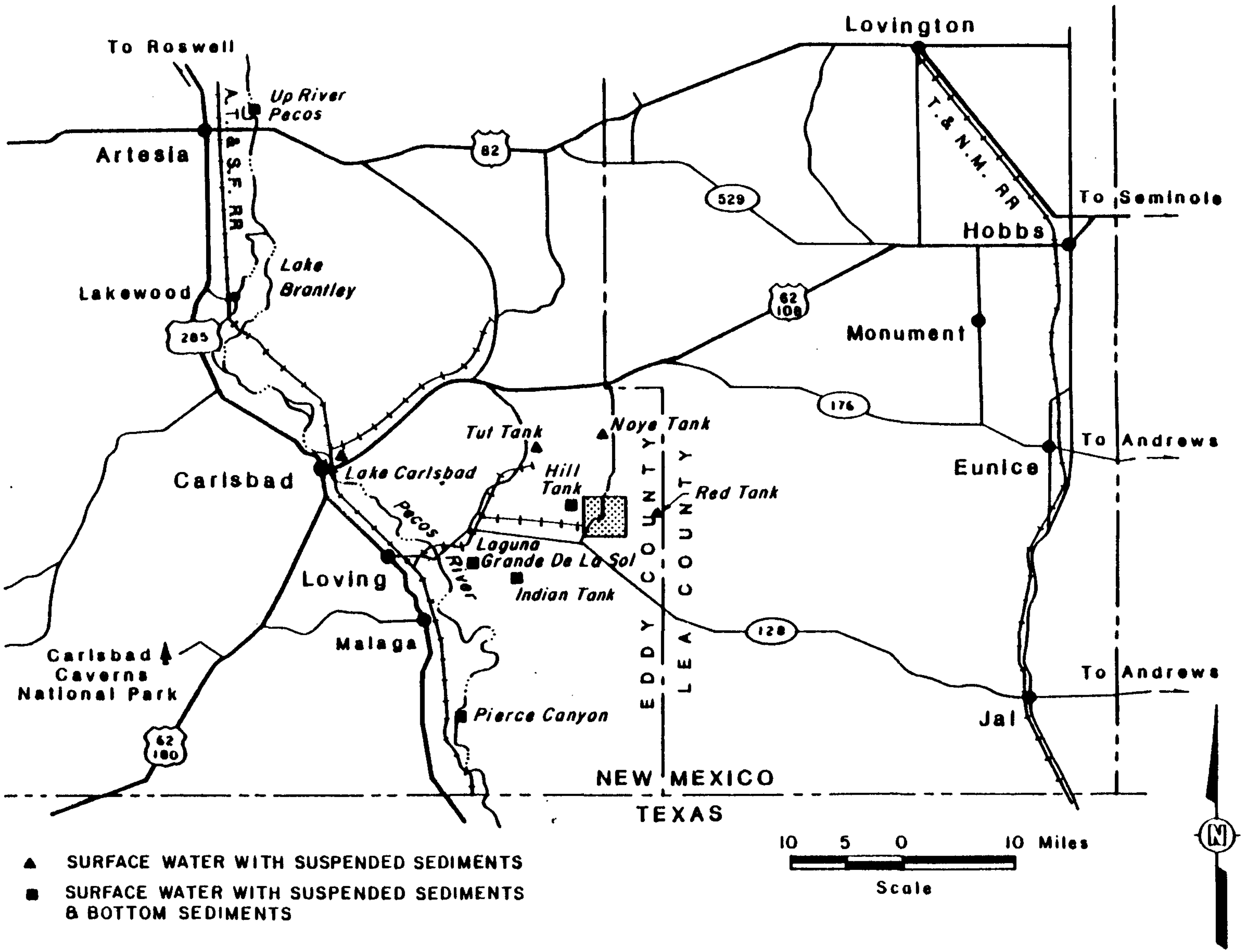


FIGURE 5-4 RBP SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

radioactivity. Sediment sample results indicated concentrations of cesium, radium and uranium above that of the surface waters, but within expected environmental radioactivity ranges (NCRP, 1976).

Figure 5-5 indicates groundwater sampling locations for the Water Quality Sampling Program (WQSP) which were analyzed for the RBP, and include several privately owned wells that supply drinking water for livestock and two that supply water for human consumption (Barn Well and Twin Wells). Sample splits were provided to the New Mexico EEG for independent analyses. Analytical results from samples collected prior to the WQSP agreed favorably with those obtained by the WQSP (Mercer, 1983; Simpson et al., 1985).

Surface water, groundwater, and sediment sample data are presented in the annual WIPP Environmental Monitoring Reports (Reith et al., 1986; Banz et al., 1987; Flynn, 1988).

5.2.5 Biotic Radiation Baseline

This subprogram characterized background radiation levels in biotic organisms along possible pathways to man (Figure 4-1). Vegetation, rabbits, quail, beef, and fish are potential exposure pathways and were sampled and analyzed for concentrations of transuranic and naturally occurring radionuclides. The rationale for the samples and their locations is discussed in Reith and Daer (1985). Biotic samples were collected in 1986 and 1987 from the locations shown in Figure 5-6. Analyses do not show concentrations of radionuclides in excess of those routinely encountered in environmental sampling (Banz et al., 1987; Flynn, 1988).

5.3 ECOLOGICAL MONITORING PROGRAM (EMP)

DOE Order 5400.1 (1988d) requires the characterization of ecological parameters during the preoperational environmental monitoring efforts. The EMP was the functional successor to the WIPP Biology Program which was initiated in 1975 to perform baseline nonradiological ecological studies before the start of WIPP construction. Table 5-3 indicates parameters which have been monitored by this program for evidence of possible site impacts, and Figure 6-11 shows the locations of the seven permanent ecological monitoring plots

TABLE 5-3

ECOLOGICAL MONITORING PROGRAM PARAMETERS

TYPE	PARAMETER(S)	MEASUREMENT FREQUENCY
General Environmental Monitoring		
Meteorology	Temperature (at 2 m)(1)	Continuous
	Wind Speed (at 10 m)	Continuous
	Wind Direction (at 10 m)	Continuous
	Precipitation	Daily
	Barometric Pressure	Continuous
	Relative Humidity	Continuous
Aerial Photography	Area of Land Disturbed	Annually
Air Quality	Pollutant Gas Concentration (O_3, CO, H_2S, SO_2, NO_x)	Continuous
	Total Suspended Particulates	Weekly
Water Quality	General Chemistry and Pollutants (Chemical Constituents)(2)	Annually
Wildlife Populations	Breeding Bird Density	Annually
	Small Mammal Density	Annually
Salt Impact Studies		
Soil Chemistry	pH, EC, Na, Cl, Mg, Ca, K	Quarterly
Soil Microbiota	Microbial Activity Level	Quarterly
	Leaf Litter Decomposition	Quarterly
Vegetation	Foliar Coverage	Biannually
	Annual Plant Density	Biannually
	Species Richness	Annually
Surface Photography	Visual Impacts	Biannually

(1) Height expressed in meters above ground level.

(2) Chemical Constituents = Chloride, iron, manganese, phenols, sodium, sulfate, pH, specific conductance, total organic carbon, total organic halogen, arsenic, barium, cadmium, chromium, fluoride, lead, mercury, nitrate, selenium, silver, volatile hazardous substances, semi-volatile hazardous substances, PCBs.

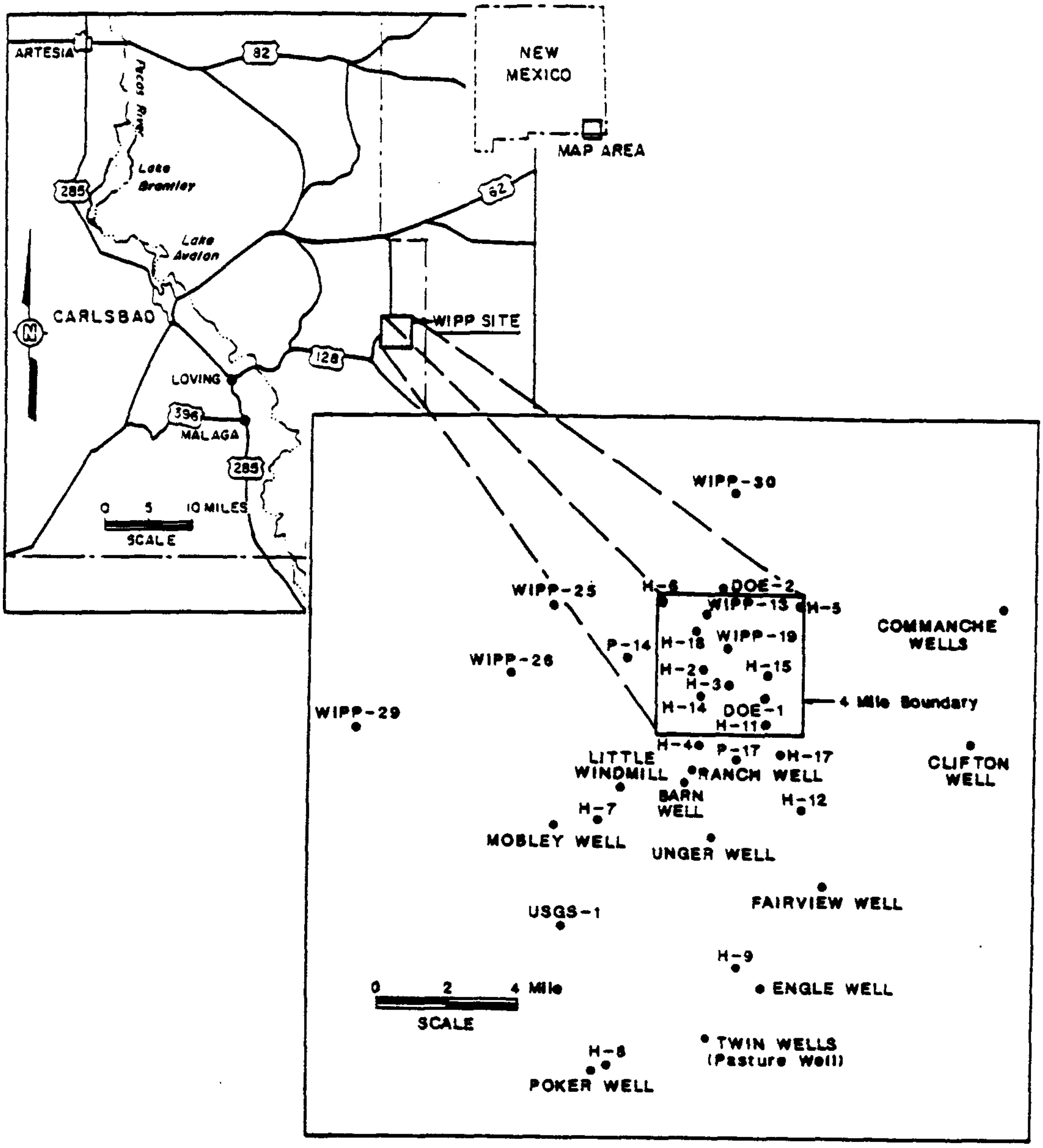


FIGURE 5-5 RBP GROUNDWATER SAMPLING LOCATIONS

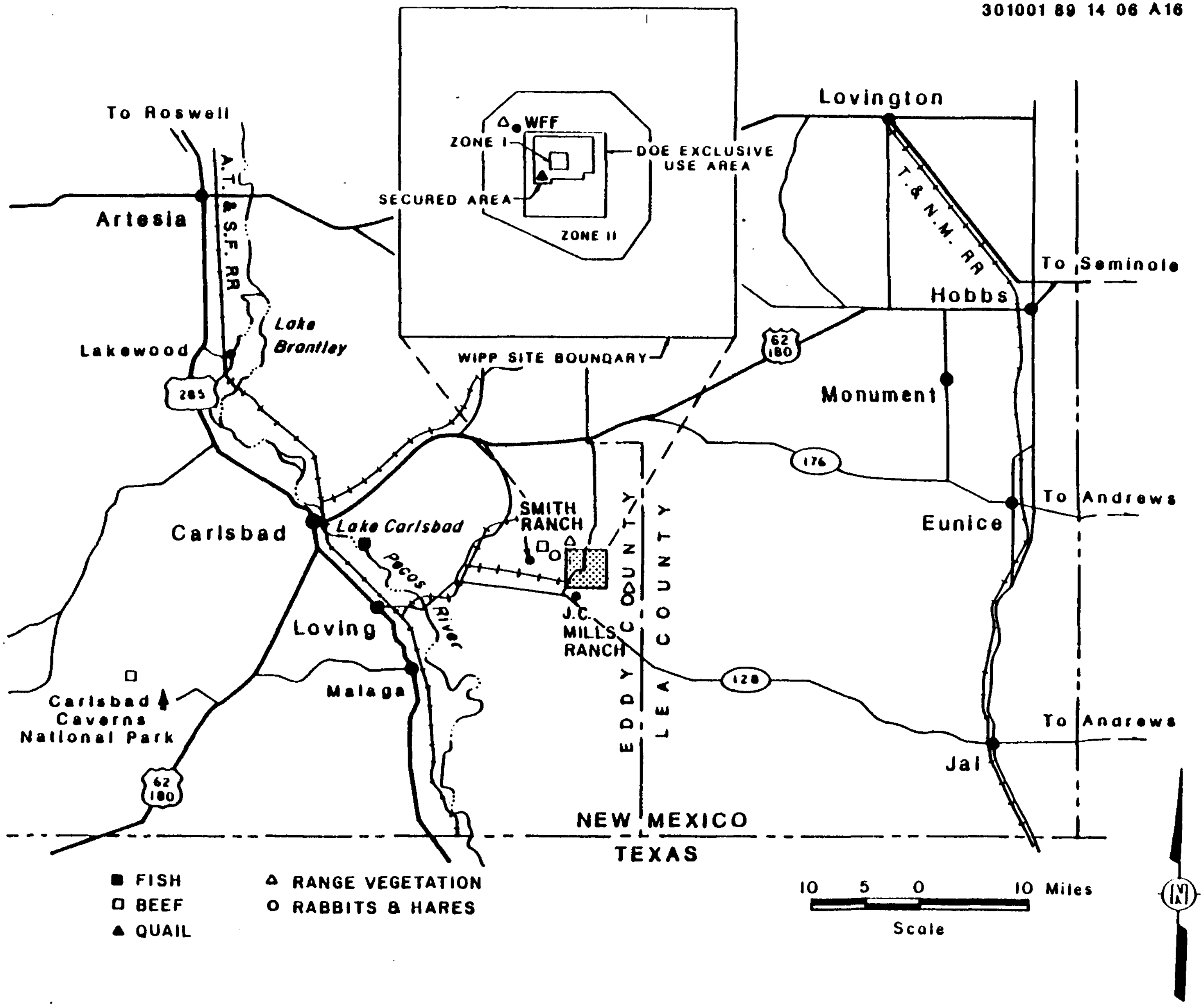


FIGURE 5-6 RBP BIOTIC BASELINE SAMPLING LOCATIONS

which have been incorporated into the OEMP. Sampling for the EMP focused on the vegetation and animal communities immediately surrounding the site and on the ecological parameters most likely to reflect the impact of construction and operational activities. The EMP consisted of six subprograms:

Meteorology: Temperature, relative humidity, barometric pressure, precipitation, and wind speed and direction were continuously monitored at the site.

Air Quality: Atmospheric gases (H_2S, SO_2, CO, O_3, and NO_x) were continuously monitored at the site. Total suspended particulates were measured weekly from LoVol filters collected at the Far Field location (WFF).

Water Quality: Surface water, groundwater, and sediments were periodically sampled to determine the impact of WIPP construction on water bodies in the vicinity.

Aerial Photography: Aerial photographs were taken twice a year to document changes in the extent of land use and habitat disturbance.

Vertebrate Census: Breeding bird and small mammal populations were surveyed annually to monitor for WIPP-related changes in population densities.

Salt Impact Studies: Four subprograms were included as follows:

Surface Photography: Surface photographs were taken semiannually in each permanent monitoring plot to document alteration of habitat structure.

Soil Chemistry: Soil samples were collected at three depths (0 to 2 cm, 30 to 45 cm and 60 to 75 cm) and analyzed for direct evidence of salt-related chemical changes in the soil.

Soil Microbiota: Microbial activity levels and decomposition rates were monitored in recognition of the role these organisms play in maintaining energy flow through the ecosystem and their sensitivity to chemical changes in the soil.

Vegetation Survey: Foliar cover, species composition and the density of annuals were monitored for indications of salt impacts on native vegetation in the ecosystem.

In general, the EMP has shown no significant environmental impacts attributable to WIPP. Results of the EMP have been published in the Ecological Monitoring Program reports (Reith et al., 1985; Fischer et al., 1985; Fischer, 1987 and 1988).

5.3.1 Meteorological Monitoring

Weather information has been recorded to supplement characterization of the local environment and facilitate the interpretation of data from other environmental activities at WIPP. Meteorological conditions were monitored by SNLA around the WIPP site from 1975 through 1980.

Between 1984 and 1988, temperature, wind speed, wind direction, and precipitation were continuously monitored at a 10-meter (33 feet) mast at the northeast corner of Zone I. Weather data have been presented in the Annual Ecological Monitoring reports and summarized in the Annual Site Environmental Monitoring report prepared at the end of each calendar year in accordance with DOE Order 5484.1B (DOE, 1986b). In 1987, barometric pressure and relative humidity were added to the monitoring program.

5.3.2 Air Quality

This subprogram measured concentrations of airborne particulates and atmospheric gasses such as carbon monoxide, hydrogen sulfide, sulfur dioxide, nitrogen oxides, and ozone. These parameters were measured by SNLA between 1975 and 1980, and were monitored at the northwestern corner of the Zone I boundary. No long-term effects on air quality have been recorded during the construction phase; however, occasional short-term gas concentrations above the State of New Mexico air quality standards have been recorded for ozone, sulfur dioxide, and hydrogen sulfide. Although the elevated level of hydrogen sulfide was probably due to the close proximity of the monitoring station to freshly paved areas of the site during the summer of 1988, sources for the other gasses have not been identified.

5.3.3 Water Quality

This subprogram monitored both surface water and groundwater for impacts to water quality resulting from WIPP activities. Also, a data base of the chemical and physical conditions of surface water and groundwater was obtained to assist interpretation of data from other environmental monitoring programs such as the RBP. Surface water samples were collected annually from the locations specified in Figure 5-4. In addition to the radioanalyses indicated in Table 5-2, water samples from Red Tank, Hill Tank, Indian Tank and Laguna Grande were analyzed for the chemical constituents identified in Table 5-3.

Groundwater samples have been collected at locations identified in Figure 5-5, and data have been summarized in the annual Ecological Monitoring Program reports (Reith et al., 1985; Fischer et al., 1985; Fischer, 1987 and 1988). In general, the water quality data have compared favorably from one sampling episode to the next.

5.3.4 Aerial Photography

Semiannual low-level aerial photographs of the site and vicinity monitored visually detectable impacts of the facility and provide a chronological record of these impacts. Aerial photography of the facility reveals that approximately 66 hectares (163 acres) of land has been disturbed by WIPP construction. This is approximately 12 hectares (30 acres) less than the amount of disturbance predicted in the Final Environmental Impact Statement (DOE, 1980).

5.3.5 Vertebrate Census

Selected wildlife populations were surveyed annually to determine the effects of WIPP construction activities and resultant habitat modifications on natural populations of wildlife species. Breeding densities are reported for each bird species in the Ecological Monitoring Program annual reports, as are the species densities for small mammals.

An increase in the number of "flycatcher" bird species near the facility compared to the more distant control locations was found in both 1986 and 1987. This increase was probably due to habitat changes, such as the greater availability of perches and nest sites from buildings, fences, and pipes, and to the greater availability of insect food attracted to the lights around the site. Also, in 1986 and 1987 a decline in small mammal populations from 1985 levels in all locations was observed. Because of the widespread nature of the phenomenon, this is believed to be a natural cyclical decline and not related to WIPP activities.

5.3.6 Salt Impact Studies

The salt impact studies consisted of four subprograms whose purpose was to ascertain the impacts of the surface storage of mined salt on the local soil and vegetation.

5.3.6.1 Surface Photography

A panoramic series of photographs was taken from the center of each of the permanent ecological monitoring plots semiannually. These photographs provide a chronological record of the visual impacts of the overall WIPP project and especially the surface storage of salt.

5.3.6.2 Soil Chemistry

The soil survey subprogram monitored soil changes at varying distances and directions from the two salt storage piles. Quarterly surface and annual subsurface samples were analyzed to monitor changes in electrical conductivity (EC), pH, and cation concentrations which may indicate that salt is being transported from WIPP facilities. Results of this program are reported in the annual ecological monitoring reports. The studies have indicated that only limited dispersal of salt from the surface storage piles occurred. Concentrations of water-soluble ions (sodium, chloride, potassium, magnesium, and calcium) in the surface soil are seasonally elevated within 200 meters (660 feet) of the salt piles; however, summer rains flush these ions from the soil surface.

5.3.6.3 Soil Microbial Studies

Soil microbial studies monitored the level of microbial activity as measured by the fluorescein diacetate (FDA) hydrolysis assay and the rate of litter decomposition in the ecological monitoring plots. As reported in the annual ecological monitoring reports, no inhibition of microbial activity levels or microbial decomposition rates have been detected in the ecological monitoring plots.

5.3.6.4 Vegetation Survey

Vegetation in the monitoring plots has been surveyed in the spring and fall to detect impacts of salt transport and the resultant changes in soil chemistry on extant vascular plants. This subprogram monitored foliar cover for all species, density of annual species, species richness, and the structure of the vegetation community in the ecological monitoring plots. The data presented in the annual ecological monitoring reports indicate that the impacts of WIPP construction and salt storage on the vegetation in the surrounding ecosystem are minimal (Fischer, 1988).

5.4 WATER QUALITY SAMPLING PROGRAM

The Water Quality Sampling Program (WQSP) was initiated in January 1985 to collect reproducible and representative groundwater samples from three water-bearing zones in the vicinity of the WIPP site. The Water Quality Sampling Manual (WP 07-2) provides information concerning the wells sampled and the types of analyses performed for the program. Water samples were analyzed for vaious parameters including general chemistry, metals, gases, redox-couples, radionuclides, and organics.

The WQSP data supported the site characterization, performance assessment [compliance with 40 CFR Part 191 (EPA, 1985a)], and the Radiological Baseline and Ecological Monitoring Programs at WIPP. The state EEG was provided water samples from each location for independent analysis.

Generally, each program required a unique and different set of analyses but overlaps of analytical needs occurred (i.e., one set of analyses served several programs). The particular set of analyses performed on the water samples to support a given program was defined by the need and requirements of the program rather than the WQSP.

5.5 COOPERATIVE RAPTOR RESEARCH AND MANAGEMENT PROGRAM

In 1985, the Los Medanos Cooperative Raptor Research and Management Program was initiated under the sponsorship of the U.S. Department of Energy with support from the U.S. Bureau of Land Management and the Living Desert State Park. This program is independent of the Ecological and Environmental Monitoring Programs at the WIPP facility. Part of the goal of this study, conducted by researchers from the University of New Mexico, is to evaluate the impacts of WIPP activities on the breeding success of raptors (e.g., hawks and owls) which are found in unusual abundance in the vicinity. Experiments are also being conducted to determine how these impacts may be mitigated.

Results from 1986 (Bednarz, 1987) indicate that adverse impacts on nest success resulting from human intrusion during critical times in the nesting cycle are measurably reduced by slightly modifying field work schedules to accommodate nesting activities. When nests have been found in locations potentially threatened by a nearby work area (such as a well pad) the Regulatory and

Environmental Programs Section at WIPP has been notified and the scheduled use of the work area is examined. When possible, work schedules are modified to minimize impacts on the nest.

In 1986, ten artificial nest platforms were constructed and installed near the site to determine the potential for improving nesting habitat in locations removed from areas of human activity and disturbance. Some of these structures were used successfully by Chihuahuan ravens during 1987. During the summer of 1987, one nest was used by a pair of great horned owls which successfully fledged three young. Another nest was used by a pair of Harris' hawks and one young fledged.

Winter population estimates of diurnal raptors in the study area dropped substantially from the 1985-86 to the 1986-87 count periods. However, during the 1987-88 count period, the measured population increased beyond the 1985-86 levels (Bednarz and Hayden, 1988). The raptor population changes were ascribed to changes in prey populations rather than to any direct influence of WIPP activities.

6.0 OPERATIONAL ENVIRONMENTAL MONITORING PROGRAM

DOE/EP-0023, A Guide for Environmental Radiological Surveillance at DOE Installations (Corley et al., 1981), states that the factors which should be considered in determining the relative level of environmental surveillance required at a facility include:

(1) the potential hazard of the materials released, considering both expected quantities and relative radiotoxicities (the 'graded effort' concept);

(2) the extent to which facility operations are routine and unchanging;

(3) the need for supplementing and complementing effluent monitoring;

(4) the size and distribution of the exposed population;

(5) the cost-effectiveness of increments to the environmental surveillance program;

(6) the availability of measurement techniques which will provide sufficiently sensitive comparisons with applicable standard and background measurements.

The above guidance, the risk analysis in the Final Safety Analysis Report (FSAR) (DOE, 1988a), and the dose criteria in Draft DOE Order 5400.3 (DOE, 1988e), indicate that the operational dose estimates for the WIPP are significantly below dose criteria levels, and therefore that only a relatively small environmental surveillance effort would be required at WIPP. However, the purpose of the WIPP is to demonstrate that the long-term disposal of transuranic waste in bedded salt can be accomplished safely and that the natural environment will not be significantly impacted as a result of the construction and operation of the disposal facility. Because of the research and development aspects of the WIPP mission, and because of the commitments discussed in the Final Environmental Impact Statement (FEIS) (DOE, 1980) to the State of New Mexico, the public, and the scientific communities, a thorough and extensive monitoring effort is proposed for WIPP operations. The WIPP Operational Environmental Monitoring Program (OEMP) will monitor a comprehensive set of parameters in order to detect and quantify any present or future environmental impacts. It is also critical to the success and credibility of the program that the individual monitoring efforts remain flexible. As required in DOE Order 5400.1 (DOE, 1988d), the OEMP will be reviewed annually. The OEMP scope and intensity will be adjusted in response to changing facility processes, environmental parameters, and program results.

Parameters measured include ambient radiation levels, atmospheric conditions, air and water quality, soil properties, and the status of the local biological community. Nonradiological portions of the program focus on the immediate area surrounding the site, whereas radiological surveillance generally covers a broader geographic area including nearby ranches, villages, and cities. Environmental monitoring will continue at the site during project operations and through decommissioning activities.

The Radiological Baseline Program (RBP) and the Ecological Monitoring Program (EMP) were discussed in Section 5.0. A final review and assessment of the results of the RBP and EMP will be prepared. These preoperational monitoring programs have been incorporated, as appropriate, into one operational program, the OEMP.

The goal of the OEMP is to determine whether there are impacts during the operational phase of WIPP on the local ecosystem and, if so, to evaluate their severity, geographic extent, and environmental significance. Tables 6-1 and 6-2 summarize the OEMP sampling schedule and analytical array. The tables list the sample types, the number of sampling stations, the approximate sampling schedule and the environmental/ecological parameters to be monitored or analyzed. As previously noted, it is important to emphasize the need for flexibility in the design and implementation of the OEMP. Additional or different types of samples will be collected and analyzed as necessary to investigate and explain trends or anomalies that may have a bearing on the WIPP's environmental impacts. The OEMP radiological sampling and analysis schedule is less extensive than that of the RBP. Baseline conditions were characterized by the RBP prior to waste emplacement at WIPP. RBP sampling was extensive because additional baseline data cannot be collected after wastes arrive. Environmental and ecological sampling during operations will be increased if warranted.

As recommended in DOE/EP-0023 (Corley et al., 1981), the OEMP monitors levels of naturally occurring radionuclides and those associated with world-wide

TABLE 6-1

OEMP SAMPLING SCHEDULE

TYPE OF SAMPLE	SAMPLING LOCATIONS	SAMPLING FREQUENCY
Liquid Influent	1	Semiannual
Liquid Effluent	1	Semiannual
Airborne Effluent	3	Continuous
Meteorology	2	Continuous
Thermoluminescent Dosimeters	22	Quarterly
Exposure Rate Meter	1	Continuous
Atmospheric Particulate	7	Weekly
Air Quality	1	Continuous
Vegetation-Radioanalysis	4	Annual
Beef	2	Annual*
Game Birds	2	Annual
Rabbits	2	Annual
Soil-Radioanalysis	7	Biennial
Surface Water	8	Annual
Groundwater	14	Annual
Fish	2	Annual
Sediment	6	Biennial
Aerial Photography	Site Wide	Annual
Salt Impact Studies		
Surface Photography	7	Biannual
Soil Chemistry	7	Quarterly
Soil Microbiota	7	Semiannual
Vegetation Survey	7	Biannual
Wildlife Survey	4	Annual

*If available (see Section 6.4.5).

TABLE 6-2

OEMP ANALYTICAL ARRAY

TYPE OF SAMPLE	ANALYSIS
Liquid Influent	Gross α, Gross β, pH, TSS, Specific Radionuclides
Liquid Effluent	Gross α, Gross β, pH, TSS, Specific Radionuclides, Chemical Constituents
Airborne Effluent	Gross α, Gross β, Specific Radionuclides
Meteorology	Temperature, Wind Speed, Wind Direction, Precipitation, Dew Point, Barometric Pressure
Thermoluminescent Dosimeters	Penetrating Radiation
Exposure Rate Meter	Penetrating Radiation
Atmospheric Particulate	Gross α, Gross β, TSP, Specific Radionuclides
Air Quality	O_3, CO, H_2S, SO_2, NO_x
Vegetation Radioanalysis	Specific Radionuclides
Beef	Specific Radionuclides
Game Birds	Specific Radionuclides
Rabbits	Specific Radionuclides
Soil Radioanalysis	Gross α, Gross β, Specific Radionuclides
Surface Water	*Gross α, Gross β, Specific Radionuclides, TSS, pH
Groundwater	Specific Radionuclides, pH
Fish	Specific Radionuclides
Sediment	Gross α, Gross β, Specific Radionuclides
Aerial Photography	Area of Land Disturbed

TABLE 6-2
OEMP ANALYTICAL ARRAY
(CONTINUED)

TYPE OF SAMPLE	ANALYSIS
Salt Impact Study	
Surface Photography	Visual Impacts
Soil Chemistry	pH, EC, Na, Cl, Mg, Ca, K
Soil Microbiota	Microbial Activity, Litter Decomposition
Vegetation Survey	Foliar Coverage, Species Richness, Annual Plant Density
Wildlife Survey	Bird and Small Mammal Population Densities

TSS = Total Suspended Solids
TSP = Total Suspended Particulates
EC = Electrical Conductivity
Specific Radionulides = ^{238}Pu, $^{239/240}Pu$, ^{241}Pu, ^{233}U, ^{235}U, ^{241}Am, ^{232}Th, ^{226}Ra, ^{137}Cs, ^{90}Sr, ^{40}K, ^{7}Be, ^{60}Co, U_{nat}, Th_{nat}
Chemical Constituents = Chloride, iron, manganese, phenols, sodium, sulfate, pH, specific conductance, total organic carbon, total organic halogen, arsenic, barium, cadmium, chromium, fluoride, lead, mercury, nitrate, selenium, silver, endrin, methoxychlor, toxaphene, 2,4-D, 2,4,5-T silvex.

*In addition, surface water samples from Hill Tank and Red Tank will be analyze for the above chemical constituents biennially.

fallout in addition to those expected in the WIPP wastes. The geographic scope of radiological sampling is based on projections of potential release pathways for the types of radionuclides in the WIPP wastes. Also, the surrounding population centers are monitored even though release scenarios involving radiation doses to residents of those population centers are improbable. Ecological sampling activities will continue to be performed at the permanent ecological monitoring plots, whose locations are unchanged from the earlier EMP.

The general sampling schedule is presented in Table 6-1. Sampling and related activities (logging, packaging, and shipping) are conducted in accordance with the procedures and instructions described in the WIPP Environmental Procedures Manual (WP 02-03). Standard sampling practices and techniques are utilized (see Section 7.0). Most samples are analyzed by a commercial laboratory selected using a prequalifying program. Sample splits are made available to the New Mexico Environmental Evaluation Group (EEG) and some are archived. Quality assurance/quality control has been established within the framework of the overall Westinghouse Quality Program Manual (WP 07-02) and is described in Section 11.0 of this Operational Environmental Monitoring Plan.

6.1 EFFLUENT MONITORING - LIQUID RELEASES

DOE Order 5400.xy, "Requirements for Radiological Effluent Monitoring and Environmental Surveillance for U.S. DOE Operations" (DOE, 1988f), requires that monitoring of liquid waste effluent streams be adequate to demonstrate compliance with dose limits in DOE Order 5400.3, "Radiation Protection of the Public and the Environment" (DOE, 1988e). Liquid effluent monitoring is also required to quantify radionuclides released and to alert process operators of process upsets and malfunction of emission controls.

The only credible source of waste-generated liquid contamination at WIPP is the Waste Handling Building (WHB). There is no direct connection between the WHB and the sewage system; therefore, there is no direct pathway for radioactive or hazardous contaminants associated with the TRU wastes to enter the WIPP sewage system. There is a sump in the WHB which collects liquids, e.g., fire sprinkler water, from throughout the WHB. Water collected in the sump will be sampled and analyzed for radioactive contamination as shown in Table

6-2. If the water is not contaminated in excess of DOE environmental discharge limits, it will be removed to the sewage system for normal treatment. If contamination is found, the sump water will be stabilized and disposed of as routine WIPP wastes in the salt storage beds.

The sewer system discharges into the stabilization lagoons shown in Figure 6-1. The operation of this system is described in detail in Section 2.6.1 of the WIPP Facility Operations Manual (WP 04-1). Influents to the lagoon and the effluent pond are sampled as required by the above operating procedures and analyzed for pH, dissolved oxygen, and temperature for purposes of process control. Sewage system effluent water samples are collected semiannually from the effluent pond (Figure 6-1) and analyzed for radioactive and chemical constituents as listed in Table 6-2 in order to comply with the requirements of DOE Order 5400.xy (DOE, 1988f). The water supplied to WIPP is also sampled semiannually to monitor differences between the influent and effluent. A sediment sample will be collected biennially (every two years) from the location shown in Figure 6-1 and analyzed in accordance with Table 6-2.

If solids build-up in the sewage lagoon presents a problem at any time during operations, representative samples of the solids will be collected and analyzed for the parameters listed in Table 6-2 for liquid effluent. Based on the analytical results, appropriate methods of handling and disposing of the solids material will be determined.

6.2 EFFLUENT MONITORING - AIRBORNE EMISSIONS

The FSAR (DOE, 1988a) states that airborne contamination is the most significant potential human exposure pathway from WIPP operations. Therefore, airborne effluent monitoring is especially important to the WIPP OEMP. There are two potentially significant sources of contaminated airborne emissions from WIPP operations: releases generated aboveground in Waste Handling Building operations and those generated underground which are released through the Storage Exhaust Shaft (Figure 6-2). As required by DOE Order 5400.xy (DOE, 1988f) both potential sources will be monitored continuously. Monitoring will commence prior to receipt of waste.

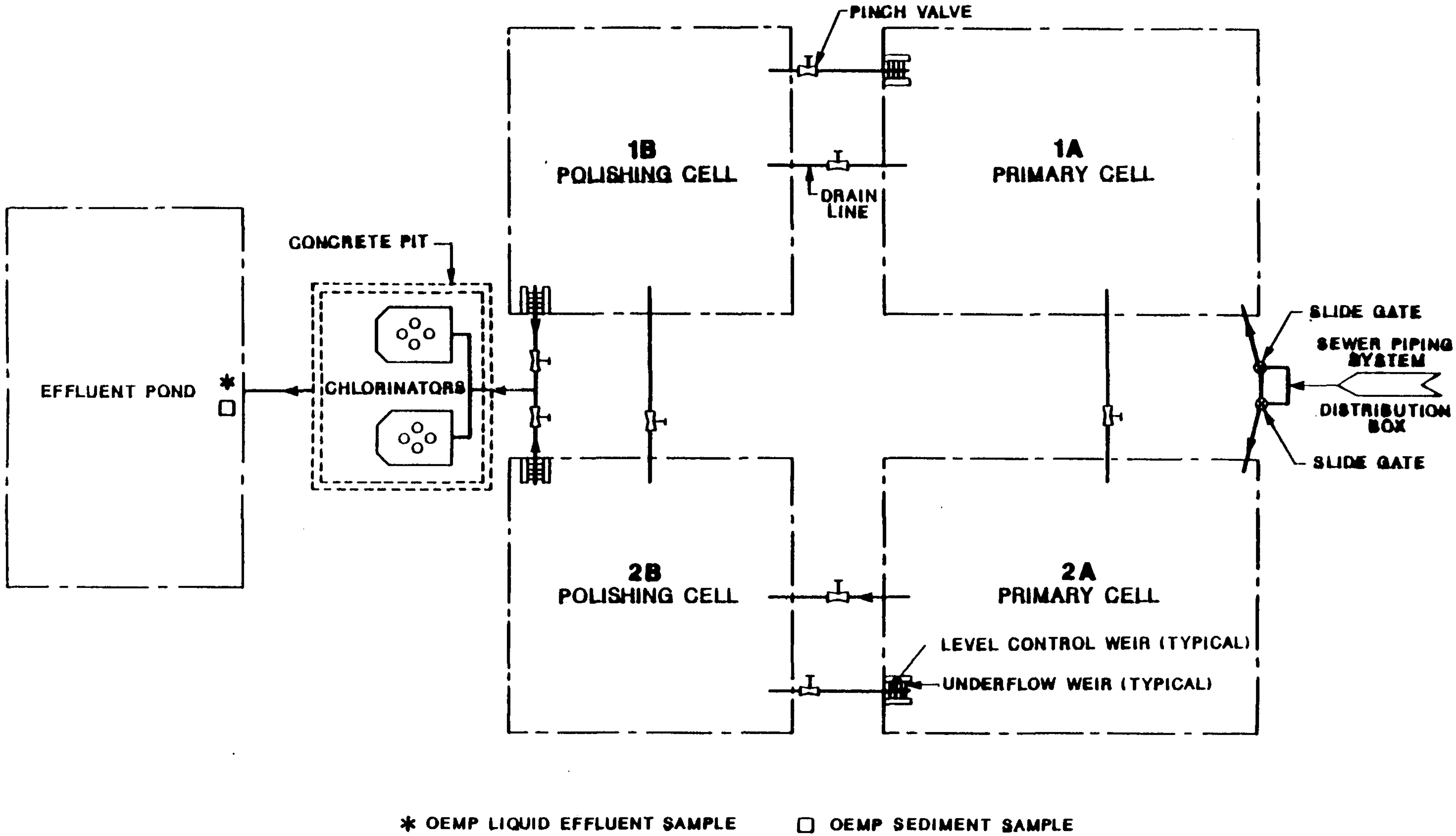


FIGURE 6-1 SCHEMATIC DRAWING OF THE STABILIZATION LAGOON

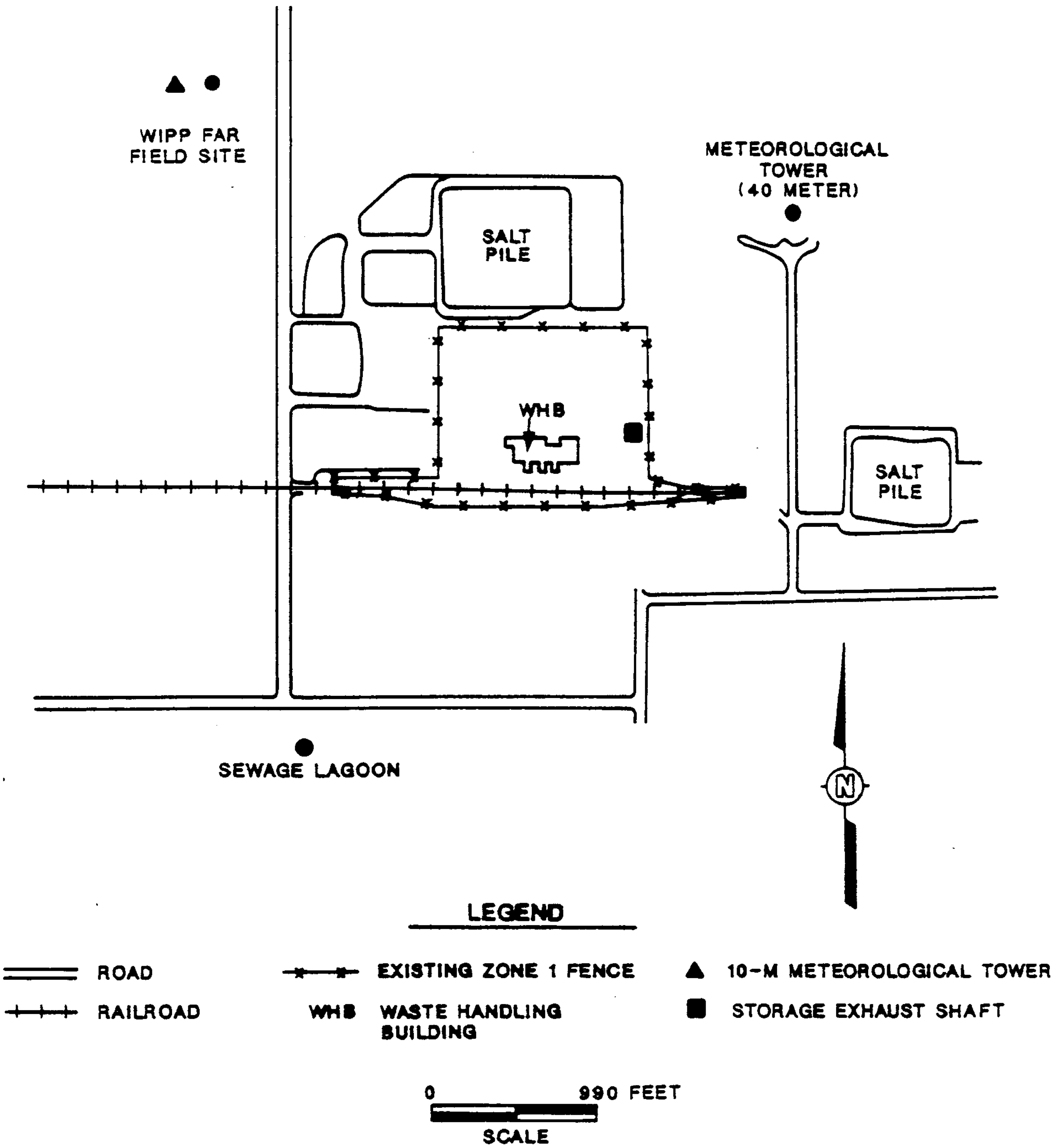


FIGURE 6-2 OEMP EFFLUENT DISCHARGE AND METEOROLOGICAL MONITORING LOCATIONS

Two monitoring stations, A and B, sample exhaust from the underground operations. Sample extraction probes monitor the unfiltered exhaust stream in the exhaust shaft (Station A), and monitor the filtered exhaust stream in the Exhaust Filter Building (Station B). The filtered exhaust will have passed through HEPA filter banks prior to reaching the sample extraction probes at Station B. Because of the large amounts of salt dust in the air-stream, standard isokinetic sampling probes are ineffective. Therefore, an anisokinetic shrouded probe system has been designed, developed and tested specifically for use at WIPP.

Station A, in the exhaust shaft, consists of three sampling arrays. Sampling array number 1 is composed of an anisokinetic shrouded probe, a mass flow measuring device, and a three-way splitter which diverts samples to an alpha continuous air monitor (CAM), a beta-gamma CAM, and a fixed air sampler (FAS). Sampling array number 2 consists of an anisokinetic probe, a mass flow measuring device, and a three-way splitter which connects to a FAS for use only when a contamination incident triggers the HEPA filter dampers. The three-way splitter is necessary to maintain a constant sampling geometry. Only one leg of the splitter is utilized for sampling purposes. The third array is configured the same as array number 2, but is on line continuously. This array will be connected to a single FAS used by the State of New Mexico State EEG.

Station B, in the Exhaust Filter Building, consists of two shrouded extraction probes. One probe connects to a mass flow measuring device and a three-way splitter which delivers samples to an alpha CAM, a beta-gamma CAM, and a FAS. The other probe is configured the same as sample array number 3 at Station A and delivers a sample to a FAS operated by the State of New Mexico EEG.

The exhaust air from the WHB will be continuously routed through two stages of HEPA filters. After the air is filtered, it will be sampled with an isokinetich sampling system connected to an alpha CAM, a beta-gamma CAM, and a FAS. Readouts and alarms from the CAMs register at the Central Monitoring Station (CMS) in the Support Building. Continuous data is also recorded in the CMS. After receipt of waste, filters from the FAS systems will be exchanged weekly and counted for gross alpha and gross beta before being sent to an off-site lab for the specific radionuclide analyses listed in Table 6-2. A mass flow measuring system, consisting of an array of thermal anemometers, provides velocity control for the isokinetic sampling system and records the total air effluent from the WHB.

6.3 METEOROLOGICAL MONITORING

DOE Order 5400.xy (DOE, 1988f) requires each DOE site to establish a meteorological monitoring program appropriate for the activities at the site and the local topography and demography. Weather data must be monitored and recorded to supplement characterization of the local environment and facilitate the interpretation of data from other environmental monitoring activities at WIPP. Meteorological conditions were monitored by SNLA at WIPP from 1975 through 1980. Between 1984 and 1988, temperature, wind speed, and wind direction were continuously monitored from a 10-meter (33 feet) mast at the northwest corner of Zone I. Equipment to monitor precipitation, barometric pressure, and humidity were added to this station during that period.

Use of the 10-meter (33 feet) tower as the primary meteorological monitoring station was discontinued in 1988, and the 10-meter station was relocated to the WIPP Far Field (WFF) sampling location (Figure 6-2) along with the air quality monitoring station and the Reuter-Stokes pressurized ionization chamber. The WFF is in the predominantly downwind direction from the WIPP exhaust releases and is the principal air quality sampling location for the OEMP.

The principal meteorological monitoring station during the operational period is a 40-meter (132 feet) tower located northeast of WIPP as shown in Figure 6-2. Temperature, wind speed, and wind direction are monitored at 3, 10, and 40 meters (10, 33, and 132 feet). Barometric pressure, dew point, and precipitation are also monitored at this location. Measurements are recorded at the CMS, which tracks numerous real-time parameters on a centralized computer system.

6.4 ENVIRONMENTAL SURVEILLANCE

The environmental surveillance program will continue to measure, with some modifications, the parameters monitored during the RBP and EMP described in Section 5.0. Each sampling subprogram of the OEMP is described below.

6.4.1 External Radiation

As shown in Figure 4-1, the most significant potential pathway for radiation exposure from WIPP operations is associated with airborne releases. The principal radioactive components of wastes coming to WIPP, listed in Table 4-4, are actinides. The actinides are primarily alpha emitting radionuclides and therefore are not effectively monitored by penetrating radiation sensitive monitoring equipment such as thermoluminescent dosimeters or pressurized ionization chambers. However, the presence of some fission and activation products in the waste, such as Cs-137 and Co-60, do warrant an environmental monitoring program for external radiation.

Thermoluminescent Dosimetry

Thermoluminescent dosimeters (TLDs) are used to measure penetrating (gamma) radiation levels in and around the WIPP site. TLD packages containing four lithium fluoride (LiF) chips are installed approximately one meter (3.3 feet) above ground level. Dosimeter packages for the RBP were provided and evaluated by Eberline Corporation in Albuquerque, New Mexico. However, WIPP has been directed by DOE/AL to establish its own in-house dosimetry system for both the operational environmental and occupational exposure monitoring programs. A Harshaw model 4400 manual system is used for analyzing the OEMP environmental dosimeters. The Eberline and Harshaw dosimeters will be used in parallel until the Harshaw system is running smoothly to establish comparability between the baseline and operational TLD programs.

Initially, TLDs will be exchanged and evaluated quarterly as in the RBP, and a study will be conducted to determine whether a change to a semiannual exchange schedule is warranted. A semiannual exchange would provide better statistical data, but may pose other problems such as loss of accuracy over the time period or retrievability. For at least a year, an additional TLD package will be placed at each location. These additional TLDs will be exchanged semiannually instead of quarterly. The data will be evaluated and a report generated at the end of the study. On the basis of the results of the study, a decision as to whether a quarterly or a semiannual exchange is warranted will be made and implemented.

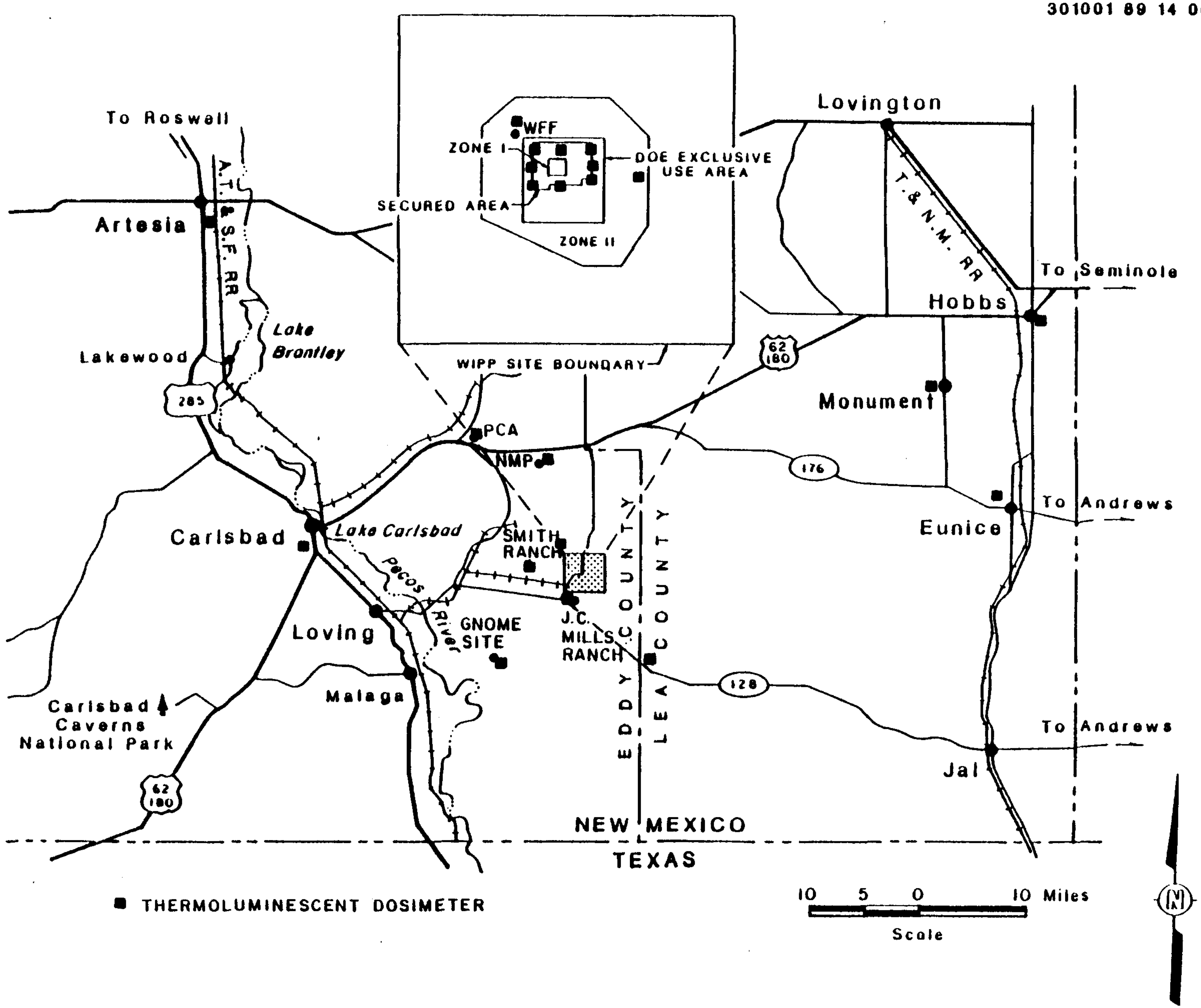


FIGURE 6-3 OEMP THERMOLUMINESCENT DOSIMETER LOCATIONS

During the OEMP, TLDs will be located at 22 of the previously established RBP sites in a pattern based on meteorological and demographic considerations (Figure 6-3). This array will provide TLD coverage: 1) in the principal downwind direction northwest of the site; 2) east and northeast, which are downwind during the strong spring winds; 3) southeast along New Mexico Highway 128 as a background or control site; 4) at the Project Gnome site ; 5) near the major population centers; 6) at private ranches; and 7) as specifically requested by local citizens. These 22 locations include a TLD station at each air monitoring station, as recommended in DOE/EP-0023 (Corley et al., 1981) (Figures 6-3 and 6-4).

Continuous Exposure Rate

DOE/EP-0023 (Corley et al., 1981) recommends:

> For the monitoring of intermittent or unplanned releases, and for better identification of source terms, exposure-rate instrumentation should be available. . . . The deployment of at least one continuously-recording exposure-rate instrument is recommended, preferably near the site boundary, to provide detection and approximate magnitude of sudden changes in airborne natural radioactivity, fresh fallout, or other unmonitored sources, and to verify dispersion calculations.

A Reuter Stokes, model RSS-1012, high-pressure ionization chamber (HPIC) was established at the WFF site in November 1988. The WFF is the primary environmental monitoring location for WIPP releases. The HPIC provides a detection range of 1 uR/h to 100 uR/h. Estimates of approximately 66 mrem for annual background gamma dose equivalent were obtained during the RBP from the HPIC data collected at the Zone I boundary north of the exhaust shaft. The 66 mrem value is comparable to the background radiation levels determined from post-Project Gnome monitoring activities and SNLA dosimetry studies.

6.4.2 Airborne Particulates

The FSAR (DOE, 1988a) identifies the atmospheric pathway as the most significant exposure pathway to man from WIPP. Therefore, airborne particulate sampling for alpha-emitting radionuclides is emphasized in the OEMP. Air sampling results will be used to evaluate potential doses to environmental populations from inhaled or ingested radionuclides or from external radiation. The inhalation of airborne radionuclides, either directly from the source (facility) or from resuspension following deposition, may result in their absorption from the lung, the gastro-intestinal tract, or the skin. Absorption and subsequent distribution in the human body depends on the particle size and the chemical state of the radionuclide.

DOE/EP-0023 (Corley et al., 1981) recommends that:

> As a minimum, five air samplers should be utilized for each DOE site with potential airborne releases. . . . These would include: a background or control location, three sites at locations of maximum predicted ground level concentration from stack (or vent) releases, averaged over a period of one year, and a single location in the nearest community within a 15 km radius of the site.

Low volume (about two cubic feet per minute) fixed air samplers (LoVols) are used to collect airborne particulates. As recommended in DOE/EP-0023, the samplers are, where possible, located approximately 1.5 meters (five feet) above ground level in sites free from unusual micrometeorological or other conditions (e.g., proximity of large buildings, vehicular traffic) which could result in air concentration measurements that are artificially high or low. The Carlsbad and Eunice stations are currently located on top of municipal buildings, primarily to provide greater equipment security. However, an attempt will be made to find more suitable sites for those stations. If better sites are found, comparability will be established by running air samplers at both the present and new sites. After comparability is adequately demonstrated, the present sites will be discontinued.

The OEMP LoVol sampling array (Figure 6-4) consists of seven sampling stations, the locations of which are based primarily on meteorological and demographic considerations and the need to provide as much continuity as possible between baseline and operational data. LoVol samplers remain at Carlsbad, Eunice, Smith Ranch, Mills Ranch, and the WFF sites. The RBP locations inside the secured area will no longer be required because the exhausts of the Waste Handling Building and the Exhaust Shaft will be sampled directly, and the RBP locations have been determined by means of AIRDOS-EPA to be too near the exhaust locations to representatively monitor releases. The RBP LoVol station at the east boundary of the secured area (Figure 5-1) is now located about one kilometer east of the storage exhaust shaft to better monitor the SES exhaust.

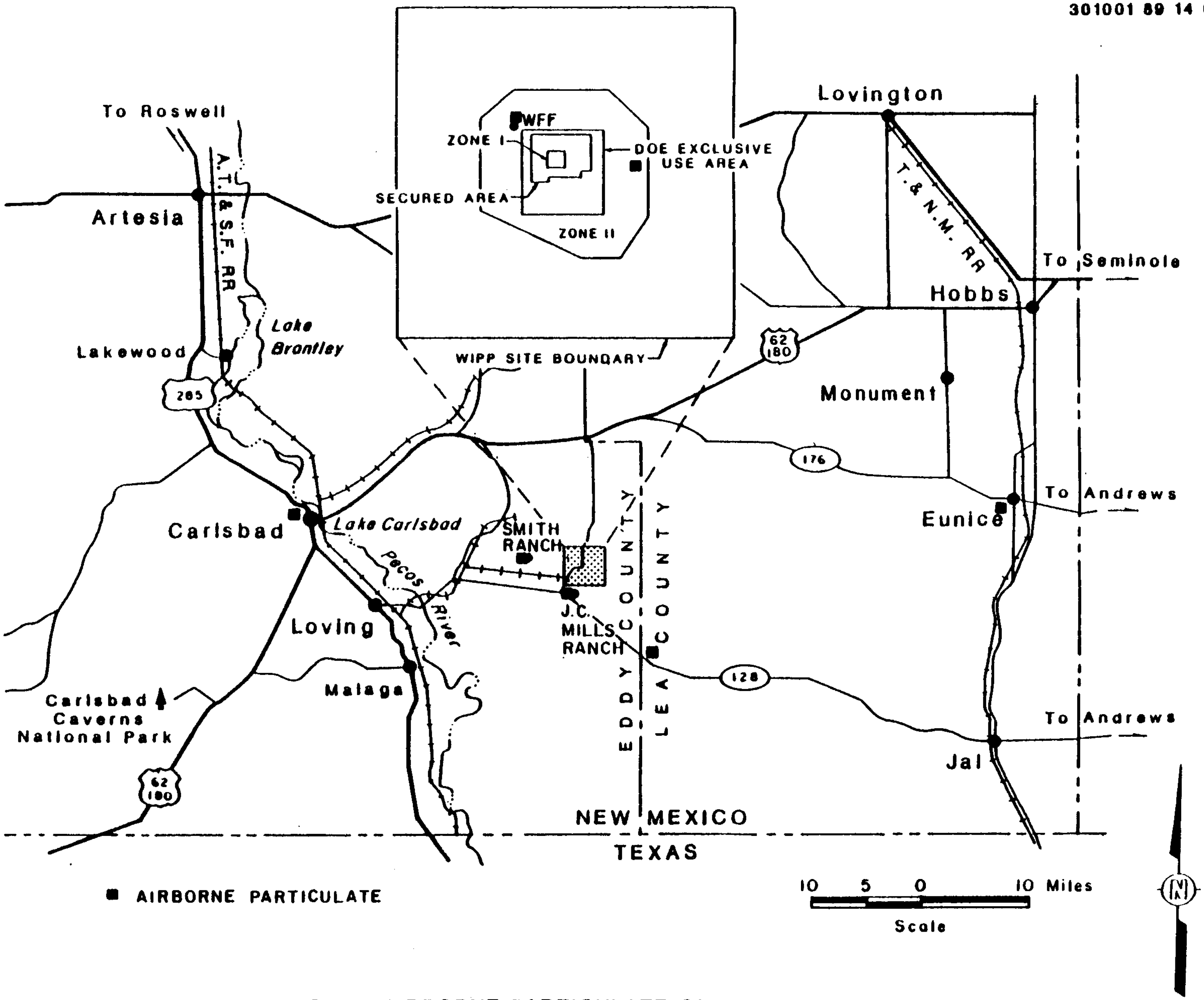


FIGURE 6-4 OEMP AIRBORNE PARTICULATE SAMPLING STATIONS

Until comparability with background data is established, the east boundary site and the new site will be run in parallel. Finally, as recommended in DOE/EP-0023 (Corley et al., 1981), a background sampling station is located about 20 kilometers (12.4 miles) southeast of WIPP near State Highway 128. Comparability will be established between the new location along State Highway 128 and the RBP sampling location in the security area south of the exhaust shaft before the RBP sampler is discontinued.

LoVol filters are exchanged weekly, weighed to estimate total suspended particulates and individually counted for gross radioactivity levels. Quarterly composites of filters from each location undergo specific radionuclide analysis in accordance with Table 6-2. Analyses are performed by a qualified outside contractor laboratory.

During the RBP, HiVols were used to sample particulates on an intermittent basis at the seven locations indicated in Figure 5-3. Weekly samples were initially collected at all locations; however, after approximately a year, the sampling frequency was decreased to monthly. An evaluation of the HiVol data collected to date will be performed and based on the results of that evaluation, a decision will be made whether to continue collecting these samples. Based on a cursory and preliminary review of the data, the intermittent HiVol samplers will not be used routinely in the OEMP, but will make up part of the WIPP emergency response capability. The samplers will remain at their present locations (Figure 5-1) and, if needed, they will be utilized to monitor accidental releases.

6.4.3 Airborne Gases

The decision to initiate the WIPP facility (DOE, 1981d) requires that air quality parameters which may be influenced by construction and WIPP operations be monitored in the preoperational and the operational environmental programs. Also, DOE Order 5484.1 (DOE, 1981a) states that "Environmental monitoring for nonradiological pollutants is necessary if it is not possible to determine compliance with federal, state or local environmental quality standards on the basis of effluent monitoring data."

Total suspended particulates, carbon monoxide, hydrogen sulfide, sulfur dioxide, ozone, and nitrogen oxides must be monitored at WIPP to comply with the Record of Decisions (DOE, 1981c). These parameters are monitored at the WFF site using a Thermo-electron integrated monitoring station which prints specific interval averages and daily summaries.

6.4.4 Vegetation

DOE/EP-0023 (Corley et al., 1981) states that samples of vegetation may be taken to measure either current or accumulated contamination levels in a given locality, dependent on whether the sample is of brush, fresh growth, or litter. It further recommends that the preferred sample will generally consist of the entire vegetative cover over the prescribed sampling area. It is also stated that for all deposition sampling, gross alpha and beta analyses are of questionable usefulness, and primary emphasis should be given to isotopic analysis.

OEMP vegetation samples are collected from the permanent and temporary locations shown in Figure 6-5. When sufficient data are available to establish comparability between the two locations southeast of WIPP, the nearer site will be discontinued in favor of the air monitoring control site near State Highway 128. In addition, if vegetable gardens are grown at the Smith and/or Mills Ranches, a leafy vegetable sample will be collected annually, if possible, and analyzed as specified in Table 6-2. Each sample will be collected as specified in the Environmental Procedures Manual (WP 02-03). Sufficient material will be collected and composited to provide a minimum of a 50-ml (1.7 ounces) wet-ashed sample. The sample will be analyzed for the specific radionuclides indicated in Table 6-2.

6.4.5 Beef

The FSAR (DOE, 1988a) indicates beef is not a significant pathway at the WIPP facility. However, DOE/EP-0023 (Corley et al., 1981) indicates meat samples may be collected annually from animals fed on vegetation grown within 25 kilometers (15.5 miles) of the site in the prevailing downwind direction. It further recommends that if samples are collected, they be taken at the local time of slaughter.

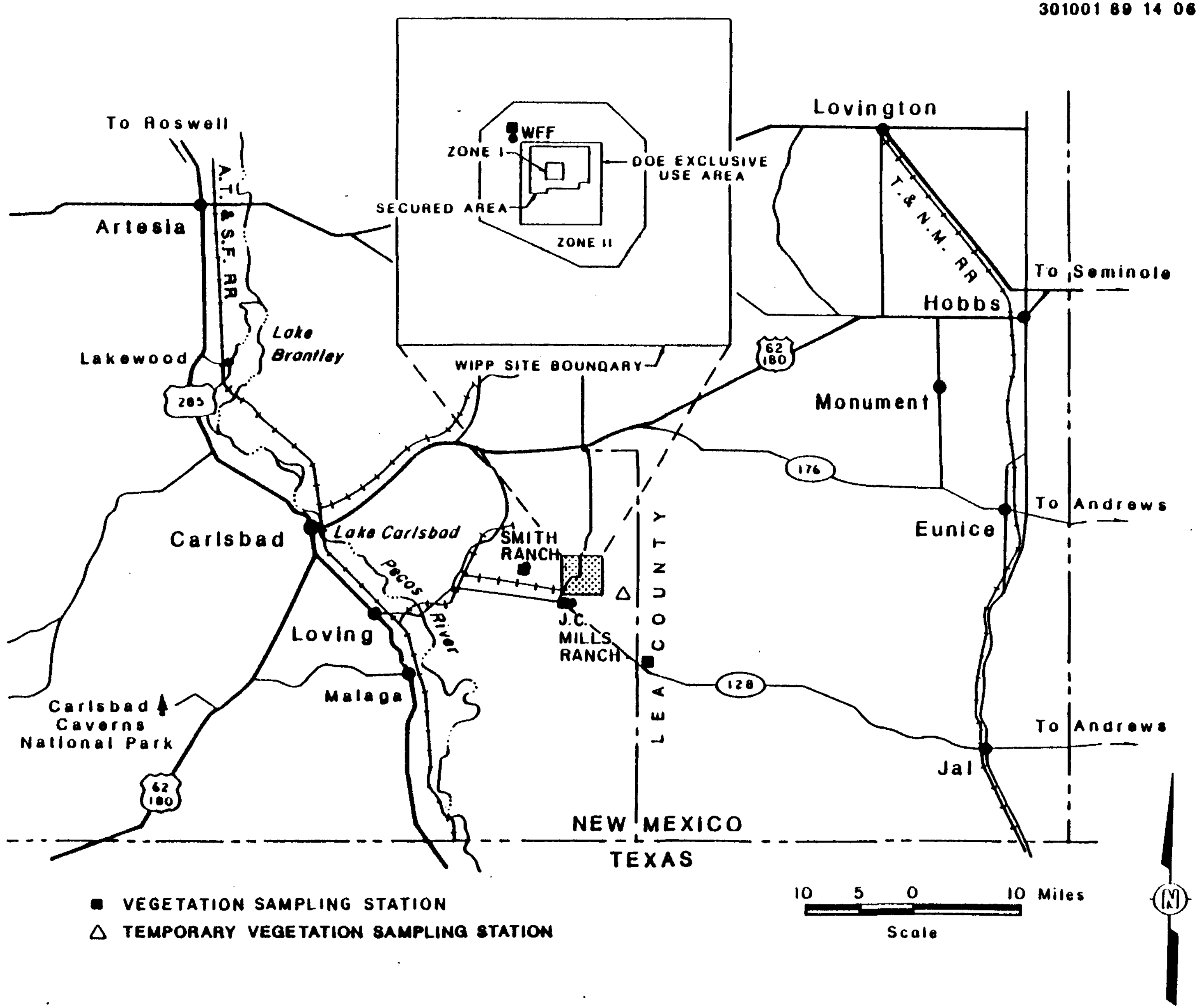


FIGURE 6-5 OEMP VEGETATION SAMPLING STATIONS FOR RADIOANALYSIS

During operations, attempts will be made to obtain muscle samples annually from locally grown beef, preferably one which has been grazed northwest of the WIPP site and one grazed in a background or control location. Since beef is not a significant pathway, the samples will be collected only if they are readily available; i.e., the samples will not be collected if the principal or only cause for slaughter is for collection of OEMP analysis samples. The samples will be analyzed as indicated in Table 6-2. Replicate samples will be provided for independent analysis by the State of New Mexico EEG.

6.4.6 Game Animals

As stated above, muscle tissue is not a significant exposure pathway. However, DOE/EP-0023 indicates that game birds and mammals hunted locally should be sampled during the hunting season in the vicinity (within 25 km) of the site.

Rabbits and quail are collected annually during hunting season. Quail are trapped at the facility, while rabbits are collected to the northwest within eight kilometers (five miles) of the site. Control samples of quail and rabbits are also collected near the control air sampling station located approximately 20 kilometers (12.4 miles) southeast of WIPP. A composite sample of muscle tissue from each type of animal is analyzed as shown in Table 6-2. Replicates of all tissue samples acquired in the OEMP will be provided to the state for independent analysis.

6.4.7 Soil Sampling

DOE/EP-0023 (Corley et al., 1981) states that:

> Although useful in special cases involving unexpected releases, or long-term accumulations, soil analysis is not recommended as a method of choice for monitoring routine releases of radioactive material on a current basis. For plutonium, one of the most commonly analyzed contaminants in soil, data from a variety of environmental and biological samples indicate that environmental concentrations in these media are generally low and often below the detection limit of state-of-the-art equipment, and of little significance in terms of exposure to humans. Nonetheless, it may be desirable to document and periodically reassess its distribution and fate in the environment in view of the public recognition factor.

OEMP surface (0 to 2 cm) soil samples are collected biennially (every two years) from the seven locations shown in Figure 6-6. Two of the sample sites are located west and south of the WHB where site sediments collect due to drainage around the WHB. The remaining sampling sites were identified on the basis of the meteorology and demography of the area, and are co-located at air particulate sampling locations. Every 6 years, samples will also be collected at each site at depths of 2 to 5 cm and 5 to 10 cm. Samples will be collected as described in the Environmental Procedures Manual (WP 02-03), and all samples will be analyzed as indicated in Table 6-2. A replicate of each sample will be archived and another will be provided to the state EEG.

6.4.8 Surface Water

DOE/EP-0023 states:

> The principal exposure pathways to individuals or groups of individuals in the environment from waterborne radionuclides are ingestion of drinking water, consumption of fish, ducks, or other aquatic species, and consumption of irrigated crops. Of secondary importance are external radiation from surface water (swimming, boating, water skiing), from sediment deposits along the shoreline, or from deposits on an irrigated field. The radiation doses from these external sources are generally orders of magnitude less important than from pathways leading to ingestion. . . . Routine laboratory determinations usually include gross beta, tritium, radiostrontium, and gamma spectrometry, according to the nuclides released from the site and other potential sources. Gross alpha and alpha spectrometry may also be included. In addition to total activity analyses, it may be desirable to measure the distribution of activity between soluble and suspended materials, the volatile nuclides, or the chemical form of a radionuclide.

OEMP surface water samples are collected annually from the eight locations specified in Figure 6-7. These locations comprise the major permanent bodies of surface water in the WIPP vicinity and provide adequate data concerning the surface water pathway. Analyses are performed as specified in Table 6-2. In addition, the water samples collected at the Hill and Red Rank locations are analyzed biennially for the chemical constituents which are listed in the Table 6-2 footnote. Replicate (identical) samples are provided to the state EEG for independent analysis. The practice of long-term storage of replicate water samples as was done for the RBP will no longer be conducted, in accordance with procedures recommended by EPA (1986b).

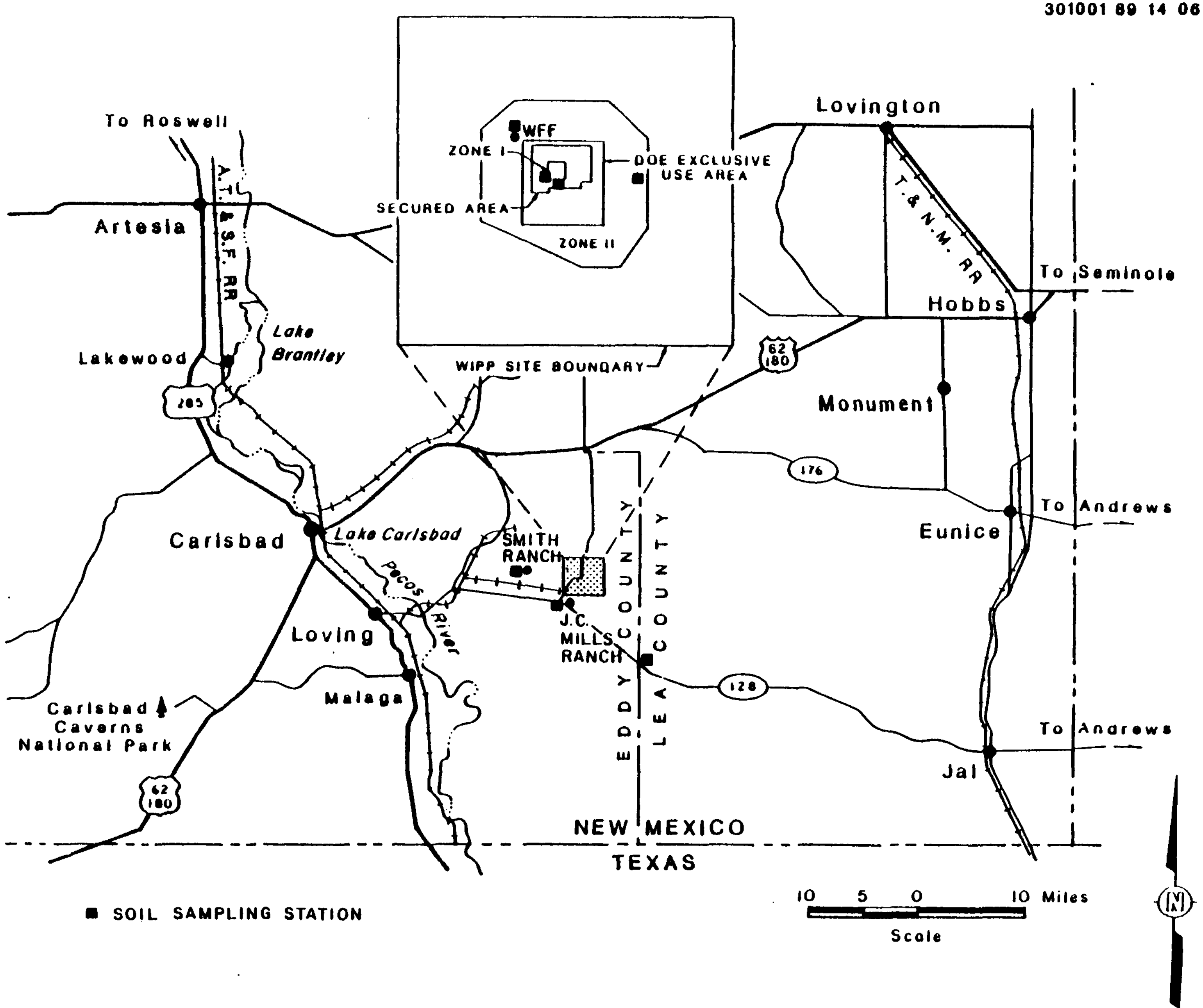


FIGURE 6-6 OEMP SOIL SAMPLING LOCATIONS

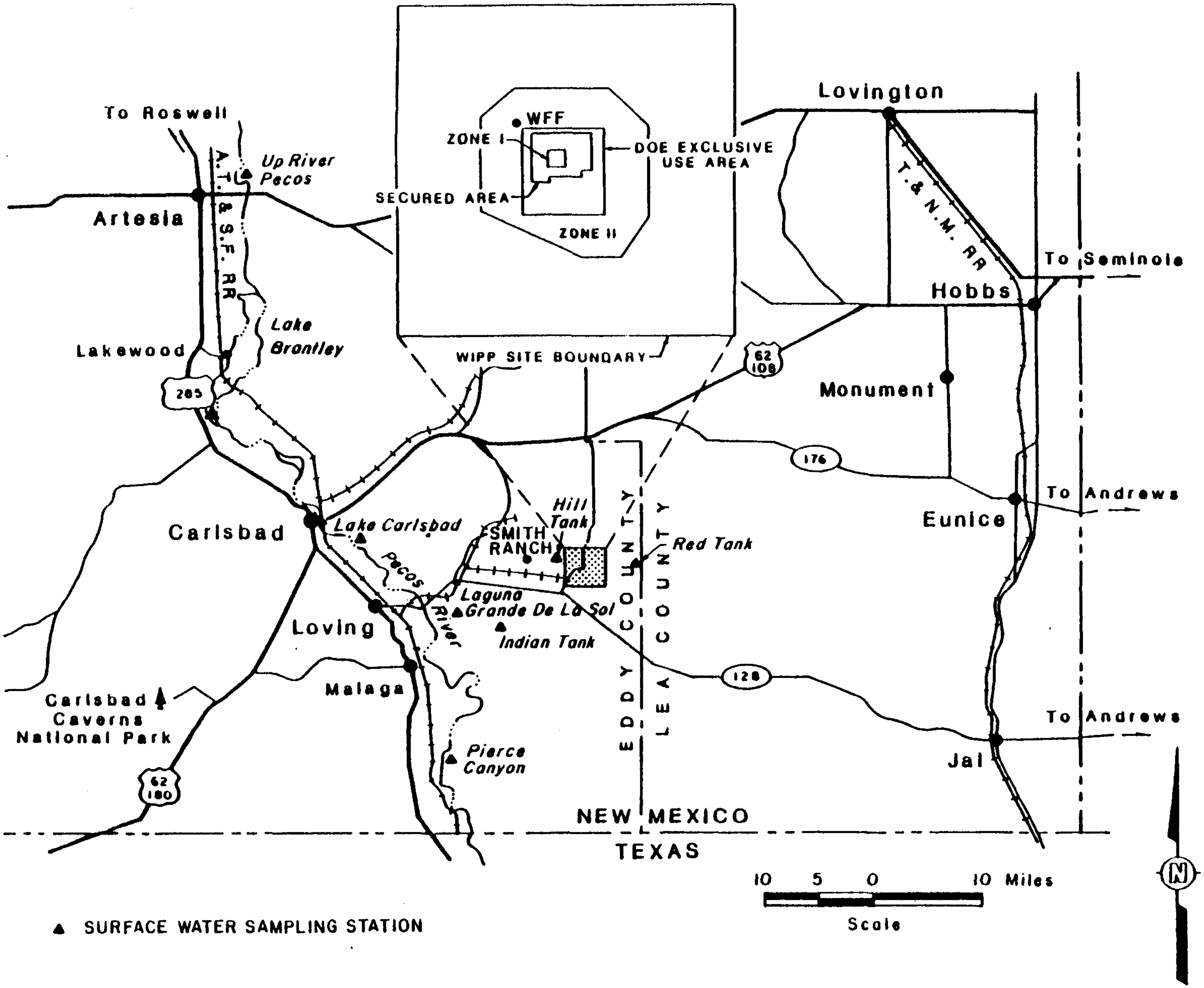


FIGURE 6-7 OEMP SURFACE WATER SAMPLING LOCATIONS

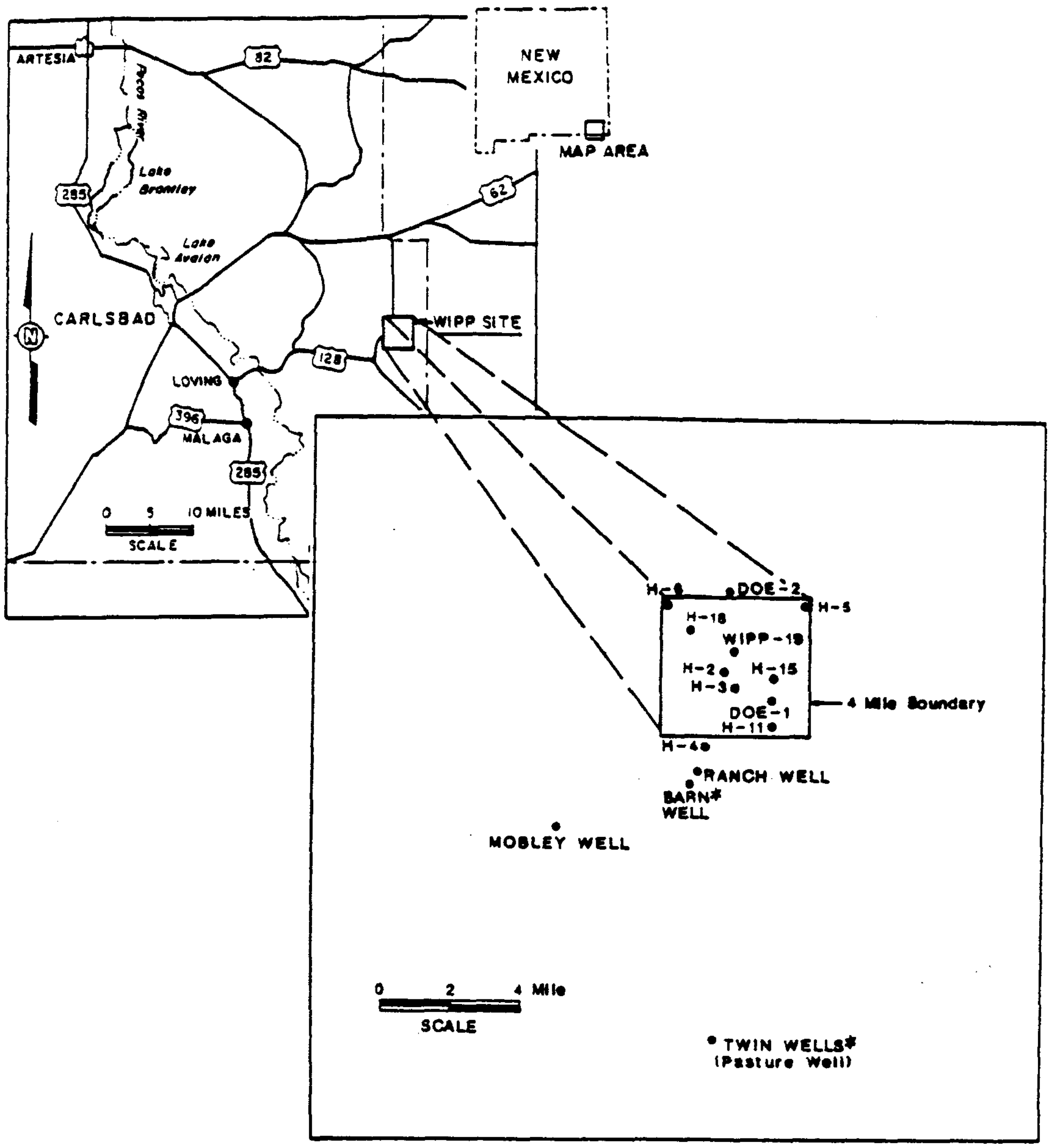
6.4.9 Groundwater

DOE/EP-0023 (Corley et al., 1981) states that:

> Analysis of radioactivity in groundwater is generally recommended for on-site wells and the nearest off-site wells with potential for influence by liquid effluents. . . . As a minimum, the nearest well downgradient of potential site influence on the water table should be sampled. . . . Routine laboratory determinations usually include gross beta, tritium, radiostrontium, and gamma spectrometry, according to the nuclides released from the site and other potential sources. Gross alpha and alpha spectrometry may also be included. In addition to total activity analyses, it may be desirable to measure the distribution of activity between soluble and suspended materials, the volatile nuclides, or the chemical form of a radionuclide. . . .

The "preoperational" Water Quality Sampling Program (described in Section 5.4 of this plan) will become the "operational" Water Quality Sampling Program, and will continue as a cooperative effort between the operating contractor and SNLA in consultation with the New Mexico Environmental Evaluation Group (EEG). This transition reflects the fact that the water sampling program supports the Performance Assessment Program (SNLA), but is no longer required to support the Site Characterization Program completed in 1988. This reduction in the number of WIPP programs that the WQSP supports allows a reduction in the frequency and number of wells which must be sampled. The protocols specified in the Water Quality Sampling Manual (WP 07-2) and the Geotechnical and Geosciences Procedure Manual (WP 07) are followed in collecting water samples from existing wells around the WIPP site.

For the OEMP, 14 groundwater samples are collected annually from the locations shown in Figure 6-8. All samples are analyzed for specific radionuclides and pH as indicated in Table 6-2. Samples from both the Culebra and Magenta members of the Rustler Formation are taken from wells H-3, H-4, H-5, and H-6. Barn Well, Twin Wells, and Ranch Well provide samples of the Dewey Lake Formation. Barn Well and Twin Wells provide water for human consumption. The remaining wells in Figure 6-8 provide Culebra samples only. Replicate samples are provided to the New Mexico EEG for independent analysis. As discussed above, long-term archiving of water samples will not be attempted. It is necessary to include numerous sampling locations in the OEMP initially because the subsurface hydrology in the WIPP vicinity is not clearly defined. As more definitive data are available, the groundwater monitoring program will be evaluated and altered as appropriate.



**Wells Used for Human Consumption*

FIGURE 6-8 OEMP GROUNDWATER SAMPLING LOCATIONS

6.4.10 Aquatic Foodstuffs

DOE/EP-0023 (Corley et al., 1981) states:

> Because aquatic organisms can concentrate many radionuclides from the water or from their food and because fish, shellfish, and waterfowl may be consumed in relatively large quantities by man, these organisms must be considered for inclusion in the routine environmental surveillance program. . . . Fish are analyzed to quantify the dietary radionuclide intake by humans, and secondarily, as indicators of radioactivity in the ecosystem. Analysis of the edible portions of food fish, as prepared for human consumption, is of major interest. . . . In fresh water the principal nuclides to be expected in fish or shellfish (in addition to the naturally occurring K-40 and U-nat) include H-3, Cs-137, and Sr-90, although any nuclide present in the water will be present in the fish.

Although aquatic foodstuffs are not considered a significant pathway from WIPP operations, catfish are collected annually from the Pecos River near Carlsbad and from a control location near the upriver surface water sampling station east of Artesia. The samples are composited and analyzed for gross alpha and beta activity and the specific radionuclides indicated in Table 6-2. Catfish are appropriate for analysis in this program because they dwell and feed in bottom sediments where transuranic radionuclides may accumulate. Again, replicate samples are provided for analysis to the EEG.

6.4.11 Sediment Sampling

DOE/EP-0023 (Corley et al., 1981) states that:

> Sediment sampling is particularly appropriate for most of the transuranics (especially ^{239}Pu), such activation products as ^{54}Mn, ^{58}Mn, ^{60}Co, and ^{65}Zn, and several fission products -- ^{95}Zr-Nb, ^{134}Cs, and ^{137}Cs. . . . Sediment samples are usually taken to detect the buildup of radionuclides by sedimentation.

Sediment samples are collected from the sampling locations on the Pecos River and Indian Tank. Sediments are also collected from the sewage lagoon outfall, as well as from Hill Tank and from Red Tank, both of which collect sediments from large surface drainage areas (Figure 6-9).

6.5 NONRADIOLOGICAL ENVIRONMENTAL MONITORING

Nonradiological environmental monitoring activities at WIPP consist of a comprehensive set of sampling programs designed to detect and quantify impacts of

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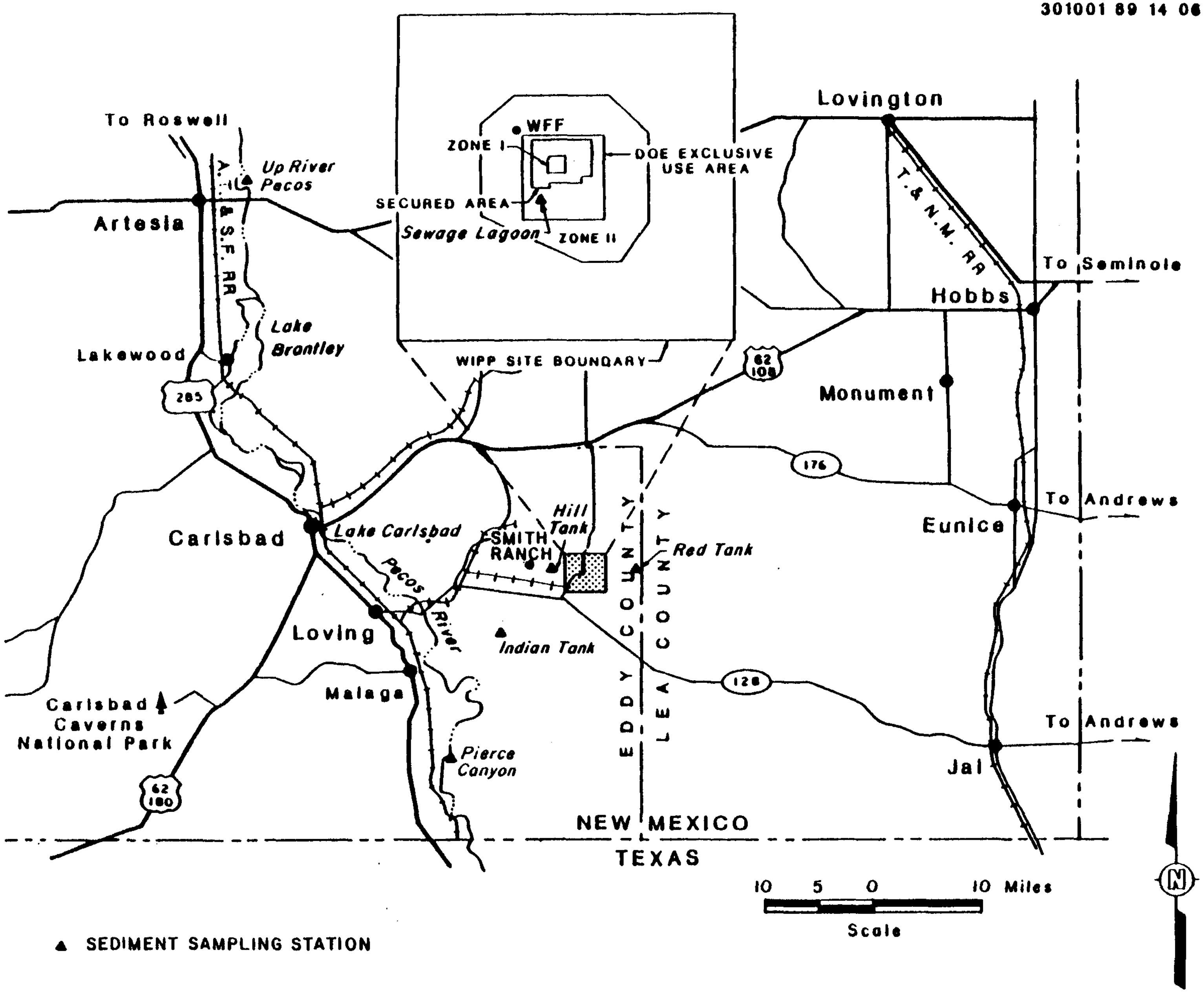

FIGURE 6-9 OEMP SEDIMENT SAMPLING LOCATIONS

construction activity and surface storage of salt on the local ecosystem. The requirements for and objectives of both preoperational and operational nonradiological environmental monitoring are described in the WIPP FEIS (DOE, 1980). The ecological monitoring program functioned as an "operational program" prior to waste emplacement because it focused on nonradiological construction effects which are ongoing.

Section 2.5 of Appendix J of the FEIS states:

> The operational ecological monitoring program, building on the foundation established through preoperational ecological monitoring, will document the ecological effects of construction and operations . . . and will focus primarily on indicator organisms and selected abiotic parameters.

Primary guidance for ecological monitoring was derived from the WIPP FEIS and the American Institute of Biological Scientists (AIBS) evaluation of the WIPP Biology Program.

Projected construction impacts on the ecosystem include the deposition of fugitive dust generated by the handling of materials such as salt, caliche, and topsoil at the site, as well as noise and other unnatural conditions associated with human activities at the site (Figure 6-10). A detailed description of the rationale and sampling strategy for the ecological studies appears in the first semiannual Ecological Monitoring Program Report (Reith et al., 1985). Table 6-2 lists parameters which will be monitored by the OEMP for evidence of possible site impacts. Results to date have been published in Ecological Monitoring Program Reports (Reith et al., 1985; Fischer et al., 1985; Fischer, 1987 and 1988).

6.5.1 Ecological Monitoring Plot Selection

Sampling for the nonradiological environmental portions of the OEMP focus on components of the ecosystem immediately surrounding the site and on the ecological parameters most likely to reflect the impact of construction and operational activities (see Section 3.5 for a discussion of the ecosystem at WIPP). Sampling activities are performed at permanently marked ecological monitoring plots whose locations are unchanged from the preoperational EMP. An identification sign located at the center of each plot serves as a

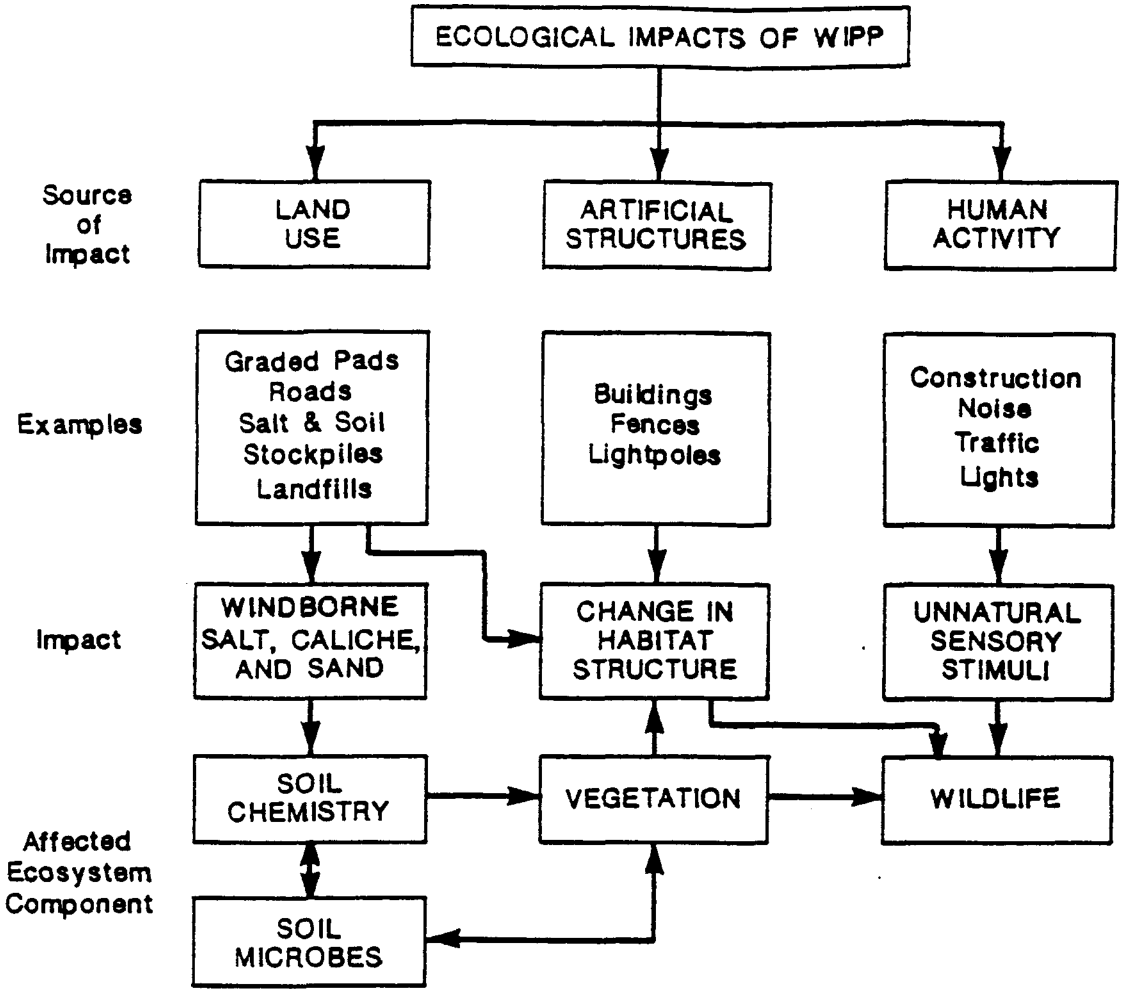

FIGURE 6-10 ECOLOGICAL IMPACTS OF WIPP

permanent reference for the selection of sampling locations. Each plot is approximately 140 meters (462 feet) by 140 meters (462 feet), although the size of some plots is slightly restricted by roads and other barriers.

Ecological monitoring plots have been located with several criteria in mind:

- Some plots are in areas not directly disturbed by construction, but where the probability and extent of ecological impacts is greatest;
- Controls have been sited where potential impacts from the site are small or negligible; and
- Comparability among the plots has been maximized by situating them where soil, vegetation, and general appearance are judged to be as similar as possible.

Figure 6-11 illustrates the location of the permanent ecological monitoring plots. The plots most likely to be impacted by site activities are Southeast 1 (SE1), Northwest 1 (NW1), and East 1 (E1). These three plots are adjacent to the two stockpiles where excavated salt is stored. NW1 is downwind from the facility and the active salt pile according to the prevailing winds, which blow from the southeast. Westerly winds tend to blow during the spring, and can be strong and persistent. During the spring westerlies, E1 is downwind of the site and the active storage pile. SE1 is adjacent to the smaller salt pile, but is outside the path of either primary or secondary wind directions.

Both SE1 and NW1 have counterparts (SE2 and NW2 respectively) located approximately 150 meters (495 feet) farther from the site and the salt piles to help determine the range of any ecological impacts. Finally, Control 1 (CT1) and Control 2 (CT2) are located more than two kilometers (1.2 miles) from the center of WIPP activities. These are believed to be sufficiently far from the facility to minimize exposure to ecological impacts, but not so distant as to be in a different vegetation type.

6.5.2 Aerial Photography

The most conspicuous and readily documented impacts of WIPP on the local ecology relate to the removal of native habitat and the construction of roads, parking lots, buildings, and storage piles. The extent of this habitat replacement is documented in aerial photographs.

301001 89 14 06 A7

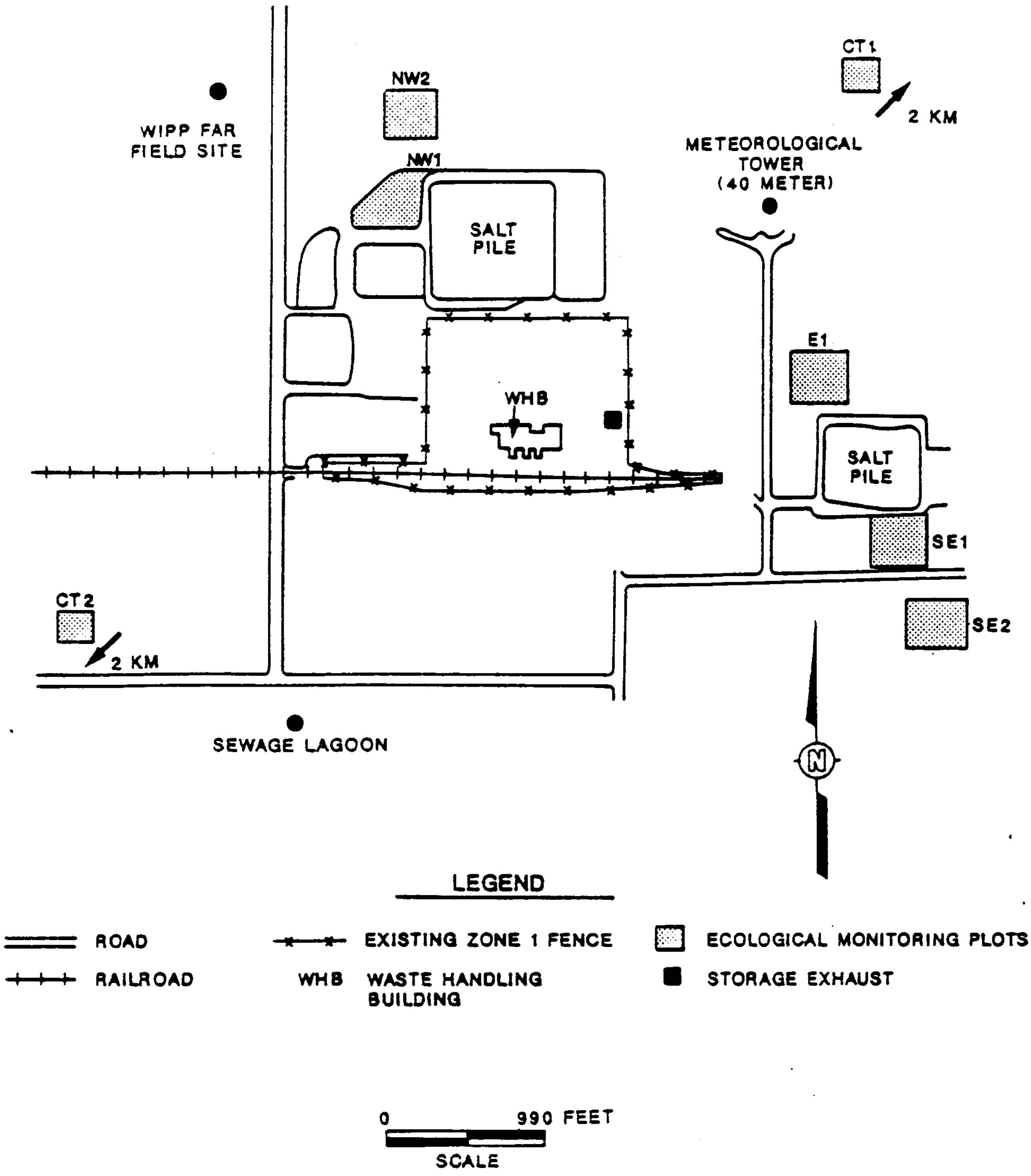

FIGURE 6-11 LOCATIONS OF OEMP ECOLOGICAL MONITORING PLOTS

Aerial photographic missions produce color stereo-pair photographs for stereoscopic examination as well as enlarged "spot photos" of the WIPP installation. The large-negative spot photographs are enlarged in both color and black and white, and used for planimetric and/or dot-matrix evaluation of the displacement of native habitat by WIPP facilities. Project personnel and local emergency response agencies are also provided spot photos for their own use. Selected key locations are temporarily flagged with conspicuous plastic sheeting to facilitate their recognition on the aerial photographs. Mission parameters may be altered as necessary to investigate phenomena of special interest.

6.5.3 Salt Impact Studies

The surface photography, soil chemistry, soil microbiota, and vegetation survey sampling subprograms make up the salt-impact studies of the ecological monitoring activities, and define salt impacts on the living components of the ecosystem. The EMP salt impact studies and the data generated from them will be thoroughly evaluated. A summary report is scheduled for release in 1989. Based on the results of that review, the individual components of these studies will be continued, modified, or discontinued.

6.5.3.1 Surface Photography

This subprogram monitors visually detectable impacts of the facility on the landscape and provides a long-term chronological record of those impacts. Oblique (taken at a height of about five feet above ground level) photographs are taken semiannually at each ecological monitoring plot (see Figure 6-11), as recommended by the AIBS in their 1980 evaluation of the WIPP Biology Program. Environmental photography activities are conducted in accordance with the Nonradiological Environmental Surveillance (NES) Procedure WP 02-340, Rev. 0, Environmental Photography. Photographs are taken from the central sign post in each of eight directions (N, NE, E, SE, S, SW, W, NW). Each exposure centers on a permanent marker installed five meters away from the central sign to ensure comparability among photos from one season to the next. Each photograph is identified for plot, direction, and date. A 24-mm wide-angle lens is used to ensure photo overlap, and a color chart on the permanent marker provides seasonal comparability.

6.5.3.2 Soil Chemistry

The goal of the soil subprogram is to monitor for changes in properties of the sandy dune soil around the WIPP site. Of greatest interest are changes in salt-related parameters such as electrical conductivity (EC), pH, and ion concentrations which may indicate that salt is being transported from WIPP facilities and deposited on surrounding soils. Sampling activities are conducted according to WP 02-336, the NES Soil Sampling Procedure.

Sample analyses are performed by a contract laboratory using standard EPA-approved analytical methods. A one-way analysis of variance is performed on data to determine whether there are significant differences between plot means, and a Student-Newman-Keuls test (SNK) (Sokal and Rohlf, 1969) is used to identify homogenous plot means. Results are reported and discussed in the annual WIPP Environmental Monitoring Report. Flexibility will be paramount to the effectiveness of the soil subprogram. Additional sampling and analysis may be necessary to substantiate or refute suggestive trends among the data and to ensure that conclusions are based upon statistically significant results.

6.5.3.3 Soil Microbiota

As discussed in the previous subsection, soils are sampled to determine if wind-blown salts accumulate at the soil surface. Such accumulations may inhibit a range of soil processes including those carried on by the microbial community. This subprogram monitors two parameters which are broad indicators of microbial function. The first is the level of microbial activity measured by the fluorescein diacetate (FDA) hydrolysis assay, the second is the rate of litter decomposition occurring at the soil surface. Both parameters are measured in litter bags emplaced in the monitoring plots at the beginning of the sampling cycle and collected at six month intervals over a year.

The FDA assay provides an indirect estimate of the total microbial community. FDA is hydrolyzed by several enzymes and correlation exists between the amount of breakdown product given off by the reaction and the rate of oxygen utilization or total microbial respiration in the sample (Schnurer and Rosswall, 1982). Dormant organisms and spores contain the enzymes in small amounts relative to the quantities found in active cells. Thus, the optical density of the sample, which is a measure of the assay end product, is proportional to microbial activity in the sample. Activity levels measured at a given time are a function of the immediate chemical and physical conditions in the environment, i.e., moisture, temperature and nutrient availability.

The rate at which surface litter, specifically oak leaves, loses organic material via decomposition is influenced to some extent by temperature, precipitation, soil chemistry, and the chemical composition of the substrata as well as by the organisms which make up the microbial community (Santos et al., 1978; Elkins and Whitford, 1982; Whitford et al., 1981 and Santos et al., 1984). The microbial community participates in key ecosystem processes such as energy flow and nutrient cycles. A delay in nutrient cycling can inhibit productivity at other levels of the ecosystem (Whittaker, 1975). Bags of oak litter are also used to measure microbial decomposition in this subprogram. The preparation, placement and collection of the litter bags are described in WP 02-338, the Procedure for NES Litter Bags.

Results from the decomposition study and the enzyme assay are evaluated statistically using a one-way analysis of variance (ANOVA) program. When significant differences are found between plot means, the SNK test is performed to identify homogenous group means. Results are reported in the annual Site Environmental Monitoring report.

6.5.3.4 Vegetation Survey

The deposition of salt on vegetation or soil may affect plant and soil chemistry to the extent that normal biological processes are inhibited. For instance, elevated levels of soluble salt in the soil can osmotically inhibit the germination and growth of seedlings. These changes in chemistry and osmotic potential may affect the soil microbial community which in turn affects decomposition and nutrient flow within the ecosystem. The FEIS (DOE, 1980) predicts that these impacts may be present, but minor based on observations of salt piles at local potash mines and at the nearby Project Gnome Site where Salado salt was excavated prior to an underground nuclear test.

The vegetation within each of the permanent monitoring plots (Figure 6-11) is surveyed in the spring and again in the fall to detect possible impacts of salt transport and the resultant changes in soil chemistry on extant vascular plants. Although measurement of vegetation parameters is not as sensitive an indicator of salt deposition as the direct measurement of ion concentrations in the soil, the importance of vegetation as a soil stabilizer and wildlife habitat requires that it be monitored closely for trends which may develop as the result of salt impacts.

The vegetation parameters measured in each plot include foliar cover for all species, density of annual species, species richness, and the structure of the vegetation community. The NES Vegetation Sampling Procedure (WP 02-337) and the Plant Specimen Collection and Herbarium Management Procedure (WP 02-346) define the survey activities. Vegetation coverage and density are measured at the beginning and end of each growing season and are used to determine species richness in the plant community. Changes in community structure are documented by means of the fixed-location comparative photographs discussed in Section 6.5.3.1.

Field data is compiled and averaged for each species in each plot. Results are reported in the annual Site Environmental Monitoring report.

6.5.4 Vertebrate Census

Birds and mammals comprise the upper levels of the food chain in the natural ecosystem around WIPP. These organisms may be impacted by noise and human presence as well as by changes in habitat structure due to salt inputs. Population densities are monitored annually to define normal cycles of abundance and to detect gross changes in populations or communities which may be due to activities at the WIPP facility.

The FEIS (DOE, 1980) suggests that local animal populations may be affected by activities in addition to the destruction of a small portion of their natural habitat. Some species may be frightened or otherwise repulsed by the noise and light generated by the project and by associated vehicular traffic. Other animal species exploit man-made structures and may invade the environment around WIPP. Some of the above impacts (e.g., habitat removal) were projected with relative certainty by the FEIS; others (e.g., salt effects) were projected tentatively in terms of likelihood and severity.

Selected wildlife populations are surveyed annually to determine the effects of WIPP construction activities and consequent habitat modifications on natural populations of wildlife species. Survey methods are based on standard techniques such as described by Emlen (1971) for birds and Hayne (1949) for mammals. Wildlife species are generally more dispersed than the other populations monitored in the EMP, necessitating the use of survey techniques which sample larger areas than encompassed by the ecological monitoring plots. Therefore, the wildlife surveys are performed in association with the established monitoring plots, but are not necessarily contained within them. Field activities are detailed in WIPP Procedures WP 02-362 (NES Bird Census) and WP 02-363 (NES Small Mammal Census).

Results of the Emlen transects (breeding bird densities) are calculated separately for each bird species. Breeding densities of birds are reported for each species in the annual Site Environmental Monitoring report.

Small mammals are surveyed annually at the site using a capture/recapture technique and Sherman live traps. Species densities are reported in the annual Site Environmental Monitoring report.

7.0 SAMPLE HANDLING AND LABORATORY PROCEDURES

Environmental sampling and analytical laboratory procedures to obtain quality results under the WIPP Operational Environmental Monitoring Program are contained and/or described in the following documents:

- Environmental Procedures Manual (WP 02-03)
- Water Quality Sampling Manual (WP 07-2)
- Ecological Monitoring Program Semiannual Report (Reith et al., 1985)
- Geotechnical and Geosciences Procedure Manual (WP 07)
- Radiation Safety Manual (WP 12-5)
- Management and Operating Contractor WIPP Quality Program Manual.

The WIPP has field analytical capabilities as well as contract analytical support from Westinghouse Advanced Energy Systems Division (WAESD), Eberline Analytical Corporation (Eberline), and IT Corporation Laboratory, Export, Pennsylvania. Each laboratory is responsible for maintaining an approved quality assurance program.

7.1 SAMPLE HANDLING

Sample Identification

The sample identity codes used in the OEMP Radiological Environmental Surveillance (RES) and the Nonradiological Environmental Monitoring programs (Nonradiological Environmental Surveillance - NES) are unique to each sample collected. A four-tiered hierarchy of sample-specific information to accurately identify the sample type, the location of sampling, the date, and a sequence of the sampling event is recorded on the appropriate data sheets. A detailed description of the sample identification system for radiological samples is given in the RES Scheduling, Documentation, and Field Preparation Procedure (WP 02-303). The sample identification system used for nonradiological samples is described in the NES Scheduling, Documentation, and Field Preparation Procedure (WP 02-332). These documents, included in the Environmental Procedures Manual, also describe the use of RADCOMP, a scheduling and data management software program used in sample identification and data tracking. Sample identification, calculations, computer inputs and other applicable internal review procedures are implemented according to the NES/RES Quality Assurance/Quality Control Implementation Procedures (WP 02-302).

Environmental Activity Levels

During operations, all TRU wastes will arrive at the WIPP site in sealed containers and will remain in sealed containers. Therefore, radionuclide levels in environmental samples are expected to remain very low during operations. All environmental samples are collected in accordance with accepted practices and widely recognized methodologies and criteria for environmental monitoring (WP 02-03).

Packaging and Shipping of Samples Off-Site

Environmental samples sent off-site for analysis are packaged according to the specific sampling procedures (i.e., soil, water, vegetation, etc.) listed in the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2). The NES/RES Sample Tracking Procedure (WP 02-304) outlines the chain-of-custody requirements that insure the integrity of samples. WIPP does not handle high-activity samples in the environmental monitoring programs. Contract laboratories are required to follow Quality Assurance/Quality Control (QA/QC) procedures to ensure no cross-contamination of high- and low-activity samples which they may process. The quality of the data from analytical contract laboratories is verified by 1) participation in interlaboratory cross-checks, 2) duplicate, spike, and blank sample analysis, and 3) a comparison of results from sample splits provided to the New Mexico Environmental Evaluation Group (EEG) for analysis.

Quality Assurance

A comprehensive QA program has been implemented to assure that the data collected are representative of actual concentrations in the environment. Each contract laboratory is responsible for maintaining an approved quality assurance program detailing 1) routine calibration of instruments, 2) frequent source and background checks (as appropriate), 3) routine yield determinations of radiochemical procedures, 4) replicate/ duplicate analyses to check precision, 5) standard and spike analyses to check accuracy, and 6) analyses of reagents to ensure chemical purity that could affect the results of the analytical process. The accuracy of radionuclide determination is ensured through the use of standards traceable to the National Bureau of Standards, participation in the Environmental Protection Agency Cross-check Interlaboratory Comparison Program, and other interlaboratory analytical assessment programs, when available.

7.2 RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

External Radiation

Thermoluminescent dosimeters (TLDs) are used at WIPP to measure penetrating (gamma) radiation levels in and around the WIPP site. TLD packages containing five lithium fluoride (LiF) chips are collected and evaluated quarterly. Dosimeters are currently provided, read, and annealed by Eberline Corporation in Albuquerque, New Mexico, but are being replaced by a WIPP operated system. The environmental monitoring dosimetry is a Harshaw TLD card consisting of four TLD-700 (Li-7 enriched LiF) chips. The reader is a Harshaw 4400C system. Field dosimeters are accompanied during shipment and installation by control dosimeters, which are kept in a copper-lined lead cave during the field cycle (quarterly) exposure period. These control dosimeters enable data to be corrected for transient exposure during shipment and distribution. Detailed procedures for handling TLD packages are given in the Thermoluminescent Dosimeter (TLD) Handling Procedures (WP 02-308). The Environmental Radiation Monitoring Procedure (WP 02-313) provides instructions for obtaining measurements of ambient gamma radiation using the Reuter-Stokes RSS-1012, Environmental Monitoring System.

Airborne Particulates

The model CMP-14CV samplers (HiQ Environmental Products) are used at WIPP for particulate collection. These samplers have a regulated flow rate of 950 ml per second (two cubic feet per minute) of air through a 47-mm (1.9 inch) glass fiber filter. Filters are collected weekly and sent to the analytical laboratory in accordance with the Low-Volume Airborne Particulate Sampling Procedures (WP 02-312). A gross alpha and gross beta count (Table 6-2) of each weekly filter is completed prior to compositing filters from each location for each sampling quarter. The quarterly composite is then analyzed using gamma spectrometry for representative gamma-emitting radionuclides typically present in the environment or expected to occur in the waste received at WIPP. Finally, the composite sample undergoes destructive chemical analysis for the specific alpha and beta emitters of concern. High volume airborne particulate samplers are also maintained and available in the event of an accidental release. Sampling procedures for the high volume airborne particulate equipment are given in WP 02-311. Laboratory methods for analyses of radionuclides are given in Table 7-1.

Airborne Gases

The Atmospheric Monitoring Station manufactured by ThermoElectron, Inc., is used to monitor potential pollutant gas concentrations continuously. The station is composed of seven analyzers which monitor SO_2, H_2S, O_3, CO, NO, NO_2, and NO_x gases. A detailed description of the station is given in the Ecological Monitoring Program Report for 1986 (Fischer, 1987). The station is operated in accordance with the Ambient Air Quality Monitoring Procedure (WP 02-341). Calibration and maintenance of monitoring equipment are performed in accordance with the NES/RES Equipment Maintenance and Control Procedures (WP 02-306) to ensure accuracy of results.

Biological Materials

Samples of native mammals, birds, sport fish, locally-produced beef and vegetation are collected and prepared for radionuclide analyses as described in the Biotic Sampling Procedures (WP 02-310). Samples, other than vegetation, are transported in ice to the sample preparation laboratory. Samples are either oven-dried between 105°C and 135°C for 24 hours, or ashed at 700°C depending on the requirements of the contract laboratory. Methods of analyses are given in Table 7-2.

Soil Sampling

Soil sampling procedures used at WIPP are given in the RES Soil Sampling Procedures (WP 02-307). A template insert allows the collection of samples at three depths for each location: 0-2 cm (0-0.8 in.), 2-5 cm (0.8-2.0 in.), and 5-10 cm (2.0-3.9 in.). Every sample is a composite of 10 randomly located subsamples, each delineated by a 10x10 cm (3.9x3.9 in.) stainless steel template. Soil samples are poured through a splitter to remove organic debris and gravel. Soil samples are air-dried prior to shipment to the contract laboratory. Methods of analyses for radionuclides are given in Table 7-3.

TABLE 7-1

METHODS USED FOR RADIOLOGICAL ANALYSIS OF AIRBORNE PARTICULATE SAMPLES

PARAMETER	REFERENCE METHOD
Gross Alpha Gross Beta	Procedure number OI-86-2, Rev. 0, Gross Alpha and Beta Activity on WIPP and Other Environmental Air Filters, Westinghouse Electric Corporation - Advanced Energy Systems Division (WAESD).
Cesium 137, Cobalt 60, Radium 226, Thorium 228, Potassium 40, Beryllium 7	Procedure number A-524, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Wastewater and Environmental Samples, WAESD.
Neptunium 237	Procedure number A-508, Determination of Np 237 in Environmental Samples, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239/240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix C, WAESD.
Uranium 238 Uranium 234/233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix A, WAESD.
Americium 241, Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Polonium 210, Lead 210	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix J, WAESD.

TABLE 7-2

BIOTIC SAMPLING AND ANALYTICAL PROCEDURES

PARAMETER	REFERENCE METHOD
Cesium 137, Cobalt 60, Radium 226, Thorium 228, Potassium 40, Beryllium 7	Procedure number A-524, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Wastewater and Environmental Samples, WAESD.
Neptunium 237	Procedure number A-508, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239/240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix C, WAESD.
Uranium 238, Uranium 234/233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix A, WAESD.
Americium 241 Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Litter Decomposition	Elkins, N. Z., and W. G. Whitford, 1982, "The Role of Microarthropods and Nematodes in Decomposition in a Semi-Arid Ecosystem," Oecologia, Vol. 55, pp. 303-310. Santos, P. F., E. Depree, and W. G. Whitford, 1978, "Spatial Distribution of Litter and Microarthropods in a Chihuahuan Desert Ecosystem," J. of Arid Environments, Vol. 1, pp. 41-48. Santos, P. F., N. Z. Elkins, Y. Steinberger, and W. G. Whitford, 1984, "A Comparison of Surface and Buried Larrera tridentata Leaf Litter Decomposition in North American Hot Deserts," Ecology, Vol. 65, pp. 278-284. Whitford, W. G., D. W. Freckman, N. Z. Elkins, C. W. Pardu, R. Parmelee, J. Phillips, and S. Tucker, 1981, "Diurnal Migration and Responses to Simulated Rainfall in Desert Soil Microarthropods and Nematodes," Soil Biol. Biochem., Vol. 13, pp. 417-425.

TABLE 7-2

BIOTIC SAMPLING AND ANALYTICAL PROCEDURES
(CONTINUED)

PARAMETER	REFERENCE METHOD
Bird Density	Emlen, J. T., 1971, "Population Densities of Birds Derived from Transect Counts," Auk, Vol. 88, pp. 323-342.
Mammal Survey	Hayne, D. W., 1949, "Two Methods for Estimating Populations from Trapping Records," J. Mammal, Vol. 30, pp. 399-411.
Microbial Activity Levels	Schnurer, J., and T. Rosswall, 1982, "Fluorescein Diacetate Hydrolyses as a Measure of Total Microbial Activity in Soil and Litter," Applied Environmental Microbiology, Vol. 43, (6), pp. 1,256-1,261.
Vegetation Foliar Cover Species Richness Density of Animals Seedling Emergence	Cain, S. A., and G. M. Castro, 1959. Manual of Vegetation Analysis, Harper Brothers, New York.

TABLE 7-3

METHODS OF SOIL ANALYSIS

PARAMETER	REFERENCE METHOD
Cesium 137, Cobalt 60, Radium 226, Thorium 228	Procedure number A-524, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Wastewater and Environmental Samples, WAESD.
Neptunium 237	Procedure number A-508, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239-240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix H, WAESD.
Uranium 238, Uranium 234-233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix G, WAESD.
Americium 241, Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Water Soluble Extraction of Anions	Soil Extraction for Common Anions, ITAS-Pittsburgh Laboratory Methodology, 1985.
Chloride, Titrimetric	Method 325.3 Method for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
pH on Saturation Paste, Conductivity on Extract, Sodium Absorption Ratio	Sobeck, A., W. Schuller, J. Freeman, and R. Smith, Field and Laboratory Methods Applicable to Overburdens and Minesoils, United States Environmental Protection Agency - 600/2-78-054, p. 95, March 1978.
Calcium, Direct Aspiration	Method 215.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Magnesium, Direct Aspiration	Method 242.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.

TABLE 7-3

METHODS OF SOIL ANALYSIS
(CONTINUED)

PARAMETER	REFERENCE METHOD
Potassium Direct Aspiration	Method 258.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Sodium, Direct Aspiration	Method 273.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.

Surface Water and Sediments

Surface water and sediment samples for radionuclides are collected and handled according to the RES Surface Water and Sediment Sampling Procedures (WP 02-309). This procedure describes methods for collecting, preserving, and packaging representative water and sediment samples. Laboratory methods for analyses of radionuclides are given in Table 7-4.

Groundwater

Groundwater sampling for radiological analyses is conducted according to the Water Quality Sampling Manual (WP 07-2), except for the private wells which are sampled in accordance with the Geotechnical and Geosciences Procedure Manual (WP 07). This sampling plan includes detailed procedures on collecting a representative sample by measurement of field parameters to determine a chemical steady-state with respect to those constituents. Included in this plan are the procedures associated with the pumping of groundwater, the serial sampling and analysis program, and the final sample collection and preparation for shipment to contract laboratories. The Water Quality Sampling Program is conducted by Westinghouse in coordination with Sandia National Laboratories. The methods of analyses for various radionuclides are listed in Table 7-4.

7.3 NONRADIOLOGICAL ENVIRONMENTAL MONITORING

Soil Sampling

Soil sampling and handling procedures are given in the NES Soil Sampling Procedures (WP 02-336). Six surface samples at 0-2 cm (0-0.8 in.) are collected quarterly at random locations from each ecological study plot (Figure 6-11). Each sample is a composite of ten subsamples collected by using a 10x10 cm (3.9x3.9 in.) template inserted into the soil. Soils are sifted through a No. 0.20 mesh screen to remove large organic matter and gravel, and are air-dried for a minimum of 48 hours. The parameters and methods of analyses are given in Table 7-3.

Biological Materials

Biotic sampling and handling procedures for the Ecological Monitoring Program are given in the NES Vegetation Sampling Procedure (WP 02-337) and the NES Litter Bag Handling Procedure (WP 02-338). Details on field methods and how they have been modified are given in the Ecological Monitoring reports (Reith

TABLE 7-4

METHODS USED FOR GROUNDWATER AND SURFACE WATER ANALYSIS

PARAMETER	REFERENCE METHOD
Alkalinity	Method 403, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Bromide, Titrimetric	Method 320.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Chloride, Potentiometric Method	Method 407C, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Cyanide Determination by Flow Injection Analysis	Quick Chem Method No. 10-204-00-1-A, Lachat Instruments-1987.
Fluoride (Potentiometric) Ion Selective Electrode)	Method 340.2, Method for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Nitrate/Nitrite Determination by Flow Injection Analysis	Quick Chem Method No. 10-107-04-1-A, Lachat Instruments-1987.
Nitrogen/Nitrate (Colorimetric, Brucine)	Method 352.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
pH (electrometric)	Method 150.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Phenol Determination by Flow Injection Analysis	Quick Chem Method No. 10-210-00-1-A, Lachat Instruments-1987.
Phosphorus, All Forms (Colorimetric; Ascorbic Acid; Single Reagent)	Method 365.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Residue, Nonfilterable	Method 160.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Residue, Filterable	Method 160.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.

TABLE 7-4

METHODS USED FOR GROUNDWATER AND SURFACE WATER ANALYSIS
(CONTINUED)

PARAMETER	REFERENCE METHOD
Conductance (Specific Conductance, µmhos at 25°C)	Method 120.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Sulfate (Turbidimetric)	Method 375.4, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Total Organic Halides	Method 9020, Test Methods for Evaluating Solid Waste, USEPA SW-846 3rd Ed., 1986.
Total Organic Carbon	Method 9060, Test Methods for Evaluating Solid Waste, USEPA SW-846 3rd Ed., 1986.
Inductively Coupled Plasma-Atomic Emission Spectrometric Method for Trace Element Analysis Of Water and Waste	Method 200.7, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Arsenic (Atomic Absorption, Furnace Technique)	Method 206.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Molybdenum (Atomic Absorption, Direct Aspiration)	Method 246.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Selenium (Atomic Absorption, Furnace Technique)	Method 270.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Titanium, Direct Aspiration	Method 283.1, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Mercury, Manual Cold Vapor	Method 7470, Test Methods for Evaluating Solid Waste, USEPA, SW-846 3rd Ed., 1986.
Strontium, Direct Aspiration	Method 303A, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Thallium (Atomic Absorption, Furnace Technique	Method 279.2, Methods for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.

TABLE 7-4

METHODS USED FOR GROUNDWATER AND SURFACE WATER ANALYSIS
(CONTINUED)

PARAMETER	REFERENCE METHOD
Lithium, Aspiration	Method 317B, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Cesium, Direct Aspiration	Method 303A, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th Ed., 1985.
Base-Neutral and Acid Extractables	Method 625, Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, U.S. Environmental Protection Agency, 600/4-82-057, 1982.
Gas Chromatography/Mass Spectrometry for Volatile Organics	Method 8240, Test Method for Evaluating Solid Waste, U.S. Environmental Protection Agency, SW-846 3rd Ed., 1986.
Gas Chromatography/Mass Spectrometry for Volatile Organics	Method 8270, Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, SW-846, 3rd Ed., 1986.
ITWC 007 Silica	Quick Chem Method No. 10-114-27-1A, Lachat Instruments - 1988.
Iodide, Titrimetric	Method 345.1, Method for the Chemical Analysis of Water and Waste, United States Environmental Protection Agency - 600/4-79-020, 1983 Revision.
Pesticides and PCBs	Method 608, Method for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA - 600/4-82-057, July 1982.
	Method 8080, Test Methods for Evaluating Solid Waste, USEPA SW-846, 3rd Ed., 1986.
Cesium 137, Cobalt 60	Procedure number A-524, WAESD.
Radium 226, Thorium 228	Procedure OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix E, WAESD.
Strontium 90	Procedure number A-516, Rev. 1, Determination of Sr 89 and Sr 90 in Waste Water and Environmental Samples, WAESD.

TABLE 7-4

METHODS USED FOR GROUNDWATER AND SURFACE WATER ANALYSIS
(CONTINUED)

PARAMETER	REFERENCE METHOD
Neptunium 237	Procedure number A-508, WAESD.
Thorium 232, Thorium 230	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix B, WAESD.
Uranium 238, Uranium 234, Uranium 233	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix A, WAESD.
Plutonium 238, Plutonium 241, Plutonium 239/240	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix C, WAESD.
Americium 241, Curium 244	Procedure number OI-86-4, Rev. 2, Full Radionuclide Analysis of WIPP Samples, Appendix D, WAESD.
Hydrogen 3 (Tritium)	Procedure number A-531, Rev. 0, Determination of Beta Emitting Radionuclides by Liquid Scintillation Counting, WAESD.

et al., 1985; Fischer et al., 1985; Fischer, 1987 and 1988). Analytical methods and references for various sampling subprograms are given in Table 7-2.

Surface Water and Sediments

Surface water and sediment sampling and handling procedures for nonradionuclide analyses are conducted according to the NES Surface Water and Sediment Sampling Procedure (WP 02-345) and the Guidance Manual: "Surface Water and Sediment Sampling for the Environmental Monitoring Program at WIPP" (Prill and Buckle, 1986). The parameters and methods of analysis are given in Table 7-4.

Groundwater

The Water Quality Sampling Manual (WP 07-2), Section 4.0, includes the field analytical procedures, techniques for calibration of equipment, and the precision and accuracy expected for each procedure. Field parameters for nonradiological analyses include pH, EC, specific gravity, specific conductance, temperature, flow volumes and rates, chloride, calcium, magnesium, total sulfide as H_2S, alkalinity, and dissolved iron. Samples are also collected and sent to the contract laboratory for more extensive analyses. Parameters and reference methods to be used for groundwater analyses are given in Table 7-4.

8.0 DATA ANALYSES

This section describes the criteria and methods to be used for statistically analyzing data collected in the OEMP. The goal of statistical data analyses is to provide an objective and reliable means for interpreting data in relation to the stated objects of the data collection program. For the OEMP, the principal goal of data analyses will be the comparison of a data point or data set to equivalent data collected at another location and time (such as preoperational baseline data or data collected at a control location), or to a fixed standard. The basic requirements and recommendations for data analyses are stated in DOE/EP-0023 (Corley et al., 1981) and DOE Order 5400.xy (DOE, 1988f).

For each parameter, several levels of analyses are required before statistically valid interpretation can be achieved. The type of analysis used at each level will vary among parameters due to the particular characteristics of the parameter and the specific objectives of monitoring each parameter. Five general levels of data analyses are described here. Analyses at each of these levels will be considered for each parameter. The levels are:

(1) determination of the accuracy of each point measurement by means of the quantification and control of precision and bias;

(2) evaluation of the effects of auto-correlation due to the location and time of sampling on the expected value of the point measurement;

(3) identification of an appropriate model of variability (i.e., a probability density distribution) for each point measurement and the calculation of descriptive statistics based on that model;

(4) treatment of data anomalies, such as values below the limit of detection, negative values, missing data, and outliers; and

(5) interpretation of the data through statistically valid comparisons (tests) of data groups and trend analysis.

In the following sections, each of these levels of data analyses are described and the requirements for application to the OEMP are presented.

8.1 ACCURACY

Accuracy is the closeness of a measurement to its actual, or true, value. Since the true value cannot be determined independently of measurement, accuracy cannot be determined absolutely. However, accuracy is controlled by two basic elements: bias, or the consistent over- or underestimation of the true value; and precision, or the concentration of repeated measurements around a central (expected) value. Accuracy is maximized when bias is minimized and precision is maximized (Gilbert, 1987).

To some extent, precision and bias are controlled by strict adherence to sample collection, handling, and measurement protocols. In the OEMP, procedures are in place which specify the protocols for those functions performed at WIPP (WP 02-03) and quality control procedures establish control on precision and bias for contractors (see Section 11.0).

The remaining element of precision and bias will be quantitatively estimated through periodic performance of the following types of measurements:

- measurement of replicate samples (two or more separate samples taken at the same time, from the same location, and with the same procedures);
- measurement of duplicate samples (two or more aliquots of one sample) or the repeated measurement of the same sample (as in two or more counts of a single air filter);
- measurement of blank samples; and
- measurement of standard pseudo-samples (samples of an equivalent medium containing a known amount of the target species).

The measurement of replicate samples is used to estimate the amount of imprecision incurred through the entire process of sample collection, handling, and measurement. The measurement of duplicates and repeated measurements are used to estimate the amount of imprecision attributable to measurement. Blanks and pseudo-samples are used to evaluate bias incurred through measurement processes. Measurements of replicate samples and repeated measurements have been made in the RBP, particularly in the low volume air sampling program. Results of the EPA cross-check Interlaboratory Comparison Program have always indicated to date that WIPP values for gross alpha and gross beta analyses are within specified control limits.

The methods for satisfying these requirements will be dependent upon the sampling and measurement characteristics of each parameter. Generally, the following specifications will be followed:

- one replicate sample will be collected for each ten samples collected;
- at least one duplicate or one repeated measurement will be made for each discrete set of samples analyzed, or for each tenth sample analyzed, whichever is more frequent;
- one blank sample will be analyzed for each discrete set of samples analyzed (for radioactivity counts, the background count is not considered a blank); and
- measurements of pseudo-samples will be performed once per year.

Variations from these specifications may be required due to peculiarities of the individual parameters, and will be stated in the procedure for that parameter.

8.2 TEMPORAL AND SPATIAL ANALYSIS

Environmental parameters vary with space and time. The effect of one or both of these two factors on the expected value of a point measurement can be statistically evaluated through spatial analysis and time series analysis; however, these methods often require extensive sampling efforts which are in excess of the practical requirements of the WIPP OEMP. The application of these methods to a particular parameter must, therefore, be limited by consideration of its significance in the final interpretation of the data.

In particular, spatial analysis will have very limited use in this program, although the effect of spatial auto-correlation on the interpretation of the data will be considered for each parameter. Spatial variability will be accounted for by the use of predetermined key sampling locations. Data analysis will be performed on a location-specific basis, or data from different locations may be combined only when the data have been determined to be statistically homogeneous.

Time series analysis, on the other hand, plays a more important role in data analysis for the OEMP. Parameters will be reported as time series, either in tabular form or as time plots. For key time series parameters, these plots will be in the form of control charts on which control levels will be identified based on preoperational data bases, fixed standards, control location data bases, or other standards for comparison. Where significant seasonal changes in the expected value of the parameter are identified in the preoperational data base or in the control locations, corrections in the control levels which reflect the seasonal change will be made.

8.3 DISTRIBUTIONS AND DESCRIPTIVE STATISTICS

For data sets which include more than ten data points and that are homogeneous in space and time (including seasonal homogeneity), and have less than ten percent missing data, a test for conformance to the normal distribution will be performed. A probability plot is an accepted method for performing this test; however, more powerful tests of normality, such as the W Test, or D'Agostino's Test (Gilbert, 1987) are more accurate. Any standard goodness-of-fit test is acceptable, provided the assumptions of the test are met.

If normality is not met, the data will be log-transformed and retested for normality. If the transformed data fit the normal distribution, the original data will be accepted as having a log-normal distribution. If normality is still not found, two courses may be taken. One is to continue to test the fit to standard families of distributions, such as the gamma, beta, and Weibull, with proper modifications to subsequent analyses based on the these results. The other course is to use nonparametric methods of data analysis.

For data sets smaller than ten, but homogeneous and complete, the log-normal distribution will be assumed. Data sets with more than ten percent missing data will be analyzed using nonparametric methods. Nonhomogeneous data sets will be subdivided into homogeneous sets and each of these analyzed individually.

Descriptive statistics will be calculated for each homogeneous data set. At a minimum, these will include a central value and a range of variation. The central value will be the arithmetic mean of the untransformed data if the data are not censored at either end. If the data are censored, either a trimmed mean or the median will be used as the central value (which may be within the censored range). If the data set is greater than ten and is uncensored, the standard deviation will be calculated and used as a basis for the reported range in variation. If these criteria are not met, the range between the 0.25 and 0.75 quartiles will be used.

8.4 DATA ANOMALIES

Data anomalies include data points reported as being below the limit of detection (LD) or otherwise censored over a specific range of values, missing data points occurring randomly in the data set, and outliers which cannot be ascribed to a known source of variation. Treatment of data anomalies requires specific, a priori guidelines and standards.

Whenever possible, values which are below detection limits will be obtained and incorporated into the data base for statistical analysis. When no value is available, alternative methods of analysis, as described in previous sections, will be used. In particular, the use of nonparametric statistics may be required.

Missing data points comprising less than 10 percent of the data set will not affect data analyses. Results based on data in which more than 10 percent is missing will be identified as such at the time of reporting. In particular, consideration of the potential effect of missing data must be made when the majority of the data are missing from a discrete time span.

An outlier will be defined as any data point occurring in either extreme range (or tail) of the data distribution for which there is less than 0.01 probability of occurrence. For normally distributed data, this is roughly 2.3 or more standard deviations above or below the mean. When no probability model is identified, however, outliers may only be found through visual inspection of the data.

If no outside source of variation is identified to account for an outlier in a data set, it will be included in the data set and all subsequent analyses. If the inclusion of such outliers is found to affect the final results of the analyses significantly, both results (with and without outliers) will be reported.

8.5 COMPARISONS AND REPORTING

Comparisons between data sets will be performed using standard statistical tests. The selection of the specific test will be dependent upon the relative power of the test and the degree to which the underlying requirements of the test are met. In addition to tests comparing data from distinct locations and times, trend analyses will be performed on time series where sufficient data exist. As a general standard, a 95 percent confidence level will be used for the final interpretation of results.

Citation of the source of the test method or the software used to perform the test will be made when the results are reported. Data and subsequent calculated values will be reported in accordance with standard rules for significant figures.

9.0 DOSE CALCULATIONS

This section provides an overview of the methodology and assumptions used to assess the radiological consequences to members of the public from potential releases of airborne radioactivity from the WIPP facility. The FSAR (DOE, 1988a) indicates that all other potential release pathways are insignificant.

9.1 DOSE CALCULATION MODELING

Off-site radiation doses to members of the public may be estimated using measurements of emitted radionuclide concentrations in air, soil, water, vegetation, and biotic samples. Typically, the concentrations are quite low and challenge the sensitivity of analytical techniques. For this reason, radiation doses to the off-site collective population and to a maximally exposed individual are estimated using radionuclide emission rates, measured in the in-stack fixed air samplers (FAS), as a source term.

The AIRDOS-EPA computer code model (Moore et al., 1979) is used to estimate the off-site environmental concentrations, human exposure, and radiation doses resulting from the atmospheric release of radionuclides. The code, which is a modified version of AIRDOS-II (Moore, 1977), is used for both routine and accidental release assessments. Most input parameters required by the code characterize the area surrounding the site or are specific to the radionuclides released. These input data are identical for both routine and accident release assessments. Other input, such as the source terms and the meteorological assumptions, are specific to the release assessment. The following discussions indicate when differences exist between routine release modeling and accident release modeling.

9.2 OVERVIEW OF AIRDOS-EPA

In general, AIRDOS-EPA estimates the radiation dose to either a maximally exposed individual or to an exposed population resulting from a specified airborne release of radionuclides. Based upon a characterization of the area around the site and the specified meteorological conditions, the code estimates: (1) concentrations of radioactivity in air, (2) rates of deposition on ground surfaces, and (3) ground surface concentrations. These results are coupled with intake rates for man to estimate the radiation dose to an adult receptor associated with all possible exposure pathways.

9.3 METEOROLOGICAL MODELING

The area surrounding the WIPP site is modeled as an 80-kilometer (50-mile) radius circular grid system with the site located at the center. Site-specific meteorological data, typical of annual average conditions, are used in the assessment of routine annual releases. First, the annual frequency of wind direction is determined for each of the 16 compass directions starting at direction 1 for winds toward the north and then proceeding counterclockwise through direction 16. Next, the frequency of each of the seven Pasquill stability categories, ranging from A (very unstable) to G (extremely stable), is determined for each of the 16 compass directions. The average wind speed is entered for each wind direction and Pasquill category. The average depth of the atmospheric mixing layer (lid) for the area is specified to limit the vertical dispersion of the plume after it travels some distance downwind of the source. The value used for the lid height is 1,435 m (4,735.5 ft) [the average of the 470 m (1,551 ft) mean morning lid and the 2,400 m (7,920 ft) mean afternoon lid] (Baes et al., 1984). The site-specific meteorological data used in the assessment of routine releases are summarized in Tables 9-1 through 9-4.

For the assessment of accidental releases from the WIPP facility, meteorological assumptions would be specified to reflect on-site meteorological condition measurements at the time of the accidental release.

9.4 STACK EFFLUENT MODELING

AIRDOS-EPA (Moore et al., 1979) requires input describing the area or point of release. In the case of both routine and accidental releases from WIPP, two release points are possible; the Waste Handling Building stack and/or the Storage Exhaust stack. Input specified to the code and describing these stacks is summarized in Table 9-5.

Because the air discharged from the stacks is released at a relatively high velocity, the release effectively takes place at a height above the physical stack heights. For releases associated with routine operations, equations for momentum dominated plumes (Rupp, 1948) are used to estimate the effective stack heights. This method uses an effective "stack velocity" in determining the effective height of the release. For releases associated with postulated

TABLE 9-1

METEOROLOGICAL DATA - ASSESSMENT OF ROUTINE RELEASES

PARAMETER	VALUE (UNITS)
Lid Height	1,435 (m)
Average Temperature	288.8 (°K)
Average Rainfall	24.13 (cm/yr)
Frequency of Atmospheric Stability Classes	Table 9-2
Frequencies of Wind Directions and True-Average Wind Speeds	Table 9-3
Frequencies of Wind Directions and Reciprocal - Average Wind Speeds	Table 9-4
Pasquill Category Temperature Gradients*	
E	0.0055 (°K/m)
F	0.0280 (°K/m)
G	0.0400 (°K/m)

*Categories A-D are not utilized in the AIRDOS Code.

TABLE 9-2

FREQUENCY OF ATMOSPHERIC STABILITY CLASSES

SECTOR*	FRACTION OF TIME IN EACH STABILITY CLASS						
	A	B	C	D	E	F	G
1	0.3701	0.0168	0.0037	0.0299	0.1252	0.1121	0.3422
2	0.4469	0.0163	0.0042	0.0265	0.0898	0.0714	0.3449
3	0.5295	0.0153	0.0088	0.0306	0.0722	0.0482	0.2954
4	0.4420	0.0122	0.0021	0.0326	0.0570	0.0855	0.3686
5	0.5465	0.0178	0.0076	0.0293	0.0561	0.0726	0.2701
6	0.5657	0.0046	0.0062	0.0428	0.0413	0.0428	0.2966
7	0.5331	0.0134	0.0134	0.0404	0.0538	0.0336	0.2723
8	0.6558	0.0061	0.0048	0.0400	0.0461	0.0218	0.2254
9	0.5740	0.0084	0.0042	0.0391	0.0705	0.0517	0.2521
10	0.3376	0.0084	0.0038	0.0287	0.0738	0.1937	0.3540
11	0.1871	0.0100	0.0047	0.0535	0.1212	0.1796	0.4439
12	0.2813	0.0246	0.0086	0.1044	0.1597	0.1413	0.2801
13	0.2030	0.0070	0.0034	0.0240	0.0907	0.1979	0.4740
14	0.2627	0.0208	0.0091	0.1053	0.1756	0.1144	0.3121
15	0.2320	0.0044	0.0132	0.0485	0.1497	0.1174	0.4347
16	0.2981	0.0154	0.0154	0.0615	0.1231	0.0712	0.4153

*Sectors are numbered counterclockwise starting at 1 for due north.

TABLE 9-3

FREQUENCIES OF WIND DIRECTIONS AND TRUE-AVERAGE WIND SPEEDS

WIND TOWARD*	FREQUENCY	WIND SPEEDS FOR EACH STABILITY CLASS (METERS/SEC)						
		A	B	C	D	E	F	G
1	0.091	3.91	2.62	2.62	3.69	3.29	3.58	2.40
2	0.127	4.37	3.92	3.25	3.94	4.80	5.54	2.71
3	0.188	3.95	3.78	3.85	3.86	4.18	4.56	2.94
4	0.085	3.28	4.01	3.87	3.95	3.92	3.32	2.95
5	0.052	4.47	5.34	6.61	5.32	5.39	4.80	3.01
6	0.049	4.74	5.10	6.25	5.64	6.18	5.16	2.93
7	0.043	4.42	2.98	3.05	4.17	4.91	4.04	2.65
8	0.033	4.08	3.39	4.36	4.23	4.28	3.57	2.65
9	0.034	4.26	4.29	3.15	3.87	4.40	3.79	2.70
10	0.031	4.03	2.27	2.25	3.16	3.52	3.97	2.94
11	0.029	3.57	2.27	2.86	3.31	3.41	4.54	2.79
12	0.031	4.28	3.18	0.85	3.08	4.88	5.21	2.11
13	0.050	5.66	3.37	5.11	4.74	5.09	6.01	3.57
14	0.042	4.85	0.85	4.10	3.73	3.40	5.39	3.00
15	0.038	3.75	3.61	4.08	2.73	3.58	5.81	2.63
16	0.052	3.54	2.28	3.15	2.73	2.45	2.11	2.23

*Wind directions are numbered counterclockwise starting at 1 for due north.

TABLE 9-4

FREQUENCIES OF WIND DIRECTIONS AND RECIPROCAL-AVERAGE WIND SPEEDS

		WIND SPEEDS FOR EACH STABILITY CLASS (METERS/SEC)						
WIND TOWARD*	FREQUENCY	A	B	C	D	E	F	G
1	0.091	3.11	2.00	2.00	2.71	2.58	2.78	1.83
2	0.127	3.46	2.74	2.99	2.76	3.48	4.45	2.29
3	0.188	3.04	2.46	3.21	3.09	3.04	3.55	2.12
4	0.085	2.51	3.20	3.33	2.84	2.93	2.50	1.68
5	0.052	3.31	4.09	5.99	4.08	3.68	3.64	1.90
6	0.049	3.11	3.59	5.54	3.81	4.16	3.69	1.96
7	0.043	3.12	1.80	2.80	2.85	3.46	2.57	1.86
8	0.033	2.84	2.28	2.84	2.75	3.21	2.34	1.89
9	0.034	3.00	2.12	2.89	1.99	2.70	2.08	1.91
10	0.031	2.75	1.47	2.25	1.71	2.04	2.51	2.02
11	0.029	2.52	1.40	3.10	1.99	2.30	2.76	2.00
12	0.031	2.68	1.96	0.85	1.47	1.94	2.55	2.11
13	0.050	3.57	1.76	2.64	2.39	2.71	4.35	2.15
14	0.042	3.14	0.85	2.02	1.99	1.71	4.23	2.11
15	0.038	2.50	2.42	2.05	1.62	2.19	1.76	1.83
16	0.052	2.70	1.21	2.89	2.04	1.83	1.17	1.63

*Wind directions are numbered counterclockwise starting at 1 for due north.

TABLE 9-5
STACK INFORMATION

PARAMETER	WASTE HANDLING BUILDING	STORAGE EXHAUST FILTER BUILDING
Number of Stacks	1	2
Stack Height	32.0 (m)	7.3 (m)
Stack Diameter	2.4 (m)*	3.1 (m)
Velocity of Stack Gas	9.5 (m/sec)	13.6 (m/sec)

*Equivalent diameter.

accidents, the effective stack heights would be estimated using Rupp's equation and would reflect actual stack velocities measured during the accidental release.

9.5 DISPERSION MODELING

The basic equation used to estimate plume dispersion in the downwind direction is the Gaussian plume model of Pasquill (1961) as modified by Gifford (1961). The values of the horizontal and vertical dispersion coefficients (σ_y and σ_z) used for dispersion and depletion calculations are those recommended by Briggs (1969). The code maintains a mass balance along the plume to reduce the concentration of the plume by accounting for removal of radionuclides due to deposition. With respect to deposition of radionuclides on ground surfaces, the code permits considering both dry deposition and scavenging. Dry deposition is the process by which particles deposit on grass, leaves, and other surfaces by impingement, electrostatic deposition, chemical reactions, or chemical reactions with surface components. The rate of deposition on earth surfaces is proportional to the ground-level concentrations of the radionuclides in air (Slade, 1967):

$$R_d = V_d \chi$$

where:

R_d = Surface deposition rate, pCi/cm^2-sec,

χ = Ground level concentration in air, pCi/cm^3, and

V_d = Deposition velocity, cm/sec.

It should be noted that even though V_d has units of velocity, it is a constant of proportionality and as such must be experimentally determined from field studies in which the ratio R_d/χ can be reliably determined. For particles less than 4 microns in diameter, V_d is set at 0.1 cm/sec (Heinemann and Vogt, 1979). This value is, however, based on vegetation cut at a specific height and fails to measure total deposition on a unit area basis. The value must therefore be divided by the fraction of atmospherically depositing nuclides intercepted by the aboveground edible portion of the vegetation to arrive at a total value of V_d. Using a mean forage grass interception fraction of 0.57 produces a deposition velocity (V_d) of 0.18 cm/sec (.07 in/sec) for small particulates. Since specific values for V_d (total) have not been published for vegetable crops, it is assumed that the value is the same as that used for forage.

The rate of deposition by scavenging is a function of the precipitation rate and is principally a mechanism of washout of particles from a plume by rain or snow. The scavenging coefficient is an average value for the entire year and includes all periods without rain- or snowfall; i.e., the model treats scavenging as a continuous depletion, at a constant rate, of contaminants from the plume over the entire year. The scavenging coefficient has units of sec^{-1}. The scavenging rate (R_s), in pCi/cm^2-sec, is:

$$R_s = \theta \chi_{ave} L$$

where:

θ = Scavenging coefficient, sec^{-1}

χ_{ave} = Average concentration of nuclide in a column of air to the lid height, pCi/cm^3

L = Height of the lid, cm.

The sum of the dry deposition and the scavenging rates was used as the value for the total ground deposition rate used in assessing routine releases. For conservatism, the scavenging rate is ignored in accident release assessments.

9.6 TERRESTRIAL MODELING

As previously described, the area surrounding the WIPP site is modeled as an 80-kilometer (50-mile) radius circular grid system with the site located at the center. Fifteen distances, each representing the midpoint of a grid sector, are specified in each of the 16 compass directions. The AIRDOS-EPA (Moore et al., 1979) model calculates radionuclide concentrations at distances of 0.8, 2.4, 3.8, 4.0, 5.6, 7.2, 8.8, 10.4, 12.0, 13.6, 15.2, 24, 40, 56.1, and 72.1 kilometers (0.5, 1.5, 2.4, 2.5, 3.5, 4.5, 5.5, 6.5, 7.5, 8.5, 9.5, 15, 25, 35, and 45 miles) from WIPP. WIPP-specific data for population, agricultural acreage, and beef and dairy cattle were used as code input for each grid sector. These data are summarized in Figures 9-1 through 9-4 from the Final Safety Analysis Report for WIPP (DOE, 1988a).

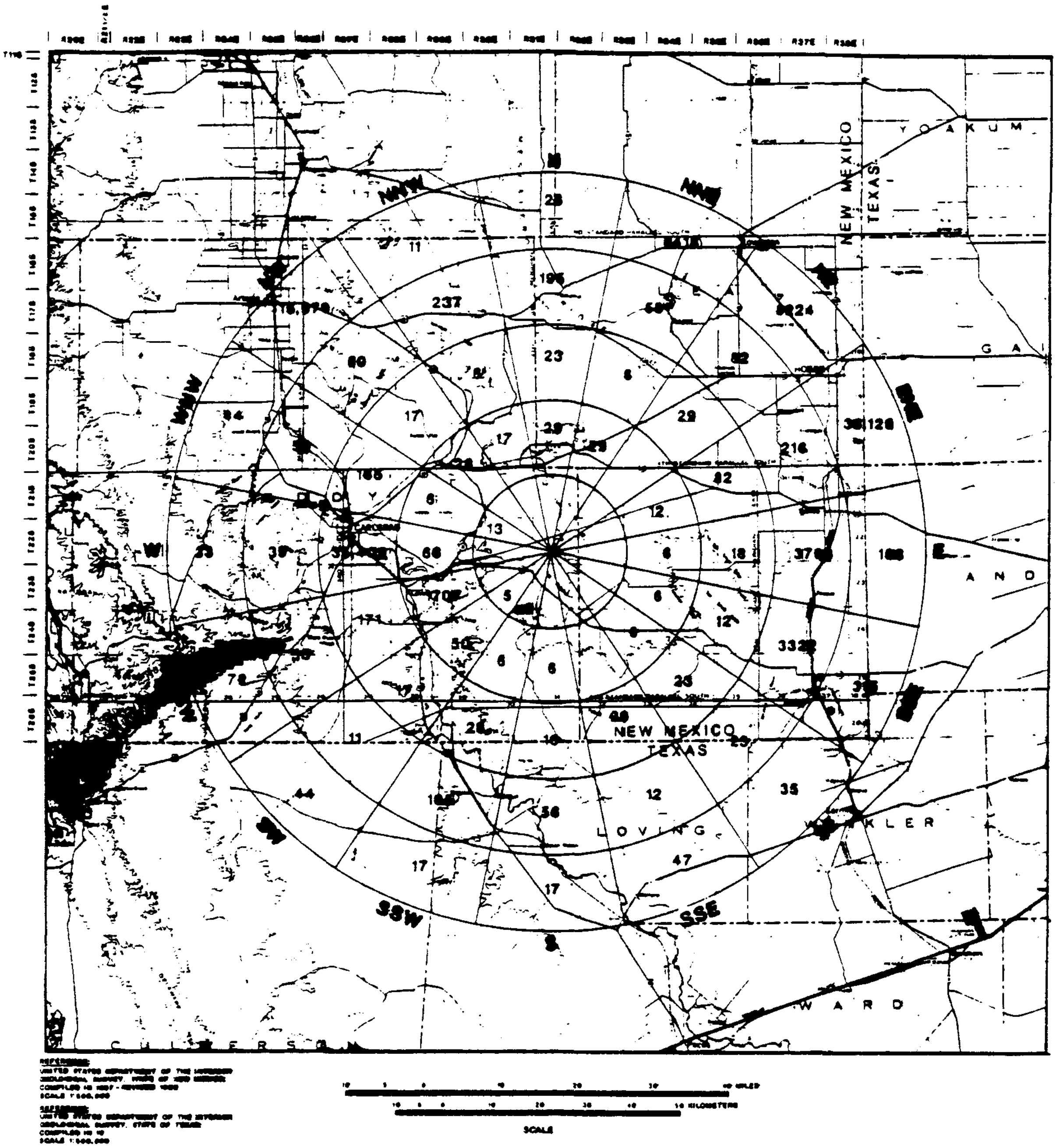

FIGURE 9-1 1985 POPULATION WITHIN 50 MILES OF WIPP

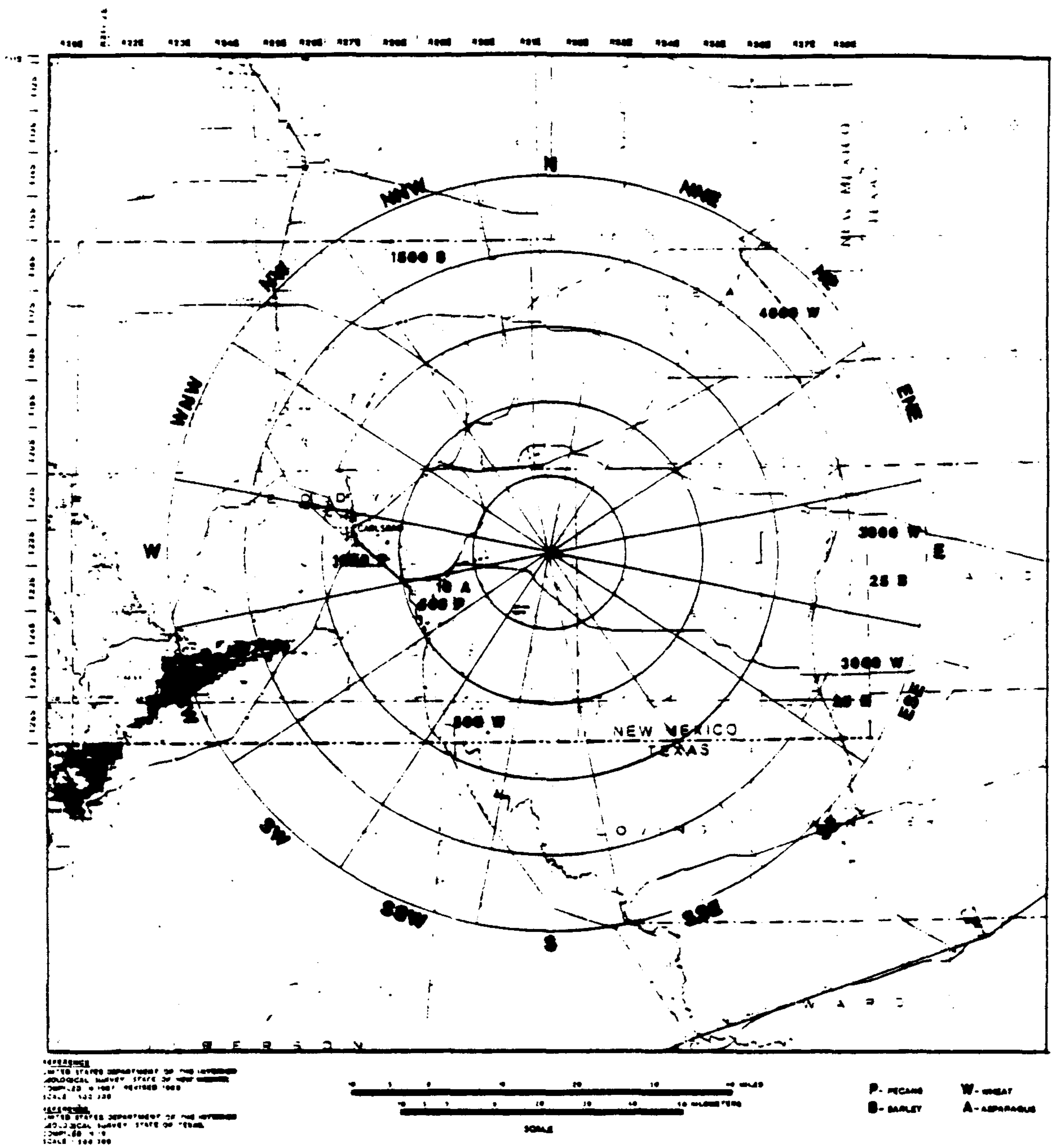

FIGURE 9-2 AGRICULTURE ACREAGE WITHIN 50 MILES OF WIPP

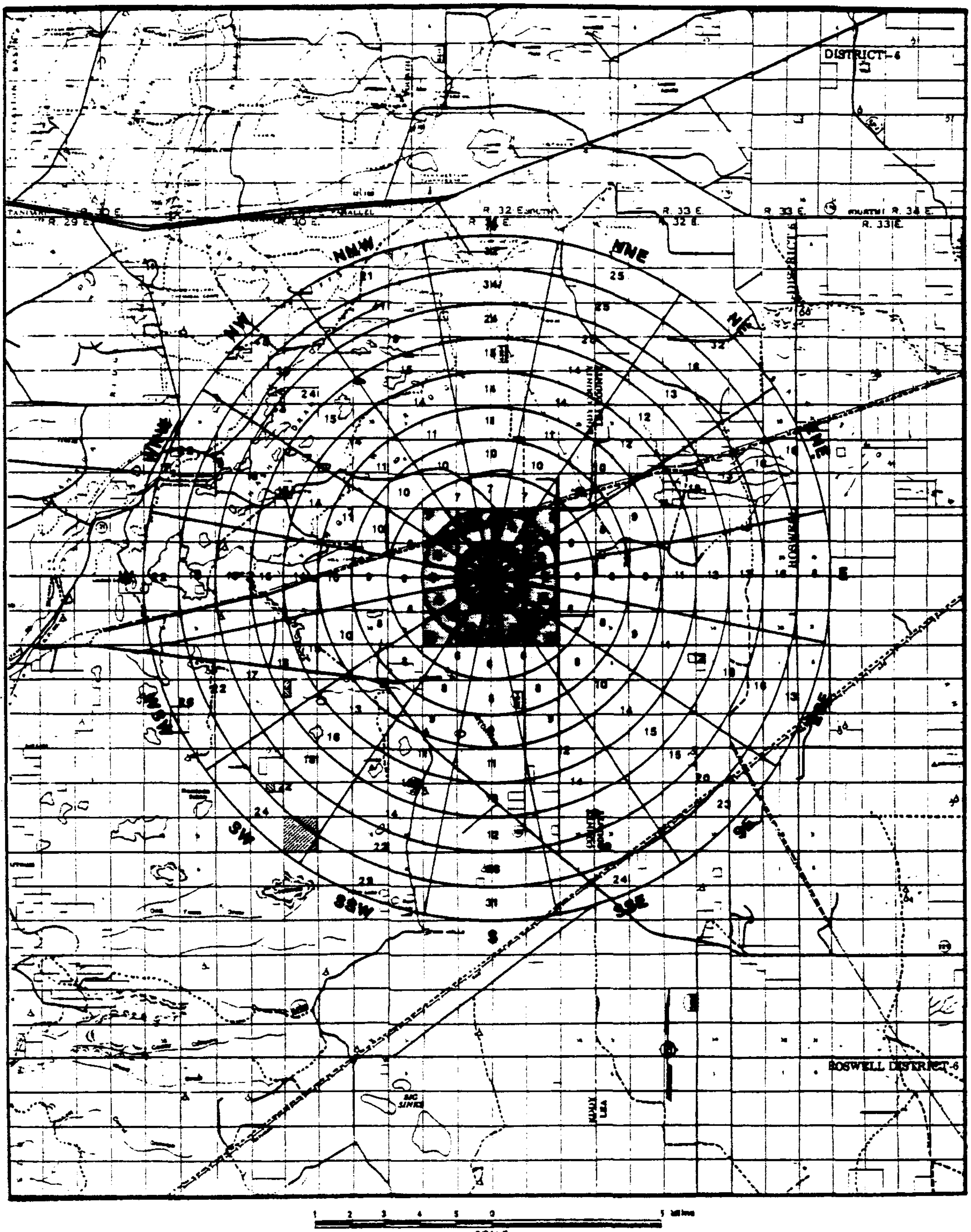

FIGURE 9-3 BEEF CATTLE WITHIN 10 MILES OF WIPP

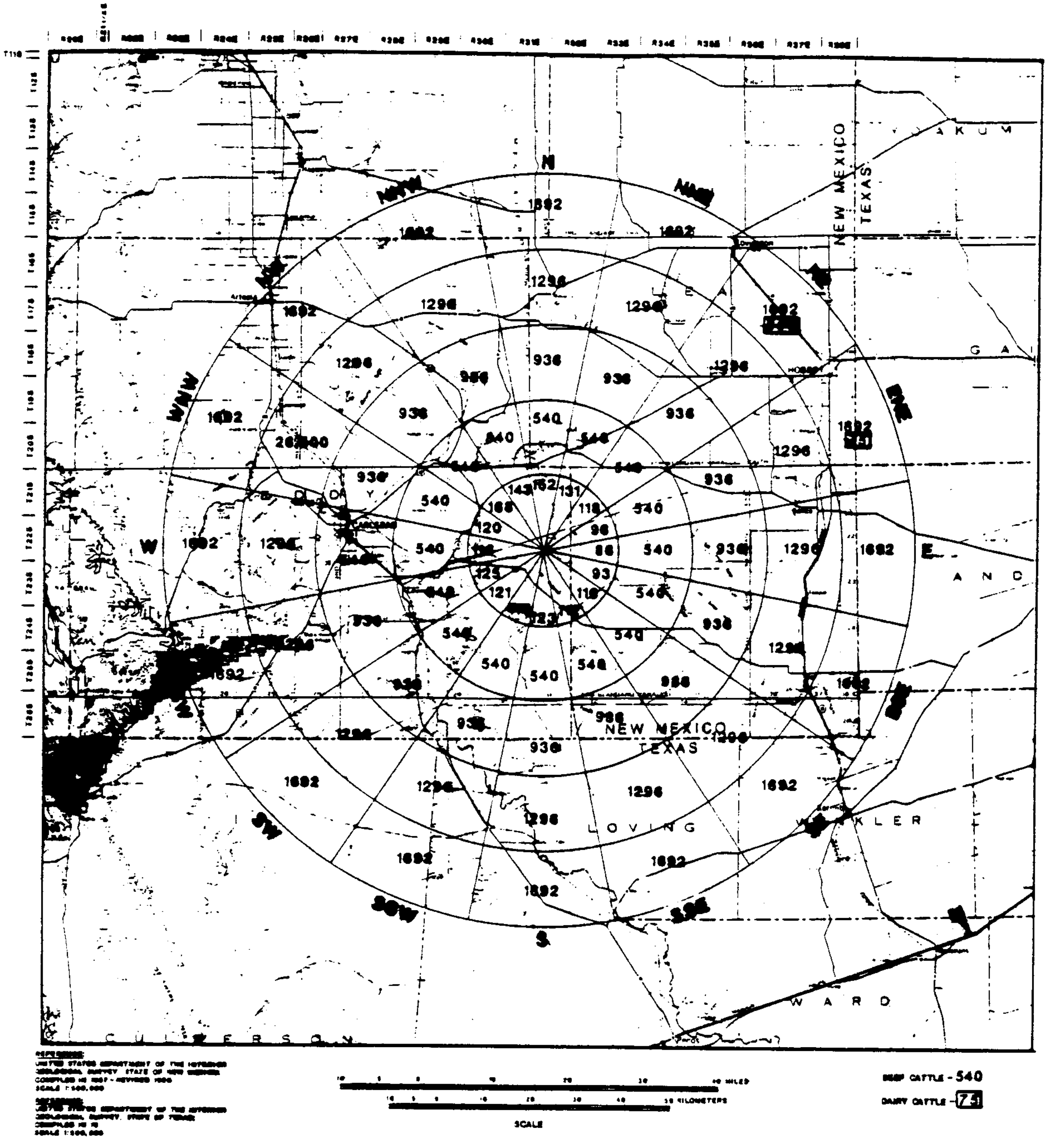

FIGURE 9-4 BEEF AND DAIRY CATTLE WITHIN 50 MILES OF WIPP

Input parameters used for terrestrial modeling and food crop transport and their bases are provided in Tables 9-6 and 9-7. As indicated, conservative assumptions were used in instances where published guidance was not available or was not relevant. The period of time allowed for long-term buildup of radioactivity on surface soils is 12.5 years, one-half of the anticipated operational life of the facility. Foraging animals are conservatively assumed to be on pasture during the entire year and not to receive any additional food supply. On the basis of a WIPP evaluation, the muscle mass of the steers at slaughter was assumed to be 200 kg (441 lb) and milk production was estimated at 11 liters/day (11.6 quarts/day). The fraction of the beef herd slaughtered each day is conservatively assumed to be 0.00274, which allows slaughtering the entire herd annually. It was also conservatively assumed that all of the leafy vegetables and 76 percent of other produce consumed by the local population are grown in the assessment area.

9.7 DOSE MODELING

Using the ground-level concentrations in air and ground deposition rates computed from the meteorological input, the code estimates intake rates at specified environmental locations and calculates the resultant doses through various modes of exposure. For the purpose of assessing the dose to the collective population, the air concentrations and ground deposition rates are average values in the cross wind direction over each sector. The average individual dose is then determined by dividing the population dose by the number of individuals in the exposed population. The dose to a maximum individual is determined directly by the code and assumes that the individual is located on the center line of the discharge plume at the point of highest off-site ground-level concentration. Human inhalation rates, ingestion rates and other factors utilized in modeling the dose receptors are summarized in Table 9-8.

The dose calculations include the following exposure pathways: (1) immersion in air, (2) exposure to contaminated ground surfaces, (3) inhalation of contaminated air, (4) immersion in water such as by swimming in a backyard pool, and (5) ingestion of food grown on contaminated land. The following organ doses were calculated: effective dose equivalent to the total body, lungs, red bone marrow, lower large intestine wall, stomach wall, kidneys, liver, endosteal cells, thyroid, testes, and ovaries. Fifty-year dose commitments

TABLE 9-6

TERRESTRIAL MODELING ASSUMPTIONS

PARAMETERS	VALUE (UNITS)	BASIS[1]
Buildup Time for Surface Deposition	4,562.5 (days)	
Fraction of Locally Grown Produce	1.0	Conservatism
Fraction of Radioactivity Retained on Leafy Vegetables After Washing	0.5	NRC, 1977
Time Delay for Ingestion:		
Pasture Grass by Animals	0 (hrs)	NRC, 1977
Stored Feed by Animals	2160 (hrs)	
Leafy Vegetables by Man	24 (hrs)	
Produce by Man	24 (hrs)	
Removal Rate Constant for Physical Loss by Weathering	2.1×10^{-3} (/hr)	NRC, 1977
Period of Exposure during Growing Season:		NRC, 1977
Pasture Grass	720 (hrs)	
Crops and Leafy Vegetables	1440 (hrs)	
Agricultural Productivity per Unit Area:		Baes and Orton, 1979
Grass-Cow-Milk Pathway	0.28 (kg/m^2)	
Produce and Leafy Vegetable	1.9 (kg/m^2)	
Effective Surface Density of Soil	240 (kg/m^2)	Moore et al., 1979
Fraction of Yearly and Daily Feed from Pasture	1.0	Conservatism
Consumption Rate of Contaminated Feed or Forage by Animals	15.6 (kg/day)	Baes and Orton, 1979
Transport Time from Animal feed-milk-man	2.0 (days)	NRC, 1977
Average Time from Slaughter of Meat to Consumption	20.0 (days)	NRC, 1977
Fraction of Meat Producing Herd Slaughtered Each Day	2.74×10^{-3}	Conservatism

TABLE 9-6

TERRESTRIAL MODELING ASSUMPTIONS
(CONTINUED)

PARAMETERS	VALUE (UNITS)	BASIS[1]
Muscle Mass of Meat Producing Animal	200 (kg)	Site specific evaluation
Milk Production of Cow	11 (l/day)	Site specific evaluation
Fallout Interception Fraction:		
Pasture	0.57	Miller, 1979
Vegetables	0.20	NRC, 1977
Fraction of Food Grown in Local Gardens:		Conservatism
Produce	0.76	
Leafy Vegetables	1.00	

[1] Values are as given in reference or are cited in the FSAR (DOE, 1988a).

TABLE 9-7

BIOACCUMULATION FACTORS*

ELEMENT	UPTAKE FRACTIONS MILK (DAYS/KG)	UPTAKE FRACTIONS MEAT (DAYS/KG)	CONCENTRATION FACTORS PASTURE	CONCENTRATION FACTORS CROPS
Co	2.0 E-03	2.0 E-02	2.0 E-02	3.1 E-03
Ni	1.0 E-03	6.0 E-03	6.0 E-02	2.6 E-02
Sr	1.5 E-03	3.0 E-04	2.5 E-00	1.1 E-01
Y	2.0 E-05	3.0 E-04	1.5 E-02	2.6 E-03
Ru	6.0 E-07	2.0 E-03	7.5 E-02	8.7 E-03
Rh	1.0 E-02	2.0 E-03	1.5 E-01	1.7 E-02
Sb	1.0 E-04	1.0 E-03	2.0 E-01	1.3 E-02
Te	2.0 E-04	1.5 E-02	2.5 E-02	1.7 E-03
Cs	7.0 E-03	2.0 E-02	8.0 E-02	1.3 E-02
Ba	3.5 E-04	1.5 E-04	1.5 E-01	6.5 E-03
Ce	2.0 E-05	7.5 E-04	1.0 E-02	1.7 E-03
Pr	2.0 E-05	3.0 E-04	1.0 E-02	1.7 E-03
Sm	2.0 E-05	5.0 E-03	1.0 E-02	1.7 E-03
Eu	2.0 E-05	5.0 E-03	1.0 E-02	1.7 E-03
Th	5.0 E-06	6.0 E-06	8.5 E-04	3.7 E-05
U	6.0 E-04	2.0 E-04	8.5 E-03	1.7 E-03
Pu	1.0 E-07	5.0 E-07	4.5 E-04	2.0 E-05
Np	5.0 E-06	5.5 E-05	1.0 E-01	4.4 E-03
Am	4.0 E-07	3.5 E-06	5.5 E-03	1.1 E-04
Cm	2.0 E-05	3.5 E-06	8.5 E-04	6.5 E-06

*From Baes et al., 1984

TABLE 9-8

DOSE RECEPTOR ASSUMPTIONS

PARAMETER	VALUE (UNITS)	BASIS
Breathing Rate of Man	9.47×10^5 (cm^3/min)	Conservatism
Depth of Water for Immersion Dose	244 (cm)	Conservatism
Fraction of Time Spent Swimming	0.01	Conservatism
Rate of Human Ingestion:		NRC, 1977
Average Individual:		
Produce	190 (kg/yr)	
Milk	110 (l/yr)	
Meat	95 (kg/yr)	
Leafy Vegetables	18 (kg/yr)	
Maximum Individual		
Produce	520 (kg/yr)	
Milk	310 (l/yr)	
Meat	110 (kg/yr)	
Leafy Vegetables	64 (kg/yr)	

are calculated assuming a one-year exposure for routine releases and a one-time exposure for accident releases.

The Dunning (1986) internal dose conversion factors are used in the calculations. The inhalation factors are based on the ICRP Task Group Lung Model (ICRP, 1979) which simulates the behavior of particulate matter in the respiratory tract. The inhalation factors used correspond to an activity median aerodynamic diameter (AMAD) of 1.0 microns. The ingestion factors are based on a four-segment catenary model with exponential transfer of radioactivity from one segment to the next. Retention of nuclides in other organs is represented by linear combinations of decaying exponential functions. In both the inhalation and ingestion models, cross-irradiation (irradiation of one organ by nuclides contained in another) is included.

The Dunning dose factors are based on the same ICRP and NCRP models endorsed by DOE (DOE, 1985b). Using DOE recommended methods, Dunning also calculated dose factors for 1.0 μm AMAD particles, but used the same organ uptake fractions for daughter isotopes as for the parent. Comparison of the Dunning dose factors with those recommended by DOE indicates that Dunning's approach is generally more conservative. External dose rate conversion factors developed by Kocher (1981) were used, as recommended by DOE.

Dose factors for the solubility class yielding the highest dose to each organ were used. For alpha emitters, a quality factor of 20 was used as recommended in ICRP Publication 26 (ICRP, 1977). Radionuclide specific input parameters are presented in Tables 9-9, 9-10, and 9-11.

Doses to members of the public will be compared to the limits mandated in draft DOE Order 5400.3 (DOE, 1988e) and 40 CFR Part 191 Subpart A (EPA, 1985a). A summary of dose limits is presented in Table 4-1. Measurements of radionuclide concentrations in effluent air streams will be made continuously during operations. The filters from the continuous air monitors (CAMs) will be monitored continuously for alpha and beta-gamma levels. Routine doses will be calculated using the total measured activity of each nuclide detected in the effluent air streams by the Fixed Air Samplers (FASs). Annual average meteorological data collected at the WIPP site will be used to estimate air

TABLE 9-9

RADIONUCLIDE SPECIFIC PARAMETERS

ISOTOPE	DECAY CONSTANT (/DAY)	PHOTON DOSE RATE CONVERSION FACTORS, KOCHER, 1981 IMMERSION IN AIR (REM-CM^3/μCi-HR)	IMMERSION IN WATER (REM-CM^3/μCi-HR)	SURFACE (REM-CM^2/μCi-HR)
Co-60	4.96 E-04	2.465 E+03	5.360 E+00	4.305 E-01
Ni-63	1.98 E-05	0	0	0
Sr-90	8.98 E-05	0	0	0
Y-90	2.60 E-01	0	0	0
Ru-106	1.88 E-03	0	0	0
Rh-106	2.00 E+03	2.030 E+02	4.390 E-01	4.052 E-02
Sb-125	2.50 E-01	4.204 E+02	9.159 E-01	8.948 E-02
Te-125m	1.20 E-02	3.018 E+01	7.766 E-02	1.359 E-02
Cs-134	9.21 E-04	1.524 E+03	3.288 E+00	3.001 E-01
Cs-137	8.72 E-05	0	0	0
Ba-137m	3.91 E+02	5.867 E+02	1.262 E+00	1.173 E-01
Ce-144	2.44 E-03	1.785 E+01	4.124 E-02	4.558 E-03
Pr-144	5.78 E+01	3.140 E+01	6.753 E-02	5.276 E-03
Sm-151	2.11 E-05	1.081 E-02	2.748 E-05	1.595 E-05
Eu-152	1.96 E-04	1.126 E+03	2.457 E+00	2.161 E-01
Eu-154	2.97 E-04	1.228 E+03	2.668 E+00	2.296 E-01
Th-232	1.35 E-13	1.034 E+00	2.612 E-03	2.363 E-03
U-233	1.17 E-08	6.288 E-01	1.561 E-03	1.156 E-03
U-235	2.67 E-12	1.443 E+02	3.233 E-01	3.988 E-02
U-238	4.22 E-13	1.038 E+00	2.654 E-03	2.519 E-03

TABLE 9-9

RADIONUCLIDE SPECIFIC PARAMETERS
(CONTINUED)

ISOTOPE	DECAY CONSTANT (/DAY)	PHOTON DOSE RATE CONVERSION FACTORS, KOCHER, 1981 IMMERSION IN AIR (REM-CM^3/μCi-HR)	IMMERSION IN WATER (REM-CM^3/μCi-HR)	SURFACE (REM-CM^2/μCi-HR)
Np-237	8.88 E-10	2.967 E+01	7.132 E-02	2.338 E-02
Pu-238	2.20 E-05	1.372 E+00	3.511 E-03	3.304 E-03
Pu-239	7.78 E-08	5.655 E-01	1.431 E-03	1.27 E-03
Pu-240	2.89 E-07	1.304 E+00	3.351 E-03	3.144 E-03
Pu-241	1.44 E-04	0	0	0
Pu-242	5.01 E-09	1.085 E+00	2.781 E-03	2.608 E-03
Am-241	4.14 E-06	2.486 E+01	6.161 E-02	1.781 E-02
Cm-244	1.08 E-04	1.274 E+00	3.275 E-03	2.895 E-03
Cf-252	7.18 E-04	9.495 E-01	2.443 E-03	1.967 E-03

TABLE 9-10
RADIONUCLIDE SPECIFIC PARAMETERS

ISOTOPE	ORGAN DOSE CORRECTION FACTORS, KOCHER, 1981										
	T.BODY	R.MAR.	LUNGS	ENDOST.	S.WALL	LLI WALL	THYROID	LIVER	KIDNEYS	TESTES	OVARIES
Co-60	.570	.540	.530	.560	.490	.490	.660	.500	.530	.700	.480
Ni-63	0	0	0	0	0	0	0	0	0	0	0
Sr-90	0	0	0	0	0	0	0	0	0	0	0
Y-90	0	0	0	0	0	0	0	0	0	0	0
Ru-106	0	0	0	0	0	0	0	0	0	0	0
Rh-106	.553	.528	.518	.582	.478	.468	.647	.484	.507	.692	.466
Sb-125	.539	.511	.502	.582	.461	.451	.631	.467	.489	.678	.447
Te-125m	.170	.032	.083	.137	.060	.052	.170	.061	.138	.260	.059
Cs-134	.560	.540	.530	.580	.490	.480	.662	.490	.520	.700	.480
Cs-137	0	0	0	0	0	0	0	0	0	0	0
Ba-137m	.558	.532	.522	.581	.482	.047	.655	.488	.512	.696	.473
Ce-144	.515	.388	.459	.721	.407	.390	.655	.414	.440	.674	.355
Pr-144	.612	.587	.579	.608	.538	.534	.700	.548	.582	.755	.507
Sm-151	.046	.005	.013	.019	.008	.008	.026	.005	.015	.063	.009
Eu-152	.560	.520	.520	.580	.480	.480	.660	.490	.520	.700	.470
Eu-154	.570	.530	.530	.580	.490	.490	.670	.500	.530	.710	.480
Th-232	.096	.043	.066	.111	.055	.051	.098	.058	.062	.114	.049
U-233	.191	.135	.161	.258	.142	.138	.228	.144	.146	.241	.125
U-235	.541	.480	.500	.722	.450	.442	.673	.456	.468	.690	.398
U-238	.050	.016	.028	.047	.022	.020	.042	.023	.024	.059	.020

TABLE 9-10

RADIONUCLIDE SPECIFIC PARAMETERS
(CONTINUED)

ISOTOPE	T.BODY	R.MAR.	LUNGS	ENDOST.	S.WALL	LLI WALL	THYROID	LIVER	KIDNEYS	TESTES	OVARIES
	ORGAN DOSE CORRECTION FACTORS, KOCHER, 1981										
Np-237	.391	.257	.339	.559	.294	.279	.496	.304	.321	.515	.259
Pu-238	.033	.004	.010	.015	.007	.007	.014	.006	.007	.035	.007
Pu-239	.074	.039	.049	.077	.042	.041	.068	.041	.042	.087	.037
Pu-240	.034	.005	.011	.016	.007	.007	.016	.007	.008	.037	.007
Pu-241	0	0	0	0	0	0	0	0	0	0	0
Pu-242	.035	.005	.011	.018	.008	.008	.017	.007	.008	.038	.008
Am-241	.385	.171	.317	.570	.261	.231	.504	.285	.317	.528	.221
Cm-244	.034	.004	.009	.012	.005	.006	.012	.004	.005	.037	.006
Cf-252	.042	.007	.013	.020	.009	.009	.019	.008	.008	.047	.009

TABLE 9-11

RADIONUCLIDE SPECIFIC PARAMETERS, INHALATION

50-YEAR COMMITTED DOSE FACTORS - DUNNING, 1986

SOL[1]	ISOTOPE	EFFECTIVE	RED MARROW	LUNGS	ENDOSTEAL	STOMACH WALL	LLI WALL	THYROID	LIVER	KIDNEYS	TESTES	OVARIES
Y*	CO-60	2.2 E-01	6.4 E-02	1.3 E+00	5.0 E-02	1.0 E-01	3.0 E-02	6.0 E-02	1.2 E-01	5.8 E-02	9.9 E-03	1.8 E-02
D	Ni-63	3.1 E-03	3.0 E-03	1.1 E-02	3.0 E-03	3.1 E-03	3.5 E-03	3.0 E-03	3.0 E-03	3.0 E-03	3.0 E-03	3.0 E-03
Y	Sr-90	1.3 E+00	1.1 E+00	1.1 E+01	2.5 E+00	8.6 E-03	7.6 E-02	8.5 E-03	8.8 E-03	8.5 E-03	8.5 E-03	8.5 E-03
Y	Y-90	8.4 E-03	1.0 E-03	3.4 E-02	1.0 E-03	1.6 E-03	4.7 E-02	3.5 E-05	1.0 E-03	3.5 E-05	3.5 E-05	3.5 E-05
Y	Ru-106	4.8 E-01	5.1 E-02	3.8 E+00	5.1 E-02	5.3 E-02	1.4 E-01	5.1 E-02	5.2 E-02	5.2 E-02	5.2 E-02	5.2 E-02
D	Rh-106	1.5 E-06	1.1 E-08	1.2 E-05	1.0 E-08	3.8 E-07	4.8 E-09	1.1 E-08	1.8 E-08	1.0 E-08	4.4 E-09	5.2 E-09
W	Sb-125	1.2 E-02	2.2 E-03	8.0 E-02	1.2 E-02	2.3 E-03	1.2 E-02	1.2 E-03	3.9 E-03	1.2 E-03	9.0 E-04	1.3 E-03
W	Te-125m	7.3 E-03	1.1 E-02	3.8 E-02	1.2 E-01	4.6 E-04	8.1 E-03	3.7 E-04	3.8 E-04	3.7 E-04	3.4 E-04	4.6 E-04
D	Cs-134	4.6 E-02	4.4 E-02	4.3 E-02	4.0 E-02	4.6 E-02	5.1 E-02	4.1 E-02	4.7 E-02	4.7 E-02	4.8 E-02	4.2 E-02
D	Cs-137	3.2 E-02	3.1 E-02	3.2 E-02	3.0 E-02	3.2 E-02	3.3 E-02	2.9 E-02	3.2 E-02	3.2 E-02	3.2 E-02	3.0 E-02
D	Ba-137m	6.5 E-07	1.3 E-07	4.0 E-06	1.1 E-07	8.3 E-07	3.9 E-08	1.2 E-07	2.3 E-07	1.3 E-07	2.4 E-08	4.0 E-08
Y	Ce-144	3.8 E-01	9.5 E-02	2.9 E+00	1.7 E-01	1.0 E-02	1.3 E-01	6.9 E-03	9.4 E-01	8.2 E-03	6.9 E-03	7.1 E-03
Y	Pr-144	4.3 E-05	6.7 E-07	3.5 E-04	6.7 E-07	2.0 E-05	6.0 E-07	5.9 E-07	1.2 E-06	8.9 E-07	5.6 E-07	5.7 E-07
W	Sm151	3.0 E-02	4.1 E-02	1.2 E-02	5.1 E-01	4.4 E-05	1.9 E-03	6.8 E-07	1.4 E-01	1.2 E-06	6.4 E-07	7.8 E-07
W	Eu-152	2.2 E-01	2.9 E-01	2.1 E-01	8.9 E-01	7.4 E-02	5.6 E-02	3.1 E-02	1.3 E+00	1.4 E-01	2.4 E-02	4.8 E-02
W	Eu-154	2.9 E-01	3.9 E-01	2.9 E-01	1.9 E+00	6.6 E-02	6.6 E-02	2.6 E-02	1.6 E+00	1.2 E-01	2.2 E-02	4.3 E-02
W	Th-232	1.6 E-03	3.3 E+03	3.5 E+03	4.1 E+04	2.8 E+00	2.9 E+00	2.8 E+00	2.3 E+01	2.9 E+00	2.8 E+00	2.8 E+00
Y	U-233	1.3 E+02	2.5 E+00	1.1 E+03	4.0 E+01	9.1 E-02	1.2 E-01	9.0 E-02	9.0 E-02	1.6 E+01	9.0 E-02	9.0 E-02
Y	U-235	1.2 E+02	2.5 E+00	1.0 E+03	3.8 E+01	8.7 E-02	1.3 E-01	8.7 E-02	8.7 E-02	1.5 E+01	8.6 E-02	8.6 E-02
Y	U-238	1.2 E+02	2.4 E+00	9.8 E+02	3.5 E+01	8.0 E-02	1.2 E-01	7.9 E-02	8.2 E-02	1.4 E+01	8.0 E-02	7.9 E-02
W	Np-237	5.0 E+02	7.1 E+02	6.0 E+01	8.8 E+03	8.0 E-02	1.5 E-01	4.1 E-02	1.9 E+03	1.5 E-01	1.1 E+02	1.1 E+02
W	Pu-238	4.6 E+02	6.5 E+02	1.2 E+03	8.1 E+03	6.0 E-03	1.2 E-01	3.5 E-03	1.8 E+03	3.7 E-03	1.0 E+02	1.0 E-02
W	Pu-239	5.2 E+02	7.3 E+02	1.2 E+03	9.1 E+03	5.6 E-03	1.1 E-01	3.3 E-03	2.0 E+03	3.4 E-03	1.2 E+02	1.2 E+02
W	Pu-240	5.2 E+02	7.3 E+02	1.2 E+03	9.1 E+03	5.6 E-03	1.1 E-01	3.3 E-03	2.0 E+03	3.5 E-03	1.2 E+02	1.2 E+02
W	Pu-241	1.0 E+01	1.5 E+01	1.2 E+01	1.9 E+02	1.6 E-04	6.7 E-04	5.6 E-05	3.8 E+01	3.2 E-04	2.5 E+00	2.5 E+00
W	Pu-242	4.9 E+02	6.9 E+02	1.1 E+03	8.7 E+03	5.7 E-03	1.1 E-01	3.3 E-03	1.9 E+03	4.1 E-03	1.1 E+02	1.1 E+02
W	Am-241	5.3 E+02	7.5 E+02	6.8 E+01	9.4 E+03	1.4 E-02	1.2 E-01	6.3 E-03	2.0 E+03	2.1 E-02	1.2 E+02	1.2 E+02
W	Cm-244	2.8 E+02	3.9 E+02	7.1 E+01	4.8 E+03	6.3 E-03	1.2 E-01	3.8 E-03	1.1 E+03	3.9 E-03	5.9 E+01	5.9 E+01
Y	Cf-252	1.5 E+02	1.4 E+02	1.1 E+03	1.8 E+03	6.1 E-01	5.0 E-01	2.2 E-01	4.7 E+02	8.5 E-01	2.0 E+01	2.0 E+01

(1)Solubility class yielding highest effective dose for particle size of 1 micron. All other organ dose factors are those yielding highest dose irrespective of solubility class.

*D, W, and Y refer to lung clearance rate in days, weeks or years.

dispersion of radionuclides at receptor locations. Doses resulting from accidental releases will be calculated based on measured radionuclide concentrations in the effluent air stream using meteorological parameters measured during the release to estimate dispersion characteristics of the plume. Procedures for analysis of effluent monitoring samples will be included in the Environmental Procedures Manual.

10.0 REQUIRED RECORDS AND REPORTS

The record-keeping and reporting requirements applicable to the radiological and nonradiological environmental surveillance programs (OEMP) at WIPP are identified in the WIPP Environmental Procedures Manual (WP 02-03). This program plan defines and delineates the responsibilities for compliance with DOE Orders 1324.2 (DOE, 1982a), 5400.1 (DOE, 1988d), 5484.1 (DOE, 1981a), and 5700.6B (DOE, 1986c). The final due dates and distribution of routine reports are also indicated in WP 02-03. The following sections identify WIPP record-keeping and reporting procedures for compliance with applicable DOE orders.

Record Keeping

Records generated by operational effluent and environmental surveillance activities are controlled and maintained in accordance with DOE Order 1324.2 (DOE, 1982a), WIPP Records Management Procedures (WP 15-030), and WIPP Document Control Procedures (WP 15-006). All original records are maintained in a fire-proof file cabinet at WIPP until transmitted to the WIPP Master Records Center for permanent filing (WP 15-030). All records, including raw data, calculations, computer programs or other data manipulation, are subject to review and verification under the WIPP Quality Assurance Program.

Records (such as reports of analyses and sample receipt forms transmitted by contract analytical laboratories) are dated upon receipt and a copy made for QC review as specified in NES/RES QA/QC Implementation Procedures (WP 02-302). Specific record and data management procedures including the recording and referencing of data manipulations are implemented according to the Water Quality Sampling Manual (WP 7-2), RES Data Management Procedure (WP 02-305), and NES Data Management Procedure (WP 02-334).

Interpretive rule 10 CFR Part 962 Radioactive Waste, By-product Material (DOE, 1987), states that the hazardous component of radioactive mixed waste is subject to regulation under the Resource Conservation and Recovery Act (RCRA). In accordance with 10 CFR Part 962, WIPP must comply with all applicable regulations specified in 40 CFR Parts 260-268 and 270 (EPA 1980a-f, 1985d, 1981, 1986a, 1983a). WIPP complies with applicable hazardous waste regulations regarding operating records, reporting and availability and retention of records as determined by DOE and EPA.

WIPP will voluntarily comply with record-keeping requirements as promulgated under 40 CFR Part 61, Subpart H (EPA, 1985b), which pertain to atmospheric radionuclide emissions (WP 02-301). In addition, unless regulations are amended in the future, records development pursuant to these criteria will be maintained at least 30 years, as specified in DOE 1324.2 (DOE, 1982a), Chapter V, Attachment 1, Schedule 25 (Medical, Health and Safety Records).

Reporting

The WIPP Operational Environmental Monitoring Plan will be reviewed and updated at least every three years in accordance with DOE Order 5400.1 (DOE, 1988d). Changes will be made as new regulations are promulgated which specify record-keeping and reporting requirements applicable to the environmental monitoring program at WIPP.

The annual WIPP Environmental Monitoring Report will be prepared according to DOE Orders 5484.1 (DOE, 1981a) and 5400.1 (DOE, 1988d). This report will summarize the degree of environmental compliance with applicable environmental regulations (see Table 4-1) and inform the public as to the impact of the operations at WIPP on the surrounding environment. The final report covering the previous year will be submitted to DOE Environmental Safety and Health Division, Albuquerque Operations Office by May 1 of each year.

The WIPP Annual Environmental Monitoring Data Report, as required by DOE Order 5484.1 (DOE, 1981a), will be prepared on the previous year's data and submitted to the Information System Branch, EG&G, Idaho, Inc., by April 1, with a copy of the cover letter to DOE Albuquerque Operations Office. Effluent Information System (EIS) and Onsite Discharge Information System (ODIS) Users Manual 101771, will be used for compiling and transferring data reports to EG&G, Idaho, Inc.

To voluntarily comply with record-keeping requirements of 40 CFR §61.94 (EPA, 1985b), the WIPP Annual Radionuclide Air Emissions Report will be submitted by April 15 to DOE Albuquerque Operations Office for emissions covering the previous calendar year.

Notification of Occurrence will be prepared, as necessary, according to DOE Order 5484.1, Chapter 1 (DOE, 1981a), for reporting, analyzing and disseminating information on significant events at WIPP. A Preoperational Environmental Survey report will be prepared before using new facilities or processes at WIPP that have the potential for adverse environmental impact, or which will process, release or dispose of radioactive materials (DOE, 1984a). An Annual Environmental Status Sheet will also be prepared and submitted to DOE with an up-to-date summary of information regarding the environmental status of WIPP.

DOE Order 5480.14 specifies instructions for implementing a DOE Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program (DOE, 1985c). No inactive hazardous-waste disposal sites requiring remedial action under CERCLA exist at WIPP. WIPP will notify the National Response Center in the case of a release of "reportable quantities" of radionuclides or other hazardous substances at WIPP as required by CERCLA §102(a) (DOE, 1985c).

A WIPP Hazardous Waste Management Plan will be submitted annually to DOE Albuquerque Operations Office as required by DOE Order 5480.2 (DOE, 1982b). WIPP will also comply with applicable reporting requirements under 40 CFR Part 264 or 265 (EPA, 1980e, f) for the hazardous components of mixed radioactive wastes as determined by DOE and EPA.

The EPA has promulgated environmental standards for the management and disposal of transuranic radioactive wastes under the authority of the EPA and the Nuclear Waste Policy Act (NWPA). The EPA has not specified reporting requirements applicable to the WIPP under this regulation.

The Office of Management and Budget Circular A-106, "Reporting Requirements in Connection with the Prevention, Control, and Abatement of Environmental Pollution at Existing Federal Facilities" (OMB, 1975), established a semiannual reporting requirement for implementing Sections 1 through 4 of Presidential Executive Order 12088 and Presidential Executive Order 11752 pertaining to the control of environmental pollution from existing federal facilities. The plans, to be submitted on December 31 and June 30, identify projects necessary to bring federal facilities into compliance with applicable environmental standards. WIPP will be in compliance with all applicable environmental regulations when it begins receiving waste; therefore, this report will not be required by WIPP.

11.0 QUALITY ASSURANCE

This section defines the policies and practices that are applied to provide confidence in the quality of the data generated by the Operational Environmental Monitoring Plan at WIPP. Quality Assurance (QA) activities associated with the plan will include:

- Organization of participants
- Documented QA program
- Design control
- Procurement document control
- Instructions, procedures, and drawings
- Document control
- Control of purchased items
- Identification and control of items
- Control of processes
- Inspection
- Test control
- Control of measuring and test equipment
- Handling, storage, and shipping
- Inspection, test, and operating status
- Control of noncompliance items
- Corrective actions
- Quality assurance records
- Audits.

These QA activities are made in accordance with the following documents:

Management and Operating Contractor (Westinghouse) Quality Program Manual (WP-QPM) - Outlines the overall QA policy for the WIPP Project.

Water Quality Sampling Manual (WP 07-2) - Includes the detailed procedures necessary to perform individual activities related to the water quality sampling program.

Environmental Procedures Manual (WP 02-03) - Includes the detailed procedures necessary to perform individual Radiological and Environmental Programs Section activities.

WIPP Procedure Manuals - A series of manuals and single procedures which describe actions required to complete a range of WIPP Project tasks (e.g., calibration, records management, and procurement).

Adherence to the policies and procedures in these documents ensures compliance with federal QA regulations including: ANSI NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities," (ANSI, 1986) and EPA, QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project

Plans," (EPA, 1983b). This section fulfills the requirements of a QA plan specified in DOE Orders 5400.1 (DOE, 1988d), 5400.3 (DOE, 1988e), 5700.6B (DOE, 1986c) and DOE 5400.xy (DOE, 1988f). All procedures manuals are reviewed regularly and are updated and enlarged as necessary.

ORGANIZATION

DOE has overall responsibility for QA at WIPP. The WIPP QA program is implemented through the combined efforts of the DOE and the major project participants. The Environmental Monitoring Program is the responsibility of the Management and Operating Contractor (Westinghouse). The organizational structure, functional responsibilities, levels of authority and lines of communication for quality-related activities at WIPP are presented in Section I of the WP-QPM. Organizational responsibilities specific to the Operational Environmental Monitoring Plan are contained in the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2).

QUALITY ASSURANCE PROGRAM

Section II of the WP-QPM discusses the WIPP QA program's applicability, program description, documentation of the program, control of the program manual, indoctrination and training, resolution of disputes and manager responsibilities. Specific quality-related activities of the Environmental Monitoring Plan are included in the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2).

DESIGN CONTROL

Section III of the WP-QPM establishes the requirements and responsibilities for control of design activities and performance of technical reviews. Specific requirements for design control related to the Environmental Monitoring Plan are included in the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2) and will be in accordance with WIPP Procedure WP 09-012.

PROCUREMENT DOCUMENT CONTROL

Section IV of the WP-QPM establishes the policy requirements and associated responsibilities for the preparation, review, and control of procurement documents. The procurement of items and services for the Environmental Monitoring Plan will be in accordance with WIPP Procedure WP 15-009.

INSTRUCTIONS, PROCEDURES, AND DRAWINGS

Section V of the WP-QPM establishes the provisions and responsibilities for the preparation and use of instructions, procedures, and drawings when performing quality related activities. Procedure preparation, review, approval, control and revision will be done in accordance with the requirements of WIPP Procedure WP 15-101. The approved procedures will be included within the Water Quality Sampling Manual (WP 07-2) and the Environmental Procedures Manual (WP 02-03), as appropriate.

DOCUMENT CONTROL

Section VI of the WP-QPM establishes the requirements for the preparation, review, approval, issuance, and control of documents. It specifies the requirements that are considered necessary to ensure that documents such as procedures, instructions, and drawings (including changes) are properly controlled when used for the performance of quality-related activities. It also requires that a system be established and maintained for controlling documents which are prepared by other WIPP participants for the performance of quality-related activities. This system is contained in WIPP Procedure WP 15-006. Specific requirements for document control related to the Environmental Monitoring Plan are contained in the Environmental Procedures Manual (WP 02-03).

CONTROL OF PURCHASED ITEMS AND SERVICES

Section VII of the WP-QPM establishes the policy requirements and associated responsibilities for the control of purchased materials, equipment and services. Procedures for such control are contained in the Purchasing Policies and Procedures Manual WP 15-6.

IDENTIFICATION AND CONTROL OF ITEMS

Section VIII of the WP-QPM establishes the measures to ensure that only correct and accepted items are used. Procedures for the control of items are contained in the Property Management Manual WP 15-5. Requirements for the identification and control of items related specifically to the Environmental Monitoring Plan (e.g., samples) are contained in the Water Quality Sampling Manual (WP 07-2) and the Environmental Procedures Manual (WP 02-03).

CONTROL OF PROCESSES

Section IX of the WP-QPM describes the measures employed to ensure that processes are performed by qualified personnel using approved procedures and are accomplished under controlled conditions in accordance with applicable codes, standards, and specifications. Requirements for the control of processes specific to the Environmental Monitoring Plan, including sample collection and preservation, are contained in the Water Quality Sampling Manual (WP 07-2) and the Environmental Procedures Manual (WP 02-03).

INSPECTION

Section X of the WP-QPM describes the general inspection program applied to all facility operations (e.g., inspection of procured and constructed items and project participant overview). Requirements for inspections specifically related to Environmental Monitoring Plan activities, such as sample equipment operation checks and chemical reagent integrity checks, are described in the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2).

TEST CONTROL

Section XI of the WP-QPM describes the measures to be taken to ensure that test activities are accomplished in accordance with appropriate written procedures or checklists under suitably controlled conditions and that test results are properly documented and evaluated. Analyses of environmental samples will be performed in accordance with EPA, American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI) or other nationally accepted methods. Specific field testing procedures of the Environmental Monitoring Plan are controlled by the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2).

CONTROL OF MEASURING AND TEST EQUIPMENT

Section XII of the WP-QPM establishes the requirements for the control of all measuring and test devices used. These requirements will ensure that all measuring and test devices are properly controlled, calibrated, and adjusted at specified periods to maintain accuracy within specified limits.

Periodic calibration of measuring and test devices will be performed by the Westinghouse Calibration Laboratory in accordance with WIPP Procedure WP 10-003. Operational calibration (performed as part of instrument usage) and standardization of equipment, when required, will be performed in accordance with the individual procedures contained in the Water Quality Sampling Manual (WP 07-2) and the Environmental Procedures Manual (WP 02-03). All equipment used will be of proper type, range, accuracy, and precision to provide data compatible with the specific testing requirements. All standards used in calibration will be traceable to the National Bureau of Standards (NBS) or other standards recognized by the DOE.

HANDLING, STORAGE, AND SHIPPING

Section XIII of the WP-QPM describes the requirements necessary to ensure that the handling, storage, and shipping of items are controlled and performed in accordance with established instructions, specifications, procedures or drawings. The handling, storage, and shipping of samples collected for the Environmental Monitoring Plan are controlled by the Water Quality Sampling Manual (WP 07-2) and the Environmental Procedures Manual (WP 02-03). Extensive sample documentation for chain of custody tracking ensuring sample integrity is included in the above mentioned procedures manuals.

INSPECTION, TEST, AND OPERATIONS STATUS

Section XIV of the WP-QPM describes the overall measures to be used to ensure that the status of items with regard to required inspections and tests is clearly indicated. The status of test activities related to the Environmental Monitoring Plan is generally indicated on documents traceable to the items tested. Specific requirements for documenting test status are contained in the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2).

CONTROL OF NONCONFORMING ITEMS

Section XV of the WP-QPM describes the system for ensuring that appropriate measures are established to control nonconforming conditions that are detected during the procurement, installation, testing or operation of facility equipment, components, systems or structures. Procedures used for noncompliance control are included in WIPP Procedure WP 13-003.

CORRECTIVE ACTION

Section XVI of the WP-QPM establishes requirements necessary to identify, document, and complete appropriate corrective actions after encountering conditions adverse to quality. Procedures controlling corrective actions are contained in WIPP Procedure WP 13-001.

QUALITY ASSURANCE RECORDS

Section XVII of the WP-QPM provides the policy regarding identification, preparation, collection, storage, maintenance, disposition and permanent storage of QA records associated with site activities. Records management procedures controlling the management of all records are contained in WP 15-030. Procedures specific to the Environmental Monitoring Plan are contained in the Environmental Procedures Manual (WP 02-03) and the Water Quality Sampling Manual (WP 07-2).

AUDITS

Section XVIII of the WP-QPM establishes provisions and responsibilities for audits conducted to evaluate the effectiveness of the WIPP Quality Assurance Program. Periodic audits will be performed in accordance with the WIPP Procedures WP 13-004, WP 13-005, and WP 13-006.

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APPENDIX A

DOE 5400.xy REQUIREMENTS

This appendix provides specific responses to the requirements statements in DOE Order 5400.xy as required in DOE Order 5400.xy, Chapter I.

DOE ORDER 5400.xy REQUIREMENTS

COMMENT	RESPONSE
GENERAL	
Chapter I.1 - Operators of DOE-controlled facilities shall provide the capabilities to detect and quantify unplanned releases of radionuclides, consistent with the potential for offsite impact, and to support consequence assessments as necessary.	The capabilities to detect and quantify unplanned releases have been developed and provided at WIPP.
Chapter I.2 - To the extent applicable and practicable, the recommendations found in this Order shall be incorporated into the design and operation of effluent monitoring and environmental surveillance systems.	The provisions of DOE Order 5400.xy have been considered in the design and operation of the environmental monitoring program at WIPP.
Documentation of the decisions made concerning incorporation of the specific guidance statements, including a description of any alternative methods selected, shall be included in the site Environmental Monitoring Plan.	Appendices A and B of the OEMP provide documentation of decisions regarding incorporation of DOE Order 5400.xy guidance.
Chapter I.3 - Documentation of the various alarm settings and the bases for their selection shall be provided in the Environmental Monitoring Plan as described by the requirements listed in Attachment 3 (Summary of Requirements).	As appropriate, alarm settings and their bases will be provided in the OEMP as they are developed.

COMMENT	RESPONSE
The cognizant field element shall provide appropriate review and concurrence.	The DOE Albuquerque Operations Office has provided review and concurrence as appropriate.
EFFLUENT MONITORING - LIQUID RELEASES	
Chapter II.1.a - All effluent streams shall be evaluated and their potential for release of radioactive material assessed. Based on this assessment, the rationale for the effluent monitoring system(s) shall be documented in the Environmental Monitoring Plan.	Routine liquid effluent streams are limited to sanitary wastes. Liquids from the Waste Handling Building sump are discharged to the liquid waste treatment facility only after sampling and analysis. See Section 6.1 of the Operational Environmental Monitoring Plan (OEMP) for a description of the Liquid Effluent Monitoring Program.
Chapter II.1.b - Liquid effluents from DOE facilities shall be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.3.	Liquid Effluent Monitoring will comply with the requirements of DOE Orders 5400.1 and 5400.3.
Chapter II.2 - Facility operators shall provide monitoring of liquid waste streams adequate to (1) demonstrate compliance with the requirements of DOE 5400.3, Chapter II, paragraph 2.a(1); (2) quantify radionuclides discharged from each release point; and (3) alert process operators of upsets in processes and emission controls.	Monitoring of liquid effluents will be performed semiannually. Since there are no direct pathways for radioactive materials to liquid waste streams, all discharges for contaminants into liquid effluents are expected to be well below DCG values.

COMMENT	RESPONSE
Where continuous monitoring is provided, the overall accuracy of the results shall be determined (± percent accuracy and the percent confidence level) and documented in the Environmental Monitoring Plan.	Continuous monitoring is not required for WIPP because there is no discharge of contaminants to the sewage system.
Provisions for monitoring of liquid effluents during an emergency shall be considered when determining routine liquid effluent monitoring program needs.	During emergency situations, e.g., fire suppression system discharge, liquids will be collected in sumps and analyzed prior to treatment or discharge.
Chapter II.3 - The selection or modification of a liquid effluent monitoring system shall be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.	See above, Chapter II.2, for an analysis of the liquid effluent monitoring system.
For all new or modified facilities coming on-line, a preoperational assessment shall be made and documented in the Environmental Monitoring Plan to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.	All liquid discharges will be monitored and will meet discharge limits.

COMMENT	RESPONSE
The performance of the effluent monitoring systems shall be sufficient to enable the managers and/or contractor to determine whether effluent releases of radioactive material are within the limits specified in DOE Order 5400.3.	Procedures and administrative controls will ensure discharges are within appropriate limits.
The required detection levels of the analysis and monitoring systems shall be based on the characteristics of the radionuclides that are present or expected to be present in the effluent.	Required detection levels will be consistent with appropriate DOE limits.
Chapter II.3.b - Sampling systems shall be sufficient to collect representative samples that provide for an adequate record of releases from a facility and to predict trends and long-term monitoring needs.	The sampling program will provide sufficient information. Trend analysis of data will predict long-term needs.
Sampling and monitoring equipment shall be calibrated when installed and recalibrated any time it is subject to maintenance or modification that may affect equipment calibration.	Continuous monitoring systems are not required. Maintenance and calibration of grab sampling and analysis equipment will be in accordance with DOE requirements.
Sampling and monitoring systems shall be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	Continuous monitoring is not required. The samples taken are grab samples and undergo specific radioanalytical assay in accordance with standard analytical methods.

COMMENT	RESPONSE
Chapter II.3.c - Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) shall be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.	Continuous monitoring is not required; only grab sampling will be performed and no on line monitoring systems will be used.
Chapter II.4.b - If continuous monitoring and recording of the effluent quantity (stream flow) is not feasible for a specific effluent stream, the extenuating circumstances shall be documented in the Environmental Monitoring Plan.	Continuous monitoring is not required. The rationale for grab sampling of liquid effluent is discussed in Section 6.1 of the Operational Environmental Monitoring Plan.
Chapter II.6 - To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits given in DOE Order 5400.3, continuous monitoring systems shall have alarms set to provide timely warnings when concentrations of radionuclides increase significantly.	As discussed above, continuous monitoring is not required.
Chapter II.7 - As they apply to the monitoring of liquid effluents, the general quality assurance program provisions described in Chapter X shall be followed.	Appropriate provisions of the quality assurance requirements have been incorporated into the monitoring of liquid effluents.

COMMENT	RESPONSE
EFFLUENT MONITORING - ATMOSPHERIC EMISSIONS	
Chapter III.1.a - All sources (facilities) of airborne emissions from each facility (DOE site) shall be evaluated and their potential for release of radionuclides assessed. Based on this assessment, the rationale for the effluent monitoring system(s) shall be documented in the site Environmental Monitoring Plan.	Potential sources have been evaluated and all potential paths will be continuously monitored. All exhaust points are monitored as discussed in Section 6.2 of the Operational Environmental Monitoring Plan (OEMP).
Chapter III.1.b - Atmospheric emissions from DOE-controlled facilities shall be monitored in accordance with the requirements of DOE Orders 5400.1 and 5400.3.	The monitoring program discussed in Section 6.2 of the OEMP does meet the requirements of DOE Orders 5400.1 and 5400.3.
Chapter III.2 - The criteria for monitoring (listed in Figure III-1) shall be used for establishing the airborne effluent monitoring programs for DOE-controlled sites.	The Projected Dose Equivalent in a year to a member of the public is less than 1 mrem whole body and less than 3 mrem to any organ (see WIPP FSAR, Chapter 6) (DOE, 1988a). Based on this information, only periodic confirmation sampling and analysis would be required. However, due to the R&D aspects of WIPP, a more extensive sampling and analysis program has been developed and is presented in Section 6.2 of the OEMP.

COMMENT	RESPONSE
Chapter III.4 - For all new or modified facilities coming on-line, a preoperational assessment shall be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of atmospheric emmissions to be expected from the facility, and to establish the associated atmospheric emmission monitoring needs of the facility.	Evaluations of atmospheric effluents were performed and evaluated in the WIPP FEIS (DOE, 1980) and WIPP FSAR (DOE, 1988a). A preoperational assessment of WIPP has been conducted and is documented in the Operational Environmental Monitoring Plan.
The performance of the atmospheric emissions monitoring systems shall be sufficient to enable the DOE contractor to determine whether the releases of radioactive materials are within the limits specified in DOE 5400.3.	The monitoring program discussed in Section 6.2 of the OEMP is sufficient to determine whether releases of radioactive materials are within the specified limits.
Sampling and monitoring equipment shall be calibrated when installed and recalibrated any time it is subject to maintenance or modification that may effect equipment calibration.	The requirements of Section XII of the WIPP Quality Program Manual will ensure that all measuring and test devices are properly controlled, calibrated, and adjusted at specified periods to maintain accuracy within specified limits.
Sampling and monitoring systems shall be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	The sampling and monitoring systems will be calibrated at least annually in accordance with the WIPP Quality Procedures Manual. Routine performance checks with known sources, when appropriate, will be conducted as specified in operating procedures to ensure equipment is functioning properly.

COMMENT	RESPONSE
Chapter III.4.a - Provisions for monitoring of atmospheric emissions during accident situations shall be considered when determining routine atmospheric emmission monitoring program needs.	An extensive Continuous Air Monitor (CAM) system is in place for routinely monitoring airborne effluents.
Chapter III.4.b - Diffuse sources (i.e., area sources or multiple point sources in a limited area) shall be identified and assessed for potential to contribute to public dose and shall be considered in designing the site effluent monitoring and environmental surveillance program. Diffuse sources that may contribute a significant fraction (e.g., ten percent) of the dose to members of the public resulting from site operations shall be initially identified, assessed, and documented.	No diffuse sources which could contribute significantly to the dose to the public have been identified.
Chapter III.5.a - Airborne effluent sampling and monitoring systems shall provide quantification of atmospheric emissions that are timely, representative, and adequately sensitive.	Texas A & M University has conducted design and testing of the airborne effluent sampling and monitoring systems. Underground CAMs are monitored routinely in the Central Monitoring Station (CMS) and will provide alarms and timely shunting of flow through the HEPA filter system, if necessary.

COMMENT	RESPONSE
Chapter III.7 - To signal the need for corrective actions that may be necessary to prevent public or environmental exposures exceeding the limits given in DOE Order 5400.3, continuous monitoring systems (as required by the criteria in Figure III-1) shall have alarms set to provide timely warnings when the concentration of radionuclides increases significantly.	The CAMs in the underground exhaust stack and in the exhaust duct of the Waste Handling Building are equipped to alarm at the Central Monitoring Station. The same is true of the CAMs in the Waste Handling Building and underground working areas.
Chapter III.8 - As they apply to the monitoring of atmopheric emissions, the general quality assurance program provisions discussed in Chapter X shall be followed.	The airborne monitoring incorporates the requirements of the quality assurance program as appropriate.
METEOROLOGICAL MONITORING PROGRAM	
Chapter IV.1.a - Each DOE site shall establish a meteorological monitoring program that is appropriate to the activities at the site, the topographical characteristics of the site, and the distance to critical receptors.	The meteorological program, described in Section 6.3 of the Operational Environmental Monitoring Plan, meets the requirements of DOE Order 5400.xy.

COMMENT	RESPONSE
The scope of the program shall be based on an evaluation of the regulatory requirements, meteorological data needed for impact assessments, environmental surveillance activities, and emergency response, considering the mathematical procedures, models, and input data requirements necessary for computing atmospheric transport and diffusion computations and performing dose assessments.	The scope of the present monitoring programs exceeds the requirements based on the evaluation of the needs addressed in FSAR (DOE, 1988a).
The program shall be documented in a meteorological monitoring section of the Operational Environmental Monitoring Plan in compliance with DOE Order 5400.1.	See Section 6.3 of the Operational Environmental Monitoring Plan for a description of the meteorological surveillance program.
Chapter IV.1.c - For data from an offsite source to be acceptable, the data shall be representative of conditions at the DOE facility and provide statistically valid, hourly data consistent with onsite monitoring requirements.	Onsite meteorological data are collected and used to satisfy onsite monitoring requirements.
Chapter IV.1.d - Specific meteorological information requirements for each facility shall be based on the magnitude of potential source terms, the nature of potential releases from the facility, possible pathways to the atmosphere, distances from release points to critical receptors, and the proximity of the site to other DOE facilities.	The offsite dose assessment in the FSAR shows that meteorological monitoring is in excess of the needs.

COMMENT	RESPONSE
Chapter IV.1.e - Meteorological information requirements for facilities shall also be based on environmental monitoring and surveillance requirements.	The meteorological monitoring is used to supply necessary information for analysis of data from the environmental surveillance program.
Chapter IV.3.c(1) - The meteorological monitoring program from each DOE site shall provide the data for use in atmospheric transport and diffusion computations that are appropriate for the site and application.	Meteorological data from WIPP provides the data used in atmospheric transport and diffusion computations made for the site.
Before any model is deemed appropriate for a specific application, the assumptions upon which the model is based shall be evaluated and the evaluation results documented.	AIRDOS-EPA (Moore et al., 1979) is used as the model for atmospheric dispersion.
Chapter IV.3.c(2) - Meteorological programs for sites where onsite meteorological measurements are not required shall include a description of climatology in the vicinity of the site and shall provide ready access to representative meteorological data.	WIPP does have an onsite meteorological monitoring capability and program. Information concerning the climatology of the area is presented in the WIPP FSAR (DOE, 1988a) and in Chapter 6.3 of the Environmental Monitoring Plan.
Chapter IV.3.d(1) - Potential release modes, distances from release points to receptors, and meteorological conditions shall be considered in assessments for DOE facilities required to take onsite measurements.	These factors have been considered in the meteorological assessments.

DOE ORDER 5400.xy REQUIREMENTS

CONTINUED

COMMENT	RESPONSE
Chapter IV.6 - Meteorological measurements shall be made in locations that provide data representative of the atmospheric conditions into which material will be released and transported.	Meteorological measurements are made in the vicinity of potential release points.
The instruments used in the monitoring program shall be capable of continuous operation in the normal range of atmospheric conditions at the facility.	The instruments used are capable of continuous operation in the normal range of atmospheric conditions at the facility.
Chapter IV.6.a - Wind measurements shall be made at a sufficient number of levels to adequately characterize the wind at potential release heights.	Wind data are collected at three (3) heights on a 40-meter tower.
Chapter IV.6.b - If instruments are mounted on booms extending to the side of a tower, the booms shall be oriented in directions that minimize the potential effects of the tower on the measurements.	Instruments are mounted on the west side of the tower. Since the predominant wind direction is from the southeast, there will be no significant effects caused by the tower.
The instruments shall be at least two tower diameters from the tower, but should be positioned three to four tower diameters from the tower.	Instruments are mounted more than two (2) tower diameters from the tower.
Chapter IV.8 - The meteorological monitoring program shall provide for routine (daily or weekly) inspection of the data and scheduled maintenance and calibration of the meteorological instrumentation and data acquisition system.	Data is routinely monitored in the CMS. Preventive maintenance is performed as a routine part of the quality control (QC) program.

COMMENT	RESPONSE
Inspections, maintenance, and calibrations shall be conducted in accordance with written procedures, and logs of the inspections, maintenance, and calibrations shall be kept and maintained as permanent records.	Procedures are being developed by the calibration laboratory which will comply with this requirement.
The instrument system shall provide data recovery of at least 90 percent on an annual basis for wind direction, wind speed, atmospheric stability, and other meteorological elements required for dose assessment.	The instrument system is expected to provide at least 90 percent data recovery.
Chapter IV.9 - The topographic setting of a facility and the distances from the facility to points of public access shall be considered when evaluating the need for supplementary instrumentation.	The relative flatness of the topography and remoteness of WIPP were considered in evaluating the meteorological monitoring needs.
If meteorological measurements at a single location cannot adequately represent atmospheric conditions for transport and diffusion computations, supplementary measurements shall be made.	Single point measurements are adequate to represent atmospheric conditions.
Chapter IV.10 - A site-wide meteorological monitoring program shall be established at each multifacility site to provide a comprehensive data base that can be used for all facilities located within the site.	WIPP is not a multifacility site.

DOE ORDER 5400.xy REQUIREMENTS

CONTINUED

COMMENT	RESPONSE
Chapter IV.13 - As they apply to meteorological monitoring, the general quality assurance program provisions of Chapter X shall be followed.	The meteorological monitoring programs incorporate the quality assurance requirements of Chapter X as appropriate.
ENVIRONMENTAL SURVEILLANCE	
Chpter V.1.a - An evaluation shall be conducted and used as the basis for establishing an environmental surveillance program for all DOE-controlled sites to provide compliance with all applicable regulations. The results of this evaluation shall be documented in the site Environmental Monitoring Plan.	The size and scope of the environmental surveillance program was based on analysis performed in support of the FEIS (DOE, 1980) and FSAR (DOE, 1988a), and was designed in accordance with requirements of DOE Orders 5400.1 and 5400.3 and the results obtained during the baseline monitoring programs.
Chapter V.1.b - The environmental surveillance program for DOE-controlled sites shall be conducted in accordance with the requirements of DOE Orders 5400.1 and 5400.3.	The environmental surveillance activities are conducted in accordance with the provisions of DOE Orders 5400.1 and 5400.3.
Chapter V.2.a - The criteria for environmental surveillance programs (listed in Figure V-1) shall be used for establishing the environmental surveillance program for DOE-controlled sites. Additional site-specific criteria shall be documented in the site Environmental Monitoring Plan.	Based on Figure V-1 requirements, only a minimal program is necessary. However, due to the R&D nature of the WIPP operations, an extensive and thorough OEMP has been established.

COMMENT	RESPONSE
Chapter V.2.b - The need for environmental sampling and analysis shall be evaluated, by exposure pathway analysis, for each site radionuclide effluent or emission (liquid or airborne). This analysis with appropriate data, references, and site-specific assumptions, along with site-specific criteria for selection of samples, measurements, instrumentation, equipment, and sampling or measurement locations shall be documented in the site Environmental Monitoring Plan.	The magnitude and choice of samples for the OEMP has been based on the pathway analysis of the FSAR (DOE, 1988a).
A critical pathway analysis (radionuclide/media) shall be performed, documented, and referenced in the Annual Site Environmental Report.	The annual Environmental Monitoring Report will utilize exposure pathway and dose calculation methods described in Section 8.0 of the OEMP.
If the projected dose equivalent from inhalation of particulates exceeds the criteria of Figure V-1, particle size analysis of the emission shall be conducted at least annually.	Projected dose equivalents from WIPP Operations do not exceed the criteria in Figure V-1 (see FSAR, Chapter 7). Particle size analysis has been performed to determine particle transport through the effluent sampling system and to ensure collection of a representative sample.
Chapter V.2.c - Further provisions shall be made, as appropriate, for the detection and quantification of unplanned releases of radioactive materials.	Particle size analysis, velocity profiles, and transport line effects have been conducted to verify operability of the CAMs and the effluent monitoring system.

COMMENT	RESPONSE
Chapter V.3.a - For all new or modified facilities coming on-line, a preoperational assessment shall be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of effluents to be expected from the facility and to establish the associated environmental surveillance program.	The Radiological Baseline Program (RBP) formally began collecting preoperational environmental data in June 1985. The information from the RBP has been used to develop the operational environmental monitoring program discussed in Section 6 of the Operational Environmental Monitoring Plan.
Calibration of dosimeters and exposure-rate instruments shall be based on traceability to NBS standards.	All calibration is performed with traceability to National Bureau of Standards (NBS) standards.
Gross radioactivity analyses shall be used only as trend indicators, unless documented supporting analyses provide a reliable relationship to specific radionuclide concentrations or doses.	Gross radioactivity analyses are used only for trend indications. Specific radionuclide analyses are used extensively in the OEMP.
The overall accuracy (± percent accuracy) shall be estimated, and the approximate minimum detectable concentration at a specified percent confidence level for environmental measurements of beta-gammas, alphas, and neutrons shall be determined and both values documented in the site Environmental Monitoring Plan.	Sections 7 and 8 of the OEMP discuss the accuracy of environmental measurements. As indicated in Section 8, a 95 percent confidence interval is generally used in the reporting of environmental data.
Sample preservation methods shall be consistent with the analytical procedures used.	All sample preservation methods are consistent with the analytical procedures used and with accepted guidelines.

COMMENT	RESPONSE
All environmental surveillance techniques shall be designed to take a representative sample or measurement of the radiation exposure pathway-significant media.	Sampling and measurement procedures provide for the collection of representative samples or measurement of the radiation exposure pathway-significant media.
Chapter V.3.b - Sampling or measurement frequencies for each significant radionuclide or environmental medium combination (e.g., those contributing ten percent or more to offsite dose) shall take into account the half-life of the radionuclides to be measured and shall be documented in the site Environmental Monitoring Plan.	For the radionuclides associated with WIPP operations, half-life is not a consideration.
"Background" or "control" location measurements shall be made for every significant radionuclide and pathway combination (e.g., those contributing ten percent or more to offsite dose) for which environmental measurements are used in the dose calculations.	Background and control samples are collected and analyzed for environmental samples.
An annual review of the radionuclide composition of effluents or emissions shall be made and compared with those used to establish the site Environmental Monitoring Plan. Any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, shall be documented in a revised site Environmental Monitoring Plan.	An annual review will be conducted and discussed in the annual Environmental Monitoring Report. The Operational Environmental Monitoring Plan will be revised as necessary.

COMMENT	RESPONSE
Chapter V.3.c - The air sampling rate shall be consistent to within ±20 percent, and total air flow or total running time shall be indicated; air sampling systems shall be leak-tested, flow-calibrated, and tested and inspected on a routine basis.	Performance of air sampling equipment is maintained within guidelines.
Chapter V.3.d - State and local game officials shall be consulted when selecting appropriate protected species to sample.	State and local game officials have been contacted, and in many cases, permits will be obtained for sampling.
DOE Operations Office and contractor staff shall consult State and regional EPA offices to determine site-specific requirements for all ground-water monitoring programs. These programs shall be documented as required by DOE Order 5400.1.	DOE will coordinate with State and regional EPA offices to determine any site-specific requirements for groundwater monitoring.
All drinking-water systems affected or that might reasonably be affected by DOE operations shall be monitored in accordance with the monitoring frequency requirements of 40 CFR Part 141.26.	No drinking-water systems are potentially impacted by WIPP operations.
Composite surface-water samples and all drinking-water samples shall be analyzed without filtering.	Both filtered and unfiltered surface water samples are analyzed.
Chapter V.14 - As they apply to environmental surveillance activities, the general quality assurance program provisions of Chapter X shall be followed.	Appropriate provisions of Chapter X are incorporated into the environmental surveillance program.

COMMENT	RESPONSE
LABORATORY PROCEDURES	
Chapter VI.1 - Laboratory practices shall be documented in the site Environmental Monitoring Plan.	Laboratory practices are discussed in Section 7 of the Operational Environmental Monitoring Plan.
Chapter VI.2.a - Each monitoring and surveillance organization shall have a sample identification system that provides positive identification of samples and aliquots of samples throughout the analytical process. The system shall incorporate a method for tracking all pertinent information obtained in the sampling process.	A unique number is assigned identifying sample location, collection date, and number of aliquots. A sample logbook is used to track all samples and pertinent sampling information.
Chapter VI.2.b - Each laboratory shall establish and adhere to written procedures to minimize the possibility of cross-contamination between samples. High-activity samples shall be kept separate from low-activity samples.	Written control procedures are used. Initial sample screening, based on activity level, is used to determine which laboratory is utilized.
The integrity of samples shall be maintained (i.e., to minimize degradation of samples by using proper preservation and handling practices that are compatible with analytical methods).	Sample preservation methods are appropriate for the analytical methods and in accordance with accepted industry practices.
Chapter VI.2.c - Specific analytical methods shall be made available for all radionuclides in the facility inventory or effluent that contribute significantly to the public dose or environmental contamination associated with the site.	Specific radioanalyses are performed for all nuclides projected to contribute significantly to dose or environmental contamination.

COMMENT	RESPONSE
Standard analytical methods shall be used for radionuclide analyses (when available). Any modification of standard methods shall be documented.	As discussed in Section 7 of the OEMP, standard analytical procedures are used for sample analyses. Modifications to standard analytical methods are documented in the appropriate laboratory procedures manual.
Methods, requirements, and necessary documentation shall be specified in analytical contracts.	Contracts with suppliers of analytical services provides specifications of methods, requirements, and necessary documentation.
Chapter VI.2.d - All sites that release or could release gamma-emitting radionuclides shall have the capability (either in-house or outside) of having samples (routine, special, or emergency) analyzed by gamma spectroscopy systems.	The WIPP site does have the necessary instrumentation to perform in-house gamma and alpha spectroscopy.
Chapter VI.2.e - Counting equipment shall be calibrated properly to obtain accurate results.	Counting equipment used in analysis of environmental samples is calibrated on a routine basis as specified in WIPP procedures WP 10-003.
Check sources shall be counted periodically on all counters to verify that the counters are giving correct results.	Check sources are counted at least daily on all counters being used.
Chapter VI.14 - As they apply to laboratory procedures, the general quality assurance program provisions of Chapter X shall be followed.	The appropriate elements of the Chapter X quality assurance program are incorporated into laboratory procedures. Contract laboratories are required to incorporate quality assurance procedures into their laboratory operations.

COMMENT	RESPONSE
Chapter VII.1.b - The statistical techniques used to produce the concentration estimates and their corresponding measures of reliability and to compare radionuclide data between sampling and/or measurement points and times shall be designed to accommodate the characteristics of effluent and environmental data.	The statistical analysis process to be used, as described in Section 8 of the Operational Environmental Monitoring Plan, is designed specifically for the WIPP operations.
Proper sampling, sample-handling, and data-management techniques shall be used to reduce, as much as possible, the variability due to sampling.	Proper sampling, sample handling, and data management techniques are in accordance with industry-wide standards.
Chapter VII.2 - The level of accuracy (or bias) of the data due to the radiological analyses shall be estimated by analyzing blanks and spiked pseudosamples and by comparing the resulting concentration estimates to the known concentrations in those samples.	Blanks and spikes are routinely analyzed to determine data accuracy.
The precision of radionuclide analytical results shall be reported as a range, a variance, a standard deviation, a standard error, or a confidence interval.	Standard deviations are routinely reported with analytical results.
Data shall be examined and entered into the data base promptly after analysis.	Data will be incorporated into the data base in a timely manner.

COMMENT	RESPONSE
Outliers shall only be excluded from consideration if they can be positively attributed to an error. As each data point is collected, it shall be compared to previous data to determine if it is an outlier or if it is to be included in the data set.	Section 8 of the Operational Environmental Monitoring Plan addresses the treatment of outliers in accordance with this requirement. Section 8 also defines data handling techniques.
Chapter VII.8 - As they apply to data analysis and statistical treatment activities, the general quality assurance program provisions of Chapter X shall be followed.	Appropriate provisions of the quality assurance requirements have been incorporated into the data analysis and statistical treatment activities.
DOSE CALCULATIONS	
Chapter VIII.2.a - The assessment models for all environmental dose assessments selected shall appropriately characterize the physical and environmental situation encountered. The information used in dose assessments shall be as accurate and realistic as possible.	The use of AIRDOS-EPA (Moore et al., 1979) for dose assessment has been tailored to the existing conditions at the WIPP site. Dose assessment calculations are based on thorough evaluations of existing data.
Complete documentation of models, input data, and computer programs shall be provided.	The use of AIRDOS-EPA is documented in the FSAR (DOE, 1988a) and in Section 9 of the Operational Environmental Monitoring Plan.
Chapter VIII.2.b - Default values used in model applications shall be documented and evaluated to determine appropriateness for the specific modeling situation.	Default values used in dose models are discussed in Section 9 of the OEMP and in the FSAR.

COMMENT	RESPONSE
When performing human foodchain assessments, a complete set of human exposure pathways shall be considered, consistent with current methods (IAEA, 1982; Moore et al., 1979; NCRP Report No. 76; NUREG/CR-3332).	As discussed in the FSAR (DOE, 1988a) and in Sections 4 and 6 of the Operational Environmental Monitoring Plan, human exposure pathways are consistent with current methods.
Surface- and ground-water modeling shall be conducted as necessary to conform with the additional requirements of the State government and the regional office of the EPA.	Extensive surface and ground-water modeling activities have been and are being performed by DOE for purposes of site characterization and to demonstrate compliance with 40 CFR Part 191 regarding the long-term performance of the facility.
Chapter VIII.8 - The general quality assurance program provisions of Chapter X shall be followed as they apply to performing calculations that assess dose impacts.	Appropriate provisions of the quality assurance requirements have been incorporated into the dose calculation activities.
REQUIRED RECORDS AND REPORTS	
Chapter IX.1 - DOE officials shall make every reasonable effort to identify and comply with the relevant reporting requirements.	Reporting requirements in relevant DOE Orders will be followed.
Chapter IX.1.a - Timely notification of occurrences and information involving DOE and its contractors shall be made to the appropriate DOE officials and to other responsible authorities.	Timely notification of occurrences will be made in accordance with provisions of DOE Orders 5484.1A, 5484.2, and 5700.6B.

COMMENT	RESPONSE
Auditable records relating to environmental surveillance and effluent monitoring shall be maintained. Calculations, computer programs, or other data handling shall be recorded or referenced.	Environmental Monitoring Program records will be maintained at the WIPP site. Data handling calculations and programs are recorded.
Chpter IX.4 - As they apply to records and reporting procedures, the general quality assurance program provisions of Chapter X shall be followed.	Applicable provisions of the quality assurance program as referenced in Chapter X will be followed.
QUALITY ASSURANCE	
Chapter X.1 - A QA Plan shall be prepared and included as a section of the Environmental Monitoring Plan and shall cover the monitoring activities at each site, consistent with the 18-element format in ANSI/ASME NQA-1.	See Section 11 of the Operational Environmental Monitoring Plan.
Chapter X.3.b - Periodic audits shall be performed to verify compliance with operational procedures, QC procedures, and all aspects of the QA program.	Periodic audits of the environmental surveillance program, including offsite analytical laboratories, are conducted routinely by the operating contractor.
Audits shall be performed in accordance with written procedures or checklists by personnel who do not have direct responsiblity for performing the activities being audited.	Routine audits will be performed as specified in the WIPP Quality Program Manual.

COMMENT	RESPONSE
Audit results shall be documented and reported to and reviewed by responsible management. Follow-up action shall be taken where indicated.	As discussed in the WIPP Quality Program Manual, audits will be documented and findings tracked to ensure satisfactory resolution.
Chapter X.3.c - The elements of a QA program as described in ANSI/ASME NQA-1 in the 18-criterion structure of 10 CFR Part 50 shall be followed.	The 18-criterion structure is followed in the QA plan.
Chapter X.5.b(2) - Radiation measuring equipment, including portable instruments, environmental dosimeters, in situ monitoring equipment, and laboratory instruments, shall be calibrated with standards traceable to the National Bureau of Standards (NBS) or other standards recognized by the DOE.	Standards traceable to NBS are used to calibrate monitoring/measurement equipment in the WIPP environmental monitoring program.

APPENDIX B

DOE 5400.xy GUIDANCE STATEMENTS

This appendix provides specific responses to the guidance statements in DOE Order 5400.xy as required in DOE Order 5400.xy, Chapter I.

COMMENT	RESPONSE
EFFLUENT MONITORING-LIQUID RELEASES Chapter II.2 - Continuous radionuclide monitoring should be provided on those release points that could: (1) exceed 1 DCG equivalent at the point of release averaged over 1 year, or (2) result in unanticipated releases to the environment.	Continuous liquid effluent monitoring is not required at WIPP because potential releases do not exceed the guidelines listed.
The monitoring effort for effluents should be commensurate with the importance of the sources with respect to their potential contribution to public dose or to contamination of the environment.	As shown in Section 6.1 of the OEMP, the liquid effluent monitoring effort is commensurate with the potential contribution of the effluent stream to public dose or contamination of the environment.
Emergency liquid effluent monitoring systems and procedures should be specified in the site/facility Emergency Response Plan.	Grab samples and subsequent analyses will be used to determine whether liquids can be released from the Waste Handling Building sump.
Chapter II.3 - Characterization should include the identification of the actual or potential presence of radionuclides and their chemical and physical properties that might affect required performance of the sampling or monitoring equipment used.	The sewage system has been evaluated and it has been determined that there is no direct path for contaminants from the Waste Handling Building to reach the sewage system. Sampling equipment will consist of normal grab sampling equipment.

COMMENT	RESPONSE
Chapter II.3.a - For those effluent streams requiring continuous monitoring, all data received from the continuous monitoring system should be used when performing statistical analysis.	Continuous monitoring of liquid effluent streams is not required at WIPP.
For discharge points releasing concentrations of radionuclides emitting alpha or weak beta, with no documentable ratios to beta and/or gamma emitters that could be used as indicator radionuclides, continuous proportional sampling and analysis should be used as an alternative to continuous monitoring.	Radionuclides are not routinely released in liquid effluents and, as stated above, continuous monitoring of samples is not required.
Chapter II.3.b - Calibration(s) should be performed in a manner consistent with manufacturers' instructions and specifications.	Equipment calibrations will be conducted in accordance with manufacturers specifications.
Each system should be checked on a routine basis, at least weekly.	Continuous sampling and/or analysis equipment are not used in the WIPP liquid effluent monitoring program.
Sampling systems should be functioning properly before a facility is placed in operation.	As stated above, automatic sampling systems are not used in monitoring liquid effluents at WIPP.

COMMENT	RESPONSE
Chapter II.3.c - Off-line liquid transporting lines should be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy confidence levels.	Off-line liquid transporting lines are not used in the liquid effluent monitoring program at WIPP.
Chapter II.4.a - The following criteria should be considered when operating a liquid effluent sampling system: • Location of sampling and monitoring systems; • Use of a pump in areas where necessary to provide a uniform continuous flow in the main sample line; • A redundant sample-collection system or one of the following alternatives to permit continued sampling during replacement or servicing of the system: (1) a substitute sample-transport	A liquid effluent sampling system is not used in the liquid effluent monitoring program at WIPP.

COMMENT	RESPONSE
system, (2) the capability to shut down the system for fast repair, or (3) an alternate method for estimating releases when the system is not capable of operating;	
• Location of sample ports in liquid effluent lines sufficiently downstream from the last feeder line to allow complete mixing (as complete as possible) of liquid and design of the sample port to allow intake of a proportional part of the liquid effluent stream;	
• Capability to determine the effluent stream and sample-line flows within an accuracy of at least ±10 percent; and	
• Design of the system to minimize deformation and sedimentation and to prevent freezing of effluent sample lines.	
<u>Chapter II.4.b</u> - Thus, continuous monitoring and recording of effluent quantity should be performed.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.

COMMENT	RESPONSE
The sampling point should be located in an accessible section of the effluent line at the position providing the most complete mixing.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.
Liquid effluent flow rates should be measured within an accuracy of at least ±10 percent and recorded.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.
Chapter II.4.c - The sampling ports should be: • Positioned downstream from the last component stream entering, in a location that will provide maximum mixing; and • Designed to accommodate a proportional amount of the full range of effluent flow for transport to the collection system.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.
If proportionality cannot be automated, both the effluent and sample flow rates should be measured.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.

COMMENT	RESPONSE
Chapter II.4.d - Consequently, design for such a junction (liquid-sample line with the sampling port) should consider either line snubbers or special fabrications to handle the added mechanical stress.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.
Chapter II.4.e - Unless sufficiently high and constant hydraulic pressure exists within an effluent system, a sampling pump of high reliability should be installed.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.
Removal of the sample from the liquid effluent line where a sampling pump is required should be accomplished using a constant-volume pump that will maintain a constant flow, regardless of line pressure changes.	Continuous monitoring is not required in the WIPP liquid effluent monitoring program.
Chapter II.4.f - The design of the collector portion of the sampling system should allow for the collection of a sample that is consistent with the method of analysis.	There are no direct pathways for radionuclides or other contaminants into the liquid effluent system. Therefore, continuous monitoring is not required.
The sample line should be routed back to either the effluent line or a waste treatment system.	There are no direct pathways for radionuclides or other contaminants into the liquid effluent system. Therefore, continuous monitoring is not required.

COMMENT	RESPONSE
Chapter II.4.g - The following special conditions should be considered when designing and operating a liquid effluent sampling/monitoring system: • Effluent lines are frequently buried in soil, which creates accessibility problems for sampling unless special provisions are considered in the discharge system design. • Biological growths can cause sample-line flow restrictions. • Effluent lines often move or are stressed mechanically. • Larger fluctuations in effluent flow rates are common. • Small-volume wastes are easier to collect in batch tanks, lending themselves to grab sampling and analysis before release.	There are no direct pathways for radionuclides or other contaminants into the liquid effluent system. Therefore, continuous monitoring is not required.

COMMENT	RESPONSE
• Sample collection may require extra precautions (e.g., precoating sample containers).	
• Effluent velocity and corrosion can significantly affect in-line sampling or monitoring probes.	
• Effluent monitoring systems and procedures should be designed to identify and quantify the full range of potential accidental releases.	
Sampling/monitoring lines and components should be designed to be compatible with the chemical and biological nature of the liquid effluent.	There are no direct pathways for radionuclides or other contaminants into the liquid effluent system. Therefore, continuous monitoring is not required.
If biocides are used, they should be selected and applied so as not to interfere with the sampling and analytical processes.	Biocides are not used in the samples collected.
When batch tanks are used for collecting liquid effluents before release to the environment, three factors should be considered:	Batch tanks are not utilized in collecting liquid effluent samples for analysis.

COMMENT	RESPONSE
• Adequate mixing of the sampled volume to provide that liquids in the tank are homogenous for sample withdrawal; • Recirculation of tank liquid through the sample lines to provide that the sample is representative; and • Frequent checks for heel or sludge accumulation as needed.	
<u>Chapter II.4.h</u> - The sampling system should be protected from adverse environmental factors including unusual operational impacts.	Continuous samples are not required. Therefore, there is no "sampling system."
At sample collection points, the ambient dose rate originating in the effluent line(s) and the sampling apparatus should be evaluated for compliance with shielding requirements necessary for reducing worker exposure.	Continuous samples are not required. Therefore, there is no "sampling system."

COMMENT	RESPONSE
Components of the sampling system should be readily accessible for maintenance.	Continuous samples are not required. Therefore, there is no "sampling system."
Chapter II.5 - Design considerations for liquid effluent monitoring systems should include the purpose of the monitoring, the types and levels of expected radionuclides, potential background dose rates, expected duration of releases, and environmental effects.	Continuous samples are not required. Therefore, there is no "sampling system."
Thus, the output signal from monitoring systems should be continuously monitored by responsible personnel.	Continuous samples are not required. Therefore, there is no "sampling system."
In addition, written response procedures should be provided describing the action that responsible personnel must take if an abnormal signal is detected.	Continuous samples are not required. Therefore, there is no "sampling system."
The output signal instrumentation, monitoring-system recorders, and alarms should be in a location that is continuously occupied by operations personnel.	Continuous samples are not required. Therefore, there is no "sampling system."

COMMENT	RESPONSE
Chapter II.5.a - An unshielded in-line monitoring system should be sufficient to quantify the gamma-emitting radionuclides in the liquid effluent line, if low ambient dose-rate conditions exist.	Continuous samples are not required. Therefore, there is no "sampling system."
For moderate ambient dose rates, in-line monitoring may be sufficient, but shielding should be employed.	Continuous samples are not required. Therefore, there is no "sampling system."
For high ambient dose conditions (i.e., those above which shielding is no longer a practical solution to controlling the background influence), off-line monitoring should be used.	Continuous samples are not required. Therefore, there is no "sampling system."
Chapter II.5.b - The following general design criteria should be considered in the design and operation of routine liquid effluent monitoring systems. If off-line monitoring is employed: • Use criteria in Chapter II paragraph 4 for sample transport.	Off-line monitoring is not used.

COMMENT	RESPONSE
• Use criteria in Chapter II paragraph 4.h for environmental protection, maintenance, and modification.	
• Use characterization study data for radionuclide measurements, including ratios of radionuclides not directly measurable, if present.	
• Use adequate shielding for detector operation and to maintain personnel exposure as low as reasonably achievable.	
• Use a predefined alarm level that is just above normal variations in release levels.	
• Locate alarm annunciators in normally occupied locations.	
• Use stable electric power sources to provide uniform voltage to the monitor and alarms systems.	

COMMENT	RESPONSE
If in-line monitoring is employed: • Use the criteria for off-line monitoring. • Use interpretive curves (primarily for ion chamber and Geiger-Muller tube monitors) that allow quick conversion of dose rates or count rates to radionuclide release rates (e.g.,)Ci/min), such that both concentrations of and curies released by the various radionuclides can be estimated.	In-line monitoring is not used.
Chapter II.5.c - However, it should be demonstrated that the chosen detector is capable of measuring with the required sensitivity.	Direct measurement is not attempted in the liquid effluent stream.
Sampling and analysis should be used to quantify release of alpha-emitters and some beta-emitters (i.e., those that cannot be adequately measured using detectors).	Sampling and analysis of liquid and solids is used to determine whether radionuclides are being released.

COMMENT	RESPONSE
Chapter II.5.d - Consequently, when designing installations for locations that are expected to have relatively high radiation dose rates, off-line monitoring should be used.	As stated above, direct measurements are not used.
Chapter II.5.e - Before a batch is released, a representative grab sample should be drawn and analyzed to determine releasability.	As appropriate, e.g., before the sump in the Waste Handling Building would be discharged to the liquid effluent system, a sample is collected and analyzed.
If the effluent originates from a continuing source(s), it is considered a "continuous" stream and should be continuously monitored and/or sampled.	There is no routine source for the release of radionuclides to the liquid effluent stream.
Chapter II.5.f - Air conditioning for hot locations and heating for cold locations should be considered to provide reliable system operation, particularly for systems using electronic components.	As stated earlier, a sampling system is not utilized.
The system should be designed and located so that the ambient dose rates will permit access for system calibration and servicing, and minimize worker exposure.	As stated earlier, a sampling system is not utilized.

COMMENT	RESPONSE
Chapter II.6 - To prevent the cumulative impact of small releases from producing a significant impact, routine grab, continuous, or proportional samples should be collected often enough to detect radionuclides of interest, including those with relatively short half-lives.	There is no routine source of release of radionuclides to the liquid effluent system. Grab samples will be collected and analyzed on a semiannual basis. Half life is not a consideration for the TRU waste.
EFFLUENT MONITORING-ATMOSPHERIC EMISSIONS	
Chapter III.4.c - If a diffuse source assessment is warranted because of potential contribution to the off-site dose, the following practices should be applied: • The assessment should be accomplished by using appropriate computational models or a downwind array of samplers arranged and operated over a sufficient period to characterize the concentrations of radionuclides in any resulting plume. • Empirical data and sound assumptions should be used with the computational models to define the source term for a diffuse source.	As stated earlier, no potential diffuse sources of contaminants have been identified which could contribute significantly to the off-site dose.

COMMENT	RESPONSE
Chapter III.5.a - The level of detail required should be sufficient to provide that the system is qualified for the task.	An extensive study of the airborne effluent sampling system has been performed by Texas A&M University.
The following factors are among those that should be considered:	
• Identification of the actual or potential radionuclides present (e.g., type, concentration);	The potential nuclides of interest are primarily alpha emitters in very low concentrations if present at all.
• Identification of fallout and naturally occurring (background) radionuclides;	The Radiological Baseline Program (RBP) has identified and quantified levels of fallout and naturally occurring radionuclides.
• Presence of materials (chemical, biological) that could adversely affect the sampling and monitoring system or detection of radionuclides;	The problem of concern is the affect of large amounts of salt loading on the sampling and monitoring equipment.

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(CONTINUED)

COMMENT	RESPONSE
• Internal and external conditions that could have a deleterious effect upon the quantification of emissions (e.g., environmental factors such as temperature, humidity, and ambient ionizing radiation; events that could result in a complete loss of the systems, such as fires, floods, or earthquakes; and gas-stream characteristics, such as temperature, pressure, humidity, and velocity);	The primary condition of concern is the very large salt loading in the effluent stream which has lead to the special extraction probe design.
• Process descriptions and variability;	Operationally, the process at WIPP should be very consistent.
• Particle size distribution of particulate materials; and	Particle size analysis of the effluent air-stream has been conducted by Texas A&M University.
• Cross-sectional homogeneity of radionuclide distribution at the sampling point.	Radionuclides should not be routinely released by WIPP operations.

COMMENT	RESPONSE
Chapter III.5.c - For point sources, documentation of the important characteristics of the exhaust handling system and other pertinent structural information, pertinent characteristics of the process and process-emission control systems, and sampling and measurement systems should be included in the site Environmental Monitoring Plan.	The exhaust and emission control systems are discussed in Sections 4 and 6 of the Operational Environmental Monitoring Plan.
Any reports or data from studies conducted to evaluate the operational performance or real or suspected deficiencies of the systems should also be provided at a single, readily accessible location (e.g., the site airborne effluent monitoring files).	The Texas A&M University report and other documentation pertaining to the effluent sampling/monitoring system will be maintained in the site environmental monitoring files.
Chapter III.5.d - A potential source should be adequately described to show the radionuclides present, the form of the materials, and the factors contributing to suspension.	Potential sources of radionuclide releases are documented and analyzed in the FSAR (DOE, 1988a).
The rationale to substantiate the approach to assessing and characterizing the source should be documented.	Discussions of the rationale behind potential sources, i.e., accident scenarios, are discussed in the FSAR.

COMMENT	RESPONSE
Chapter III.6.a - Accepted methods [C 3154-72, C 3195-73, D 3464-75, D 3796-79 (ASTM, 1985); EPA Method No. 1 (Smith, 1984)] should be used to measure gas-stream characteristics (e.g., velocity, static pressure, temperature, and moisture content) consistent with sampling conditions.	No radioactive gaseous effluents are emitted from WIPP, so no monitoring is required.
Chapter III.6.b - Samples of gaseous effluents should be extracted from an accessible location in the stack downstream from any obstruction, preferably near the outlet, so that concentrations of the material of concern are uniform.	Samples are extracted away from any obstruction.
Samples should be extracted from the effluents from a location and in a manner that provides a representative sample, if necessary using multiport probes.	Samples are extracted by three probes at three locations 21 feet below ground surface in the exhaust duct. Each probe splits each sample into three parts to ensure representativeness.
If feasible, gaseous effluents should be extracted at least eight stack or duct diameters downstream and two stack or duct diameters upstream from any major flow disturbances (e.g., bends, transitions, open flames, last stream entry, sampling probes, etc.) (EPA Method No. 1; Smith, 1984).	Effluents are sampled 21 feet upstream from the 90° bend (at ground level) in the underground storage exhaust duct.

COMMENT	RESPONSE
The extraction point should be as close as practicable to the point where the emissions from that source (DOE facility) are released to the atmosphere while still complying with the criteria defined above.	Samples are extracted 64 feet horizontally and 21 feet below the underground storage exhaust outlet. This location will minimize flow disturbances due to bends in the duct.
If possible while meeting the mixing length requirement, extraction sites should be located in vertical sections of the stack or duct.	The location of sampling the main exhaust stream is in a vertical portion of the underground storage exhaust duct.
The absence of cyclonic flow at the extraction site should be demonstrated (EPA Method No. 1; Smith, 1984).	Cyclonic flow was not observed during scale model testing.
If uniform flow and concentration cannot be demonstrated or if incomplete mixing is suspected in large-diameter stacks or ducts [diameters greater than 30 cm (12 in.)], the need for multiple inlet probes under continuous sampling conditions should be considered.	Samples are extracted from three intakes in the exhaust duct.

COMMENT	RESPONSE
If multiple inlet probes are used, the volume flow through each inlet should be proportional to the volume fraction of the effluent flow in the annular area sampled.	In the Waste Handling Building the multiple inlet probe is designed to draw inlet flows proportional to the volumetric flow rate fraction. The probe will utilize a hot wire anemometer control to maintain isokinetic sampling across the probe cross section. Measurements to date indicate that the flow profiles across the duct are very flat. In the exhaust filter ducting the airflow profile and the particulate profiles are well characterized. This allows for the selection and placement of a single point sampler to correlate with the total air flow rate.
Chapter III.6.c - Such conditions are not the norm; many vapors (e.g., radioiodine) interact with existing particles, and all materials should be collected so that quantification of emissions is accurate.	The presence of vapors such as radioiodine is not expected in wastes coming to WIPP.
Extraction probes and nozzles for the sampling of particulate materials should be consistent with ANSI N13.1-1969 and EPA Method No. 5 (Smith, 1984) for particulate materials.	Probes and nozzles are designed to be consistent with ANSI N13.1-1969.

COMMENT	RESPONSE
Probes for aerosol sampling should be positioned isoaxially in the stack or duct and sized to extract at the same velocity as the effluent stream sampled (isokinetic sampling) when particle mass median diameter exceeds 0.5)m.	The sampling flow rate and the probes are designed so that the particle velocity in the effluent stream is essentially the same as the particle velocity in the sample probe.
Probe nozzles for the sampling of aerosols should be constructed of seamless stainless-steel tubing (or, for corrosive atmospheres, other rigid, seamless tubing that will not degrade under sampling conditions) with sharp, tapered edges.	Probe nozzles will be constructed of seamless stainless-steel with tapered edges.
The angle of taper should be 30°, and the taper should be on the outside edge to preserve a constant internal diameter (EPA Method No. 5; Smith, 1984).	The outside edges of the nozzles carry the taper.
Probes should be designed such that they can be easily removed for cleaning, repair/replacement, or deposition evaluation.	The probes were designed to be accessible for cleaning and/or repair.

COMMENT	RESPONSE
Changes in flow direction should be made with bends having a curvature radius of a least five tube diameters (ANSI N13.1-1969) to accommodate the diameter of the largest particle in the sample.	All bends are made with a curvature radius of at least five tube diameters.
Probe nozzles for the sampling of only gases and vapors should be constructed of corrosion-resistant materials that do not react to any significant degree with the materials collected.	Based on the wastes to be emplaced at WIPP, there is no need for continuous sampling for gases.
The nozzles should be rigid to the point of collection, accumulation, or measurement.	The nozzles are rigid.
If aerosol samples are extracted from more than one location in the stack/duct, all individual nozzles should provide isokinetic sampling conditions (ANSI N13.1-1969).	The system installed in the exhaust ducting of the Waste Handling Building (WHB) is consistent with the guidance in ANSI N13.1-1969. The system installed in the storage exhaust duct samples anisokinetically but was designed to deliver a representative sample. The single probe placed in a well characterized flow is allowed by the ANSI standard.

COMMENT	RESPONSE
Each individual nozzle should be designed to extract a proportionate volume of the sample.	The WHB nozzles are designed to sample proportional to the flow rate. The storage exhaust duct nozzle is designed to sample at a rate characteristic of the air flow rate.
Chapter III.6.d - Where the material(s) of concern is in particulate form, gaseous effluent samples should be transported in lines that comply with ANSI N13.1-1969.	Transport lines were designed to be consistent with ANSI N13.1-1969.
If the material(s) of concern is in the form of gas(es) or vapor(s), the samples of gaseous effluents should be transported in lines with no significant leakage or loss of material (by chemical reaction, condensation, etc.).	Materials of concern are particulates.
Lines should be kept as short as possible and systems that directly expose the collector or monitor to the effluent stream are preferred.	All sample transport lines have been designed to minimize vertical distances and sharp bends.
Line diameter and materials of construction should be selected to minimize wall losses under anticipated sampling conditions.	Line diameters, construction materials, and inner surface smoothness and connections are designed to minimize wall losses.

COMMENT	RESPONSE
Aerosol transport lines should be rigid and should be electrically grounded to the point where the particles are collected/accumulated.	Transport lines are rigid and grounded to prevent electrostatic deposition.
Aerosol transport lines should not have sharp bends. Changes in direction should be made with radii of curvatures greater than five tube diameters.	Transport lines contain no bends or changes in direction less than five tube diameters.
The transport lines should be adequately supported to prevent sagging and undue stress.	Transport lines are rigid and adequately supported.
Transport lines should be made of materials resistant to corrosion under anticipated sampling conditions and should, as required by ambient temperature, be insulated and/or trace-heated to prevent condensation of materials under anticipated sampling conditions.	Transport lines are insulated, trace-heated stainless steel tubing.
Chapter III.6.e - Air-moving systems for gaseous effluent sampling should be constant displacement systems (e.g., rotary vane, gear) or other systems that will maintain constant air flow in anticipated sampling conditions.	Sources of gaseous effluents are not expected in WIPP wastes.

COMMENT	RESPONSE
Pumps and other mechanical components should be designed to operate continuously under anticipated operating conditions, with scheduled preventive maintenance and repair.	Sources of gaseous effluents are not expected in WIPP wastes.
Equipment used for intermittent or grab sampling should be designed to operate continuously for the duration of the sampling period(s).	Sources of gaseous effluents are not expected in WIPP wastes.
Chapter III.6.f - Sampler gas flows should be continuously measured and measurements recorded over the duration of the sampling period.	Flow rates will be continuously measured and recorded.
The period over which measurements are integrated and the frequency of the recording should be determined by the significance of the emission measurement sampled and the anticipated flow fluctuations.	Measurements are periodically recorded and a historical record is maintained on the Central Monitoring System (CMS).
All sampling systems should, at a minimum, have a gas-flow gage that is read and recorded daily and at the start and end of each sampling period.	Hot wire anemometers are used to measure air flow in the WHB. These measurements are recorded periodically by the CMS.

COMMENT	RESPONSE
Unless extenuating circumstances dictate otherwise, the flow measurements should be accurate to ±10 percent by calibration with National Bureau of Standards (NBS) traceable standards (DOE/EP-0096).	Airflow measurements will be within ± 10%.
Other devices, such as hot-wire anemometers, can also be applied within their limitations, but all devices should be calibrated under conditions of anticipated use using NBS traceable or equally acceptable (in the case where an NBS standard does not exist) standards.	See above.
Flow-measuring devices used for compliance determinations should be located downstream from the collector since deposition, condensation, and corrosion can result in erroneous measurements.	In the WHB the flow-measuring devices are in the same plane as the sampling nozzles. This placement has been selected so that any effects on the sampling nozzles are minimized. In the storage exhaust duct, no flow-measuring devices are coupled with the effluent sampling system nozzle.
Performance standards and design criteria for the measurement and control of the bulk effluent flows should be consistent with the requirements for sampling flow measurement and control.	Bulk flow rates are consistent with the sampling system design.

COMMENT	RESPONSE
The need for feedback systems should be considered for each emission stream having large fluctuations in flow (greater than a factor of two) and contributing a major fraction (e.g., greater than 10 percent) of the offsite emission limit for radionuclides from the facility.	Special design and testing has been performed to develop a system in the storage exhaust ducting that does not require this type of feedback. The WHB system does incorporate a feedback mechanism to adjust for this type of flow change.
Chapter III.6.g - ANSI N13.1-1969 should be followed to the extent practicable (for sample collectors).	Sample collectors were designed to be consistent with ANSI 13.1-1969.
Because the intent of sampling and measurement is to provide accurate, reliable quantification of radionuclide emissions, collectors with the most reproducible collection efficiency under anticipated sampling conditions should be used.	The sample nozzle, transport line, and collector have been specifically designed to achieve maximum sample collection.
Collector housing and hardware should be designed to minimize sample loss.	Sample collectors were designed to minimize sample loss.
Chapter III.6.h - Timeliness should be considered when quantifying radionuclides in gaseous effluents.	Continuous monitoring will be used.

COMMENT	RESPONSE
However, where a significant potential (greater than once per year) exists to approach or exceed a large fraction of the emission standard (e.g., 20 percent), continuous monitoring should be required.	Even though the potential for releases in excess of 20 percent of the emission standard is extremely low, continuous monitoring will be used.
Compensation or adjustment should be provided for pressure, temperature, humidity, and external background.	Compensation will be provided for appropriate factors.
Tritium removal is necessary before other measurements are taken if significant amounts of tritium are present; monitors using a stainless-steel vessel with a known volume of gas and a lithium-drifted germanium detector [Ge(Li)] or an intrinsic germanium detector or equivalent should be used (DOE/EP-0096).	Significant amounts of tritium will not be present.
Specifications that should be considered for airborne effluent monitoring systems are as follows (other guidance may be found in DOE/EP-0096):	
• <u>Chapter III.6.h(1)</u> - In-Line System Specifications.	An off-line monitoring system is used.

COMMENT	RESPONSE
• Meet all design criteria for air sampling except those for air sample transport.	
• Have calibrated curves for the detector assembly that allow conversion of instrument signals to release rates from which both the current concentrations and the total specific radionuclide emmissions can be estimated.	
• Have only the detectors and small electronic assemblies located in or adjacent to the effluent stream (IEC N.761-3). A detector should not be particularly sensitive to environmental conditions or require frequent attention or adjustment.	
• Chapter III.6.h(2) - Off-line System Specifications:	
• Use appropriate calibrations for radionuclides to be measured, including ratios to other non-measurable radionuclides, if present.	Sources traceable to the NBS will be used.

COMMENT	RESPONSE
• Meet performance requirements within the anticipated environmental conditions (e.g., temperature, humidity, radiation levels). Systems to control the environment for the proper functioning of the monitors should be provided.	HVAC systems are provided with each system.
• Have adequate access for maintenance, repair, and calibration.	The systems are designed to provide access for repair, maintenance, and calibration.
• Have a stable source of electrical power.	Uninterruptible power supplies will be used.
<u>Chapter III.6.h(3)</u> - In either case, the available signal range should include the full range of operating conditions, including design basis accidents.	For conditions of concern, the signal ranges and responses have been covered.
If a measuring cell or gas chamber is used to provide a known volume of gas for measurement with an immersed or adjacent detector, the following design features should be considered:	This is not applicable to WIPP.

COMMENT	RESPONSE

- A flow-through type vessel or chamber with or without absorbing medium or pressurization;

- Specifications for cell volume and pressure;

- Separation of the detector from the sample by a protective screen if practicable;

- A readily removable detector mounted so that it will be returned to and maintained in its original position, and provision for an alternate position or other means of varying response by a factor of at least ten; and

- Determination of the characteristics of different (significant) gases.

Chapter III.6.h(4) - The following criteria should be considered for monitors that measure specific radionuclides:

COMMENT	RESPONSE
Tritium Monitors - ANSI N42.18-1974 (R 1980) specifies a minimum level of detectability for tritium of 5×10^{-6})Ci/mL for continuous monitors used in gaseous effluent streams. IEC N.761-5 specifies a minimum level of detectability of 2×10^{-6})Ci/mL. The MDLs specified in ANSI N42.18 should be observed.	Significant quantities of tritium will not be in the waste. Therefore, tritium will not be monitored.
The ANSI MDL is a 1974 minimum standard, and it specifies measurable concentrations at a 95 percent confidence level after four hours of sample collection. However, the detectability level may not be obtainable with mixtures of radionuclides, and instrument response is limited by natural airborne radioactive materials (radon and thoron in equilibrium with their decay products).	Significant quantities of tritium will not be in the waste. Therefore, tritium will not be monitored.
Additional concerns that should be considered in instrument design for tritium monitors based on the IEC standard (IEC, N.761-5) are as follows: • Temperature control during sample transport to prevent condensation (much of the tritium may be in the form of airborne water vapor); and	Significant quantities of tritium will not be in the waste. Therefore, tritium will not be monitored.

COMMENT	RESPONSE
• Trapping or retention of water by a filter or sorbent (since much tritium is commonly in the form of HTO).	
Ionization chambers are widely used for measuring gaseous tritium (DOE/EP-0096). They are simple and economical. A useful rule-of-thumb for measuring tritium in air with ionization chambers is that ionization current collected at saturation is approximately 1)A/Ci. Tritium measurements of about 10^{-5})Ci/mL are possible in low-background environments, which produce ions at the rate equivalent to one mrem/hour. Shielding may be required for specific applications. If shielding is not practical, a second chamber exposed to the same gamma field without tritium should be used. Changes in pressure and temperature in the chamber can affect the calibration, and appropriate adjustment controls for these factors should be provided. Ionization chambers are more sensitive to radioactive (noble) gases that produce larger energies per disintegration and may cause major interferences.	Significant quantities of tritium will not be in the waste. Therefore, tritium will not be monitored.

COMMENT	RESPONSE
Proportional counters are also used to measure airborne tritium (DOE/EP-0096). They are relatively insensitive to background radiation and have energy discrimination capabilities. Systems using proportional counters are more complicated than those required for ionization chambers. Proportional counters require a counting gas, and many gases are flammable or combustible. Radioactive material present in natural products (e.g., commercial natural gas) may provide interference for tritium measurements and should be accounted for if used. Air can be added to methane up to 30 percent by volume at a dewpoint of 14°C (57°F) without truncating the counting plateau to unacceptable levels. Dry air may be required where tritium exists as water vapor. The high voltage should be stabilized by feedback from a known source for unattended operations.	Significant quantities of tritium will not be in the waste. Therefore, tritium will not be monitored.

COMMENT	RESPONSE
Radioiodine Monitors - Iodine cartridges used to collect radioiodine may be monitored at the collection point with a shielded detector, usually a single-channel sodium iodide thallium [NaI(Tl)] detector. Typical systems have one or more charcoal cartridges in a series, preceded by an absolute particulate filter. In-line measurements of low concentrations of radioiiodine in air will usually not be feasible because of the presence of other radionuclides or radiation fields. Iodine cartridges should be replaced at least weekly and the measurements verified by laboratory counting (DOE/EP-0096).	Significant quantities of radioiodine will not be in the waste. Therefore, radioiodine will not be monitored.
The minimum level of detectability for various iodine isotopes for continuous monitors of gaseous effluents should not exceed 3×10^{-12} μCi/mL for ^{132}I and ^{133}I, or 8×10^{-10} μCi/mL for ^{129}I [ANSI N42.18-1974 (R 1980)].	Significant quantities of radioiodine will not be in the waste. Therefore, radioiodine will not be monitored.
The same general specifications given in the preceding discussion of tritium monitors, based on the IEC standard, should be considered for iodine monitors. Specifications for iodine monitors are as follows:	Significant quantities of radioiodine will not be in the waste. Therefore, radioiodine will not be monitored.

COMMENT	RESPONSE
• Protection of the detector head from contamination (by the gaseous medium) by an interchangeable thin screen; easy removal of supplemental devices such as temperature sensors, heaters, etc., in the inlet for decontamination; and use of construction materials that are easily decontaminated or are contamination resistant.	
• Design of collection assembly and detector to minimize the holdup of gases.	
• Determination of the characteristics (e.g., collection efficiency, retention capacity, delay-time constants) for all media in the collection train (solid sorbent, absolute particulate filter) for various radioactive gases of significance in the gaseous effluents, including radon and thoron.	
• Design of systems such that replacement of sorbent and filter shall not disturb the geometry between the collector and detectors.	

COMMENT	RESPONSE
Noble Gas Monitors - The lower level of detectability specified for noble gas monitors for gaseous effluents listed in ANSI N42.18-1974 (R 1980) ranges from 5×10^{-6} µCi/mL to 2×10^{-7} µCi/mL. These MDLs should be observed. Flow-through ionization chambers or proportional counters may be used. Usable signals from noble gas monitors depend on adequate removal of other radionuclides from the sample stream.	Significant quantities of noble gases will not be in the waste. Therefore, noble gases will not be monitored.
Chapter III.6.h(5) - These MDLs (ANSI N42.18-1974 for particulate monitors) should be observed.	The MDLs presented in ANSI N42.18-1974 were considered in the design of the particulate monitors.
The following instrument characteristics described in the standard should be considered:	
• The total equivalent window thickness (mg/cm^2) that an ionizing particle normally emitted from the surface of the collected aerosol will cross to reach the sensitive area of the detector (includes distance covered in air plus the window thickness and any thin, protective screen);	These instrument characteristics were considered in the monitoring system design.

COMMENT	RESPONSE
• The best estimate of the surface emission rate determined from a primary or secondary standard or by reference to an instrument that has been calibrated against a primary or secondary standard;	These instrument characteristics were considered in the monitoring system design.
• A check source, supplied with the monitor, designed to be used in place of the filter in the retention device;	This has been accomplished. Operational check sources are also available.
• A protective cover over the detector that can be easily exchanged from the front of the detector or designed to facilitate decontamination of the detector head;	These characteristics were considered in the monitoring system design.
• The general monitor concerns for sampling and exhaust piping stated for tritium monitors on page III-12, paragraph 6.h(1);	As appropriate these concerns were considered in the monitoring system design.
• For alpha monitors, filters that retain the particles on the surface;	These characteristics were considered in the design of the system.

COMMENT	RESPONSE
• A filter holder that facilitates decontamination, considers the mechanical strength of the filter medium used and pump characteristics, and minimizes wall deposition;	This was considered in the system design.
• Avoidance of gross nonuniform particle deposition;	This was considered in the system design.
• A detector assembly that minimizes the volume of a sample which may affect the response of the detector;	As appropriate, this was considered in the design.
• A filter holder design that minimizes in-leakage and internal leakage around the filter;	This was considered in the WIPP system design.
• A filter holder design that permits fast and easy removal;	To the extent practicable, this was considered in the system design.
• A useful detector area approximately equal to that of the particle collecting surface; and	The effluent monitoring system detector has been designed to approach the size of the filter.

COMMENT	RESPONSE
• A total equivalent window thickness that is less than two mg/cm^2 for alpha monitors and is appropriate for the beta spectrum anticipated for beta monitors.	This was considered in the design of the system.
Chapter III.6.h(6) - The following specifications from the standard (CAMS) should be considered:	All the enumerated specifications were considered in the system design and incorporated as appropriate.
• The minimum detection level required in ANSI N42.18-1974 (R 1980);	
• An operating range of at least 100 times the minimum detectable levels;	
• A maximum error of ±20 percent over the upper 80 percent of is operating range;	
• The measurement reproducibility within ±10 percent at the 95 percent confidence level for the mid-scale or mid-decade reading;	
• A response time less than that required to maintain background readings within required accuracy;	

COMMENT	RESPONSE

- Continuous operation within the specified accuracy in relative humidities of 40 percent to 95 percent;
- Less than 5 percent change in calibration with continuous operation at ambient pressure and temperature;
- Voltage and frequency variations of ±15 percent of design values resulting in reading variations of less than 5 percent;
- Insensitivity to radio-frequency microwaves associated with powerline noise suppression;
- Batteries capable of supplying power for 18 hours of normal operations, or two hours under alarm conditions; and
- A sample transport line designed to meet the requirements of ANSI N13.1-1969 through primary calibration at least once with NBS traceable standards.

COMMENT	RESPONSE
The specifications in the IEC standard that should be considered are (for transuranic aerosol effluent monitors):	
• Provide check sources; design to allow the check source to be held in the retention device in place of the filter or collection medium.	This was considered in the design of the monitoring systems.
• Protect the detector assembly or design for easy exchange or decontamination.	This was considered in the design of the monitoring systems.
• Extract under isokinetic conditions; design sample transport lines and collection device to prevent particle loss.	The sampling system in the Waste Handling Building (WHB) duct is designed to sample isokinetically. The system in storage exhaust ducting samples anisokinetically as do the CAMS.
• Hold the sample flow rate to ±10 percent specified air flow with an error no greater than ±10 percent of total air volume sampled.	This was a sampling system design consideration.
• Collect by filtration or impaction; select collection medium that minimizes absorption of alpha radiation by the collection medium.	This was considered in the design of the sampling system.

COMMENT	RESPONSE
• Design the filter holder on the mechanical strength of the filter and the collection rate needed to achieve the required detection levels; filters may be circular, square, or rectangular.	This was considered in the sampling system design.
• Design the monitor to minimize leaks, particularly internal leaks, allowing flow to bypass the collection medium.	This was considered in the design of the sampling system.
• Design the monitor to allow rapid, easy removal of the collection medium without significant risk of damage to the detector.	This was considered in the design of the sampling system.
• Design the monitor to allow complementary laboratory analysis of the collection media.	Filtered samples may be analyzed in greater detail if required.
• Assess the collection efficiency of the retention device over the range of 0.01 to 10.0 μm aerodynamic equivalent diameter under normal conditions of proposed use.	This testing was performed in assessing the performance of the system.

COMMENT	RESPONSE
• Assess detector characteristics (e.g., effective area, maximum total equivalent window thickness, protective coating, variation in detector efficiency as a function of energy, etc.).	This was considered in the system design.
• For alpha spectrometers, determine the full width at one-half maximum energy resolution of the detector to the alpha energy spectrum of interest under specific background radiation levels.	This was accomplished in the design of the system.
• Design monitors to prevent affects of noxious chemicals and water vapor.	This was considered in the system design.
Chapter III.6.h(8) - NaI(Tl), lithium-drifted germanium Ge(Li), or intrinsic germanium detectors should be used if measurements of specific, gamma-emitting radionuclides are required.	Intrinsic germanium detectors are used as appropriate.

COMMENT	RESPONSE
METEOROLOGICAL MONITORING PROGRAM	
Chapter IV.1.a - For each site, the factors considered (in establishing a meteorological monitoring program) should include the following: the magnitude of potential source terms, possible pathways to the atmosphere, distances from release points to critical receptors, and proximity of the site to other DOE facilities.	Each of these factors was considered in developing the meteorological monitoring program.
Chapter IV.3.d - If AIRDOS-EPA or another EPA-approved straight-line model is used to demonstrate compliance with 40 CFR Part 61.93 for a facility located in complex terrain, an additional dose assessment should be made using a procedure that realistically accounts for temporal and spatial variations in atmospheric conditions and release rates.	The WIPP site and its vicinity is not considered complex terrain.
Chapter IV.4.d - Consequently, the use of stability classes should be avoided when assessing the effects of short duration releases that take place at a known time.	A computer model, MESOI (Ramsdell et al., 1983) will be implemented for emergency modeling and will use real-time meteorological data to assess short-term releases.

COMMENT	RESPONSE
Chapter IV.5 - When it is necessary to evaluate the consequences of a release on receptors near the release point, the basic models should be modified to account for deviations from this assumption.	Near field effects, such as plume rise and building wakes, will be considered as appropriate in the dose assessments.
Chapter IV.6 - A meteorologist or other atmospheric scientist with experience in atmospheric dispersion and meteorological instrumentation should be consulted in determining whether onsite data are required and, if so, in selecting measurement locations and the design and installation of the meteorological measurement system.	The National Oceanic and Atmospheric Administration has participated in informal reviews of the site's meteorological measurement system. The system was designed and installed by qualified atmospheric scientists.
Also, any special meteorological requirements imposed by other agencies (outside the DOE) should be taken into consideration when designing meteorological measurement systems and establishing measurement locations.	No meteorological monitoring requirements beyond those utilized at the WIPP site have been imposed by agencies outside the DOE.

COMMENT	RESPONSE
The frequency of thunderstorms, icing, or other chemical or physical agents that may cause damage or deteriorate performance should be considered in selecting specific sensors and designing the sensor installation.	These factors were considered in the selection and installation of sensors.
An uninterruptible power supply should be included in the system, and an alternate source of power should be available.	Critical monitoring and alarm systems are providing emergency backup power. There is backup power provided to the meteorological system.
Chapter IV.6.a - At a minimum, wind measurements should be made at a height of 10 m.	Wind measurements are taken at 3, 10, and 40 meter heights, on a 40 meter tower.
If a vertical temperature difference is used to characterize atmospheric stability, the temperature difference should be determined over an interval of sufficient thickness to allow adequate determination of accepted stability classes.	Temperature is measured at 3, 10, and 40 meter heights, on a 40 meter tower.
Other necessary meteorological measurements should be made using standard instrumentation in accordance with accepted procedures.	Wind speed, wind direction, temperature, barometric pressure, rainfall, and relative humidity are measured on the 40 meter tower with standard instrumentation.

COMMENT	RESPONSE
Chapter IV.6.b - Instruments mounted above a tower should be mounted on a mast extending at least one tower diameter above the tower.	Instruments above the tower will be at least one tower diameter above the tower.
Instruments mounted on booms should be positioned three to four tower diameters from the tower.	Instruments are at least three tower diameters from the tower.
The orientation of booms for wind instruments should be determined after considering the frequencies of all wind directions.	Instrument boom orientation was determined based on consideration of frequencies of all wind directions.
Temperature sensors should be placed in aspirated radiation shields, and the shields should be oriented to minimize effects of direct and reflected solar radiation.	Temperature sensors are placed in aspirated radiation shields.
Chapter IV.6.c - The onsite meteorological measurement system should include two separate data-recording systems, and at least one of the systems should be digitally controlled.	Meteorological data is digitally recorded in the central monitoring station and locally on strip charts.

COMMENT	RESPONSE
In addition, the output of the instruments should be displayed in a location where instrument performance can be monitored on a regular basis.	Meteorological instrumentation is displayed in the Central Monitoring Station.
Digitally recorded data, except for $\sigma\theta$ (standard deviation of the wind direction) and precipitation, should be averaged over at least 30 samples taken at intervals not to exceed 60 seconds.	At least 30 data points are used to calculate recorded averages.
The time period represented by the averages should not be less than 15 minutes.	Recorded averages are 15-minute averages and hourly and daily summaries.
If strip charts are used as one of the recording systems, continuous-trace strip charts should be used for wind data; multipoint strip-chart recorders may be used for the remaining data.	Continuous trace strip charts are used to record data in the Central Monitoring Station.
<u>Chapter IV.7</u> - The accuracies of the monitoring measurements should be consistent with the specifications set forth in either ANSI/ANS-2.5-1984, the version of ANSI/ANS-2.5 that is current when the monitoring system is designed, or guidance provided by the EPA if EPA guidance recommends more stringent specifications.	The accuracies of measurement instruments are in accordance with EPA guidelines.

COMMENT	RESPONSE
Chapter IV.8 - All systems should be calibrated semiannually, unless system performance indicates that more frequent calibrations are necessary.	Systems are calibrated semiannually according to WIPP Procedure WP 02-306.
Data recovery rates for meteorological elements (other than wind direction, wind speed, atmospheric stability, and other meteorological elements required for dose assessment) should be 90 percent on an annual basis.	Meteorological data recovery rates have been and should continue to be at least 90 percent.
Chapter IV.11 - Data used in dose assessments should be collected as 15-minute averages for use in emergency response applications. The 15-minute averages can be combined into hourly averages for use in consequence assessments.	Meteorological data used for emergency response dose calculations are collected as 15-minute averages.
The 15-minute data should remain readily available in a temporary archive for at least 24 hours.	The 15-minute data are currently available for at least 24 hours and the new Central Monitoring Station will store the data on the WIPP central computer.
Then either the 15-minute or hourly averages should be stored for entry into a permanent archive and climatological summarization.	Hourly and daily averages will be permanently archived.

COMMENT	RESPONSE
These data should be examined and entered into the permanent archive at least monthly.	The data are currently archived biweekly.
Chapter IV.12.a - Consequence analyses for potential routine releases should be based on climatological data because the meteorological conditions at the time of release are unknown.	Consequence analyses in the FSAR (DOE, 1988a) are based on climatological data. Routine releases are not projected for WIPP operations.
If the postulated release is continuous, the analyses should be made using a joint frequency distribution of wind direction, wind speed, and atmospheric stability based on data from at least one annual cycle.	Postulated releases from WIPP are not continuous, but are assumed to result from accident situations only.
When possible the frequency distributions should be based on five or more years of data.	Meteorological data has been collected at the WIPP site from 1979 to 1982 and from 1984 to present.
Climatological summaries used in the evaluation of consequences of an actual release should be based on hourly data for the specific period of the release.	Real time meteorological data will be included in actual release dispersion calculations.

COMMENT	RESPONSE
For example, if a continuous release occurs from May 15 through June 26, the joint-frequency distribution should be based on the meteorological observations during that period.	Due to the similarity of meteorological conditions over the course of the year in the vicinity of the WIPP site, annual average or median condition data is utilized.
Where straight-line models are inappropriate, consequence assessments for routine releases and demonstrations of compliance should be made using a time series of hourly averaged data.	Straight line models are appropriate for the WIPP site.
These time series should include all supplementary data required to account for spatial as well as temporal variations in atmospheric conditions.	Simple models are appropriate for the WIPP site, so temporal and spatial variations are not significant.
Chapter IV.12.b - Consequence analyses for postulated accidental releases should be made for each downwind direction using conservative meteorological assumptions for each release scenario.	Worst case calculations are made for a single sector. These values are then applied to each sector to determine the worst-case accident scenarios.

COMMENT	RESPONSE
For a ground-level release, these assumptions should include a low wind speed and stable atmospheric conditions; for elevated releases, a range of conditions should be evaluated because a moderate wind speed and neutral atmospheric conditions may be more conservative than a low wind speed and stable conditions.	Assumptions for low-level releases, as postulated for this site, are consistent with those detailed.
The joint-frequency distribution and choices of meteorological conditions for the accident analyses should be based on a minimum of two years of hourly averaged data.	For accident analyses, worst-case data has been utilized to assess off-site consequences.
Consequence assessments during the course of an emergency should be based on time series of actual and forecast atmospheric conditions.	Real time meteorological data from the Central Monitoring Station will be used to perform consequence assessments during the course of an emergency.
When necessary, data should be included in the time series to represent spatial variations in the atmospheric conditions.	Spatial variations and topographical changes will be included in the real-time model, MESOI.

COMMENT	RESPONSE
ENVIRONMENTAL SURVEILLANCE	
Chapter V.2.c - Although emergency monitoring is beyond the scope of this Order, provisions for environmental monitoring during an emergency situation should be considered when determining routine program needs.	An array of high volume samples have been deployed around the site and surrounding communities. Baseline studies and monthly operational checks assure that these will be functional in the event of an emergency condition resulting in a release.
Chapter V.3.a - Where significant variations in effluent releases are observed or expected, environmental sampling or measurements should be either continuous or at an interval less than one-half the expected peak-to-peak interval.	No significant variations are expected due to operational plans.
Chapter V.3.b - A good rule to follow when considering the half-life of radionuclides being measured is that the sampling and measurement intervals should not exceed twice the half-life of the radionuclide.	Due to the long half-lives of the radionuclides which may be in any release from the facility, this is not a consideration.
Chapter V.4.a - The following is a partial list of subsidiary objectives, as provided in ICRP Publication 43, that should be considered when establishing environmental surveillance program objectives:	

COMMENT	RESPONSE
• The environmental surveillance program should provide information to the public.	The program has been designed to provide a recognized presence around the site, and results are presented to the public through an extensive Speakers Bureau program.
• The program should be capable of distinguishing site radiation contributions from other local sources (natural or manmade).	The emphasis of the program is to perform this function based on comparison to data obtained from the preoperational program.
• The program should be capable of obtaining data that may be required to assess the consequences of an accident.	The effluent sampling system is designed for this purpose in addition to sampling for normal operational releases.
• The program should be capable of identifying changes in relative importance of transfer parameters.	Due to the sparsity of human pathways from WIPP facility releases, such detail has not been emphasized in this program nor in the preoperational baseline program. The emphasis has been placed on the end source of potential exposure to man, i.e., sampling of biotic foodstuffs, quail, etc.

COMMENT	RESPONSE
Chapter V.4.b - The environmental surveillance media sampled or radiation measurements made should represent, as much as possible, the actual exposure vectors to people.	The emphasis has been placed on the end source of potential exposure to man, i.e., sampling of biotic foodstuffs, quail, etc. Also, the airborne pathway has been determined to be most significant and is monitored extensively.
The effort devoted to the environmental surveillance program should reflect the significance of the radiation doses projected to occur.	The most significant pathway to man from the WIPP facility is the airborne pathway. This pathway is the primary emphasis of the monitoring program.
Once the critical pathways and nuclides are identified (i.e., a critical pathway analysis procedure is defined), an annual review comparing reported effluent releases with those considered in the original analysis should be conducted and changes in the environmental surveillance program noted in a revised Environmental Monitoring Plan and discussed in the Annual Site Environmental Report.	Periodic review of program design is indicative of a comprehensive program and is necessary to maintain such a program's integrity.
The values (the minimum number of sampling measurement locations) chosen, following a site-specific environmental assessment, should be documented in the Environmental Monitoring Plan.	The Operational Environmental Monitoring Plan includes the sample types and number of sampling stations for each environmental ecological parameter to be monitored.

COMMENT	RESPONSE
Chapter V.5.b - Appropriate environmental measurements should be added to the routine program to better define an unusual "source" if the site-specific pathway analysis shows this to be a significant (greater than 10 percent of the total off-site dose) source of exposure.	If during the performance of the program, such an anomaly is observed, the program is designed to assess such an anomaly.
Chapter V.5.c - For DOE sites, the gamma (and, where applicable, neutron) exposure (or exposure rate) should be measured or calculated; any significant skin dose from airborne beta emitters should be calculated from effluent data (see Chapter VIII).	An assessment of releases and subsequent exposure is part of the routine operational procedure and is inherent in the calculational method.
If external beta doses from deposition are considered to be significant, they should be estimated from effluent data, beta-sensitive dosimeters, or by soil sampling and laboratory analysis.	No releases resulting in significant beta exposures have been identified.

COMMENT	RESPONSE
Chapter V.6.a - Before final placement of any environmental radiation measurement station (background or control and indicator locations), an initial on-the-spot survey should be performed and documented to determine the absence of possible naturally occurring anomalies that could affect interpretation of later measurements.	The proportional baseline program has assessed the WIPP site vicinity for the presence of anomalous areas. The operational monitoring locations have been selected, based on the results of the preoperational program.
Chapter V.6.b - Selection of the indicator locations should be based on expected sources of external radiation - noble gas plumes, soil-deposited atmospheric particulates released from the site, onsite radiation-generating machines or large radiation sources, or potential routes of waste transport from the site - as well as the local population distribution.	Monitoring and sampling locations were selected, based on the pathway analysis and the local population distribution.
The technique described by Waite (1973a,b) for placement of air samplers, based on average meteorological conditions and existing population distributions, should be considered for determining external radiation measurement locations.	The selection of sampling locations for airborne particulates was based on local demographic considerations and prevailing meteorological conditions.

COMMENT	RESPONSE
Chapter V.6.c - Background or control measurement stations should be located a minimum distance of 15 to 20 km from the site in the least prevalent wind direction.	Control locations have been selected in areas which are expected to be the least affected by WIPP actions, as appropriate. These are in the direction of the least favorable winds.
Control stations should also be placed in areas typical of local geology, away from buildings (which can shield the detectors), and at similar elevations to those for indicator stations.	Although not always feasible, the locations have been selected as well as possible, based on local conditions.
Chapter V.6.d - Offsite radiation measurement locations should be used for each DOE site with predicted external radiation doses exceeding the criteria in Figure V-1.	Although offsite Thermoluminescent Dosimeter (TLD) locations are used, the predicted external radiation doses do not exceed Figure V-1 criteria.
The site perimeter or boundary locations should include locations directly up-wind from the maximum predicted ground-level concentration from atmospheric releases averaged over a period of one year.	Up-wind TLD locations are used.
Offsite measurement locations should coincide with locations where maximum predicted levels occur and where any member of the public resides or abides.	An offsite location has been selected in the principal downwind direction from WIPP.

COMMENT	RESPONSE
In this case (sites larger in radius than a few kilometers), onsite radiation measurements should also be made to include the location of predicted maximum air concentration(s), as well as other locations needed to help interpret the offsite results.	The WIPP site is a small compact, single-facility site and therefore, does not require on-site monitoring.
Chapter V.6.e - If exposure measurements are to be made at shoreline locations, dosimeters should also be placed to correspond to key water sampling locations (including the site boundary), as well as locations important for recreational, commercial, or industrial usage.	No shoreline locations are monitored.
Chapter V.6.f - If another height (other than one meter) is used, the relationship to the 1-m height should be established and documented for the site.	For environmental dosimetry, the dosimeters are placed at approximately one meter above the ground level.
The frequency should be based on predicted exposure rates from site operations at the measurement locations.	Due to the type of facility, the types of materials being handled and expected dose rates, dosimetry will be evaluated only on a quarterly basis for the environmental dosimeters.

COMMENT	RESPONSE
Integrating devices (e.g., dosimeters) should be exposed long enough (typically one calendar quarter) to produce a readily detectable dose (e.g., 10 x the minimum sensitivity of the dosimeter; for TLDs this would represent an exposure on the order of 5 to 10 mR).	Due to the type of facility, the types of materials being handled and expected dose rates, dosimetry will be evaluated only on a quarterly basis for the environmental dosimeters.
If intermittent external radiation measurements are made, their frequency should be timed to coincide with batch atmospheric releases or the intermittent use of large sources or the operation of radiation-generating machines (see DOE Order 5400.xy, Chapter V.3.b).	No large releases or use of large sources is planned at the WIPP facility.
Chapter V.7.a - The method of measurement should depend on the anticipated type of radiation (beta, gamma, or neutron).	Penetrating radiation is measured by the use of thermoluminescent dosimeters (TLDs) and a high pressure ionization chamber (Reuter Stokes). Nonpenetrating radiation/radioactivity is measured by the collection of environmental samples, primarily airborne particulate.

COMMENT	RESPONSE
Chapter V.7.b - However, in situ gamma spectrometry should be used as a method of documenting environmental mixtures of radionuclides resulting from natural and manmade sources (e.g., for dosimeter placement).	No in situ gamma spectroscopy is planned. The normally-collected environmental soil samples are considered sufficient, since no significant anomalies have been observed.
An array of continuously recording exposure-rate instruments should be considered if there is a potential for release of large inventories of gamma emitters.	No large releases of gamma-emitting radionuclides are postulated, since this facility is designed to handle transuranic wastes with some small mixed fission and mixed activation product mass contamination. A single continuously recording exposure rate meter will be located in the principal down wind direction. From the FSAR (DOE, 1988a) analysis, there is no significant potential for releases of large inventories of gamma emitters.
Chapter V.7.c - ANSI-N545-1975 and NRC Regulatory Guide 4.13 should be used for performance testing, procedural specifications, and correction techniques for TLDs.	As applicable from an operational standpoint, the guidance contained in these standards is utilized.
Annealing, calibration, readout, storage, and exposure periods used should be consistent with the ANSI standard recommendations.	As applicable from an operational standpoint, the guidance contained in these standards is utilized.

COMMENT	RESPONSE
Chapter V.7.d - Where integrating dosimeters are used, three or more dosimeters should be provided at each location (in the same package, if possible).	The standard dosimetry card incorporates four thermoluminescent (TL) chips.
Integrating dosimeters should be read without undue delay, but, above all, at a consistent time following collection.	TLDs are handled and processed per procedure with a predetermined acceptable period for processing.
Chapter V.7.g - The method of measurement (in the vicinity of high-energy machines where neutron monitoring may also be required) should be based on the anticipated flux and energy spectrum.	This is not applicable at WIPP. There are no high-energy machines at WIPP and no sources of significant neutron radiation.
As with all external radiation measurements, neutron monitoring (or surveys) should be performed at the site boundary or location of nearest occupancy in the direction of maximum expected exposure rates, especially from beam dumps or accelerator targets.	This is not applicable at WIPP due to the anticipated diffuse neutron fields.
Chapter V.8 - The categories of airborne radionuclides that should be considered for measurement in air sampling systems include particulates, gases (principally the noble gases), halogens (principally radioiodines), and tritium.	Only releases of particulates are hypothesized for WIPP, so the monitoring program is designed with primary emphasis on detecting airborne particulate.

COMMENT	RESPONSE
Chapter V.8.a - Because air is a primary exposure pathway to humans from radionuclides released to the atmosphere, environmental air sampling should be conducted to evaluate potential doses to environmental populations from inhaled or ingested radionuclides or from external radiation.	Air sampling is the primary emphasis of the environmental program since airborne effluent represents the most significant release scenario.
The collection efficiency of filters used to collect particulate materials should be considered when calculating the concentration of radionuclides in the air that was sampled.	The efficiency of the air filters utilized for particulate sampling in the environmental program is considered, but since the filtration media is essentially 99.9 percent efficient for particulate, no correction is required.
If releases of particulate materials could contribute significantly to environmental doses, measurements of particle size should be made.	Particulate size studies have been performed for the effluent release points which could significantly affect off-site doses.
Chapter V.8.c - Thus, air sampling techniques should employ methods that collect moisture from the air.	Tritium will not be monitored at WIPP because the waste will not contain significant amounts of tritium. Therefore, air sampling techniques will not include the collection of moisture from the air.

COMMENT	RESPONSE
Chapter V.8.d - Air sampling locations should be selected to represent radionuclide concentrations breathed by the population surrounding the nuclear facility.	Air sampling locations have been selected to obtain representative samples of the particulate to which the population is exposed.
Offsite air samplers should be employed at each DOE site having potential airborne releases that could result in an annual effective dose equivalent greater than one mrem to the maximally-exposed individual.	Due to the R&D nature of the WIPP facility, more extensive sampling than that required is performed at the local ranches and population centers.
Sample locations should include the following: a background or control location; locations of maximum predicted ground-level concentration from stack (or vent) releases, averaged over a period of one year where members of the public reside or abide; and locations in the nearest community within a 15-km radius of the site.	The preoperational baseline program has provided control values for comparison to operational determined levels since an operational control point would not be appropriate for this facility. Sample locations corresponding to the other locations described are maintained.

COMMENT	RESPONSE
If the maximally-exposed individual could receive an effective dose equivalent of more than 5 mrem, additional air samples should be collected in those communities within a 15-km radius of the site boundary for which the projected dose equivalents exceed the criteria in Figure V-1, and at a control (background) location (15 to 20 km from the site in the least prevalent wind direction).	Off-site exposures are not projected to exceed Figure V-1 criteria.
Unless documented site-specific evidence exists to justify otherwise, the sample(s) at each air sampling station should be collected at a height of 1.5 m above ground level (approximately the height of inhalation for adults), in a location free from unusual localized effects or other conditions (e.g., in proximity to a large building, vehicular traffic) that could result in artificially high or low concentrations.	Air samplers are mounted about 1.5 meters above the ground except for the Carlsbad and Eunice sampling stations, which are presently located on rooftops for security reasons. As discussed in Section 6 of this document, more suitable locations will be sought during the OEMP.
Locations should be selected to avoid areas where large-particle (nonrespirable) fugitive dusts can dominate the sample (Ludwig, 1976).	All locations have been selected to be representative.

COMMENT	RESPONSE
A method similar to that developed (Waite, 1973b) and evaluated by Waite (1973a) should be used to determine the number of air sampling stations and their placement.	Waite (1973 a,b) refer to locating air samplers based on population size, distance from the facility and meteorological conditions. The WIPP is located in a very sparsely populated region with only 26 people living within ten miles of the facility. The methods outlined by Waite do not apply to the conditions around the WIPP facility.
Chapter V.8.e - Unless otherwise justified, the maximum air particulate filter exchange frequency should be biweekly.	Air particulate filters will be exchanged weekly.

COMMENT	RESPONSE
The sample exchange frequency for nonparticulate sampling should be determined on a site-specific basis and shall be documented in the environmental surveillance files.	Nonparticulate air samples are not collected at WIPP.
Chapter V.8.f(1) - No single filter type is best for all purposes, but the specific filter to be used should be selected to meet site-specific requirements such as high collection efficiency, particle size selectivity, retention of alpha emitters on the filter surface, or the ease of radiochemical analysis.	The 47-mm glass fiber filter provides the desired collection efficiency for alpha particles.
Any filter media used should retain a minimum of 99 percent of dioctyl phthalate (DOP) particles with an aerodynamic mean diameter of 0.3 μm at the air face velocity and pressure drop expected in use (American Conference of Governmental Industrial Hygienists, 1974).	The filter media has been selected to retain the maximum amount of particulate in the size range of interest.
Chapter V.8.f(2) - Airborne radioiodines should be collected with charcoal or silver zeolite cartridges in series behind the particulate filter, and analyzed by gamma spectrometry, the method suggested by the Intersociety Committee (1972).	Radioiodine is not monitored at WIPP.
This type of collection device (compound filter canisters) should be used if the levels of radioiodine or the cause of the release warrant.	Radioiodine levels are not monitored at WIPP.

COMMENT	RESPONSE
Chapter V.8.f(3) - Routine environmental surveillance for short-lived noble gases (e.g., ^{41}Ar) should be performed by external radiation measurements.	Short-lived nobles gases are not monitored.
Laboratory analysis of periodic grab samples of ambient air (Denham et al., 1974) should be performed for the longer-lived radionuclides, principally ^{85}Kr, when the critical pathway analysis indicates the potential dose exceeds the criteria given in Figure V-3.	Figure V-3 criteria are not projected to be exceeded. Also, WIPP wastes will not contain significant quantities of noble gases.
Atmospheric stability and wind speed and direction during the period in which the samples were collected should be recorded to aid in interpreting and using the data for dose calculations.	Meteorological conditions are monitored continuously and recorded automatically.
Chapter V.8.f(4) - Methods for differentiating and measuring separate concentrations of HT and HTO in air (MLM-2015; Griffin et al., 1972; Ostlund, 1970) should be used when the critical pathway analysis indicates the need for differentiation.	Tritium is not monitored.
Chapter V.8.f(5) - A number of precautions should be taken when using the referenced methods and equipment for air sampling in the environment. Some of these relate to general air sampling and some relate specifically to the sampling of particulates, radioiodines, noble gases, or tritium:	

COMMENT	RESPONSE
• Sufficient material needs to be obtained for analysis of samples in a time frame set to meet reporting and data-retrieval requirements. The requirements of sufficient volume of air and number of samples should be evaluated and the need for compositing samples considered (DOE/EP-0023).	Particulate filters are collected weekly and counted for gross alpha and gross beta. The weekly filters from each location are composited quarterly to provide a sufficient size sample for more complete radiological analyses.
• Excessive material (sample or dust) collected on filters can invalidate the sample in several ways; the flow rate through the filter may be unknown, the pump may fail, the particulate material may penetrate the filter, the analysis for alpha emitters may be affected, or material on the surface may be lost when the flow is interrupted (DOE/EP-0023).	Each sample is weighed to determine the amount of sample collected and each sampler is inspected to determine proper flow rate, operation, condition of filter, etc.
• Excessive sampling velocity can invalidate the sample if too much sample is collected during a specific time period.	Air flow through the filters at 950 ml per second (2 CFM), a relatively low flow rate.
• Collection efficiency of an air filter is affected by flow rate; too low an air sampling velocity can produce a reduced collection efficiency for specific filters (Keller et al., 1970).	The air flow used is consistent with the type of glass fiber filter.

COMMENT	RESPONSE
• Ambient levels of radon and thoron and their decay products can affect the analysis of a number of filter samples. These naturally occurring radon and thoron decay products are found on air particulate filters because they adhere to particulate matter and are thus efficiently trapped by the air sampling filter. Therefore, any measurement system for other alpha and/or beta emitters (e.g., ^{239}Pu, ^{90}Sr) must be able to discriminate against the typically much larger "background." Rather than resorting to spectroscopic or chemical separation techniques, the most common method of discrimination is to retain the filter from one to seven days (American Conference of Governmental Industrial Hygienists, 1974) after collection and before counting, to allow for decay of the short-lived radon and thoron decay products.	Sufficient decay time is provided before counting.
• Too high a sampling rate reduces both the collection efficiency and retention time of charcoal filters, especially for the nonelemental forms of iodine (Bellamy, 1974; Keller et al., 1970). The retention of iodine in charcoal is dependent not only on charcoal volume, but also on the depth of the charcoal bed.	Charcoal filters are not used as collection media. Radioiodine is not monitored.

COMMENT	RESPONSE
The monitoring of airborne radioiodines is complicated by the occurrence of several species, including particulate iodine (bound to inert particles), elemental iodine vapor, and gaseous (usually organic) compounds. The monitoring program should take into account the probable occurrence of the different iodine forms, because their subsequent history in the environment will differ. While it may not be necessary to differentiate routinely between the various species, care should be taken so that no significant error results by neglecting one or more of them (DOE/EP-0023).	Radioiodine is not monitored.
• Charcoal cartridges (canisters) for the collection of radioiodine in air are subject to channeling, as with any packing of loose materials. Baffled-flow cartridge design, packing to a minimum required weight, and pretesting of randomly selected cartridges for pressure drop before operation in the field will minimize the problem. An alternative is to mount several cartridges in a series to prevent loss of iodine; each cartridge must be counted in this case (DOE/EP-0023).	Radioiodine levels are not monitored.

COMMENT	RESPONSE
• For the short-lived radioiodines (mass numbers 132, 133, 135), environmental sampling is complicated by the need to obtain a sufficient volume for analysis while at the same time, retrieving the sample soon enough to minimize decay (with half-lives ranging from two to 31 hours). Short-period grab sampling with charcoal cartridges is possible, with direct counting of the charcoal as soon as possible for gamma emissions, but radon and thoron will affect detection levels (DOE/EP-0023).	Radioiodine is not monitored.
• Because of the extremely long half-life and normally low environmental concentrations, ^{129}I determinations are usually performed by neutron activation analysis after chemical isolation of the iodine.	Radioiodine is not monitored.
Chapter V.8.f(6) - The following operational criteria relate to environmental sampling instrumentation and methods:	
• The linear flow rate across particulate filters and charcoal cartridges should be maintained between 20 and 50 m/minute (DOE/EP-0023)	The linear flow rate is maintained at approximately 35 m/minute.

COMMENT	RESPONSE
• The air sampling system should be protected as much as possible from the elements (i.e., weather, tampering, and theft).	The air samplers are secured and protected from damage or tampering.
• Air sampling devices, such as "quick-disconnect" filter holders, should be designed so that the potential for loss of sample during the collection process is minimized.	The "quick-disconnect" filter holders are designed not to lose the sample. Filter change procedures are also designed to minimize loss of sample.
• If impregnated, activated carbon is used as the adsorbent for radioiodine, the adsorber system should be designed for an average atmospheric residence time of 0.05 cm/second (0.25 second/2 inches) of adsorbent bed (NRC, Regulatory Guide 1.52).	Radioiodine is not monitored.
• NRC Regulatory Guide 8.25 contains guidance relative to determining errors associated with the total volume of air sampled.	Guidance, as appropriate, has been incorporated into the sampling and analysis methodologies. Air sample volume corrections were incorporated into RADCOMP, a WIPP computer program which schedules and tracks samples and serves as a data base for results of radiological analyses.

COMMENT	RESPONSE
Chapter V.9.a - If the preliminary analysis of public dose indicates that the annual effective dose equivalent from ingestion of terrestrial foods is one mrem or greater, then sufficient sampling and analysis should be carried out so that the foods and radionuclides contributing at least 90 percent of this ingestion dose have been evaluated.	Projected off-site doses are less than 1 mrem.
When the annual effective dose equivalent is less than one but greater than 0.1 mrem, then sufficient surveillance should be done to show that the radionuclides are behaving in the environment as expected.	Projected annual effective dose equivalent from WIPP operations are less than 0.1 mrem.
Chapter V.9.b - Even in those instances where the annual effective dose equivalent from ingestion of terrestrial foods is less than 1 mrem, periodic sampling and analysis of indicator materials, such as as soil (see DOE order 5400.xy, Chapter V.10) or vegetation should be performed to determine if there is measurable long-term buildup of radionuclides in the terrestrial environment.	Soil and vegetation are both monitored to determine whether there is long-term buildup in the environment.
Unless terrestrial foods or indicator organisms are being analyzed routinely, the pathway evaluation should be repeated annually to reaffirm the original evaluation.	Terrestrial foods and indicator organisms will be analyzed routinely.

COMMENT	RESPONSE
If wild game, such as deer or game birds, are available locally, then these should also be considered in the pathway analysis.	The pathway analysis did consider wild game. Lagomorphs and game birds will be routinely monitored.
Chapter V.9.c - Representative samples of the pathway-significant agricultural products grown within 16 km of the site should be collected and analyzed for radionuclides potentially present from site operations. These samples should be collected in at least two locations: the place of expected maximum radionuclide concentrations, and a "background" location unlikely to be affected by radionuclides released from the site.	There are no pathway-significant agricultural products grown within 16 km of the site. However, if vegetable gardens are grown at the two ranches nearest the site, green leafy vegetables will be sampled, if available. Vegetation samples will be collected at the point of maximum radionuclide concentration and at background locations during the OEMP.
Chapter V.9.c(1) - If dairy herds or "family" cows (or goats) are present in the vicinity of the site (within 16 km), representative milk samples should be taken and analyzed for radionuclides potentially present from site operations.	There are no dairy herds or "family" cows within 16 km of the site.

COMMENT	RESPONSE
The number of locations to be sampled depends on the number and distribution of the dairy herds or family cows in the vicinity (16 km) of the site (i.e., one sample at highest X/Q and in each area where estimated doses exceed the criteria in Figure V-1), but a minimum of one background and one potentially affected location should be sampled at least annually.	There are no diary herds or family cows within 16 km of the site.
For ^{131}I analyses, sampling should be at least biweekly during the local grazing season.	^{131}I is not monitored as the wastes do not contain significant quantities of iodine.
The frequency should be increased if the ^{131}I release rate is highly variable.	The wastes do not contain significant quantities of ^{131}I. Therefore, ^{131}I is not monitored.
Milk samples should be as representative as possible of the location of interest.	No milk samples will be taken during the OEMP.
Raw milk should be sampled for evaluation of potential radiation doses to individuals consuming milk produced by a family cow.	Milk will not be sampled in the OEMP.
Liquid milk samples should be refrigerated or otherwise preserved prior to analysis; however, the analytical procedure to be used shall be considered when choosing a sample preservation method.	Milk will not be sampled in the OEMP.

COMMENT	RESPONSE
Chapter V.9.c(2) - Where actual measurement of radioactivity cannot be made (e.g., radioactivity levels are below minimum detectable concentrations), dose calculations should include estimates of potential contributions.	Estimates of potential doses are made by use of effluent sampling results, local meteorological conditions, and computer simulation.
If the samples of garden vegetables are being collected for evaluation of radiation doses, then the edible portions of the vegetables should be analyzed for the radionuclides of interest.	The edible portions of vegetables collected will be analyzed for appropriate radionuclides.
The results should be expressed in terms of the radionuclide concentrations in the vegetables (consumed state) used in the dose calculation (e.g., fresh weight, peeled weight, etc.).	Results are expressed in terms of activity per unit fresh weight.
Samples of vegetables should be collected at local farms or from family gardens when the effective dose equivalent to individuals is being evaluated.	Vegetable samples will be collected from local/family gardens when available.
When collective effective dose equivalents are being evaluated, fresh produce from commercial sources should be included in the samples.	No significant source of fresh produce is grown in the vicinity of WIPP.
Local sweet corn should be sampled annually at harvest time from a "background" farm and a farm where there is a potential for contamination with radionuclides released from the site. A one to two kilogram sample of corn should be sufficient for analysis.	Sweet corn is not grown in the vicinity of the site.

COMMENT	RESPONSE
Samples collected for evaluation of intake of radionuclides by farm animals should be representative of the vegetation consumed by the animals.	Local vegetation and locally grazed beef will be sampled as discussed in Section 6 of the OEMP.
Samples collected for monitoring of long-term trends in environmental contamination should be capable of accumulating the radionuclides of interest to permit detection at the desired level.	The uptake coefficients for transuranics as a whole do not allow for partitioning between plant species to emphasize particular radionuclides and their accumulation.
Such samples should be collected from the locations of interest, including, but not necessarily limited to, a background location and a maximum location.	A well defined set of sampling locations have been selected which include the locations for a calculated maximum, typical varied conditions, and control locations.
Chapter V.9.c(3) - However, this time delay (between slaughter and delivery of the meat to retail outlets) should be accounted for when the analytical results are used to calculate radiation doses from consumption of commercially available meat.	When appropriate, the time delay will be accounted for in calculation of radiation dose from consumption of the meat. In general, radionuclide half-life is not an important consideration at WIPP.
All samples should be placed in plastic bags, sealed, and properly labeled before delivery to the analytical laboratory.	All samples are collected, sealed, and labeled according to WIPP procedures.
Meat samples collected at farms or slaughterhouses should be reduced to edible portions in a manner similar to commercial and home preparation before analysis.	Edible portions of meat samples are analyzed.

COMMENT	RESPONSE
Chapter V.9.c(4) - Analysis should be done on the whole egg (without the shell).	Eggs do not represent a significant pathway and are not analyzed as part of the OEMP.
Analytical results from local farm eggs, when available, should be used for individual dose calculations, while those from commercial eggs should be used for population dose calculations.	Eggs do not represent a significant pathway and are not analyzed as part of the OEMP. There are no commercial egg producing operations in the vicinity of the site.
Chapter V.9.d - A review of the hunting habits in the local area should be included in the preliminary pathway analysis to determine if such game are important parts of the diet of the local population or of hunters from outside of the region.	Wildlife were evaluated in the pathway analysis for the WIPP FSAR (DOE, 1988a).
If the results of the preliminary survey indicate that local game could make an important dose contribution, then a more detailed survey of the amounts of each type of game harvested and the disposition of the meat should be made and documented.	The pathway analysis in the FSAR does not indicate that local game could make an important dose contribution.
Wildlife that is relatively rare locally should not be taken as environmental samples.	Locally rare wildlife species are not sampled for the OEMP.
Chapter V.10 - Hence, soil sampling and analysis should be used to evaluate the long-term accumulation trends and to estimate environmental radionuclide inventories.	As discussed in Section 6.4 of the OEMP, soil sampling will be used to evaluate long-term accumulation trends.

COMMENT	RESPONSE
Analytical and sample preparation procedures should be tailored to the radionuclides of interest.	Specific radiochemical and gamma spectroscopy analyses will be performed for the radionuclides of interest. Analytical and sample preparation procedures are tailored to the analysis to be used.
Chapter V.10.a - Background determinations should be based on soil sampling and analysis at points corresponding to background (or control) air sampling locations.	Background locations for soil samples will be based on sampling at background air sampling locations.
Where possible, soil sampling locations should be selected to coincide with air sampling stations, since the comparability of data may be important in achieving the objectives of the overall environmental sampling program.	Soil sampling stations have been selected to coincide with air sampling stations where possible.
Except where the purpose of the soil sampling dictates otherwise, every effort should be made to avoid tilled areas or areas of unusual wind or precipitation influence when selecting soil sampling locations.	Soil sampling locations are representative of local topography and land use.
The sampling frequency of soil collected for purposes other than long-term environmental accumulation should be based on site-specific purposes and radionuclide half-life, with the purpose(s) and details documented.	Soil sampling is for determination of long-term environmental buildups. Half-lives for significant WIPP waste components are very long.

COMMENT	RESPONSE
Chapter V.10.b - Several reports are available that should be used as guidance in sampling, preparing, and analyzing soil for plutonium (NRC Regulatory Guide 4.5; Fowler et al., 1971; Sill and Williams, 1971), for radium (GJ/TMC-13; Meyer and Purvis, 1985; Myrick et al., 1983) and for other radionuclides (ASTM, 1986a; Mohrand and Franks, 1982).	NRC Regulatory Guide 4.5 was used as guidance in sampling and preparing soil samples for plutonium.
Surface soil sampling should be conducted according to methods of NRC Regulatory Guide 4.5, ASTM (1986b), or HASL-300.	NRC Regulatory Guide 4.5 was used to determine soil sampling locations and procedures.
Chapter V.11 - When liquid effluents are released to streams, rivers, or lakes, samples of these surface waters should be made according to the methods, locations, and frequencies specified in this section if the releases are projected to result in radiation doses exceeding the criteria given in Figure V-1.	Liquid effluents are not released to streams, rivers or lakes.
Routine laboratory analyses on water samples should include those radionuclides, determined by pathway analyses, that represent a significant fraction of the potential dose from the water pathway (e.g., radio-strontium, gamma spectrometry) according to the radionuclides released from the site and other potential sources.	The emphasis of laboratory procedures and analyses will be on the TRU and fission products expected in the wastes to be received at WIPP.

COMMENT	RESPONSE
Potential for unplanned releases should not be overlooked in planning for monitoring.	The Operational Environmental Monitoring Plan considers both routine and accident releases.
Chapter V.11.a - Therefore, detailed hydrological and radiological studies should be conducted for each site on streams, ponds, and lakes to establish the best sampling locations and frequencies to determine radiological doses.	The Water Quality Sampling Program and the Site Characterization Program have conducted detailed hydrological and radiological studies at the site. The information has been utilized in establishing sampling locations and frequences.
Chapter V.11.a(1) - Representative surface water background samples from rivers or streams should be collected routinely at locations expected to be unaffected by site operations (i.e., upstream locations).	Background surface water samples have been and will continue to be collected in areas expected to be unaffected by site operations.
Care should be taken to avoid eddy currents.	Samples collected will be representative of the surface water sampled. Eddy currents will be avoided during sampling.
However, an investigation should be conducted and documented to show that it (counterpart stream in the vicinity) is independent of local influence from radioactive materials.	The Radiation Baseline Program has documented environmental radiation levels at background locations.
The other offsite sampling locations for surface water should be at the edge of the effluent mixing zone and at the nearest down-current point of withdrawal for domestic or other uses.	Liquid effluents are not released to rivers or streams.

COMMENT	RESPONSE
Samples on the traverse should be taken at more than one depth and at a minimum of four to six points equidistant across the stream flow, and no samples should represent more than 10 percent of the stream flow.	When the water body is of sufficient depth, samples are taken at two or three levels. When the water body is of sufficient width, four or five stations are sampled along the traverse.
Traverse studies should be repeated whenever a significant change occurs either in the types or quantities of radionuclides (actual or expected) released or in the flow regime of the stream (such as from the addition of hydroelectric or flood-control dams).	Liquid effluents are not discharged from WIPP.
Representative background samples from ponds or lakes should be collected routinely for these surface water sources at locations expected to be unaffected by site operations.	Background surface water samples from ponds or lakes have been and will continue to be collected in areas expected to be unaffected by site operation.
Such locations should be far enough from the point of discharge so that the facility effluent has no (or as little as possible) influence on the sample content.	Liquid effluents are not discharged from WIPP.
To provide that the latter is true, the distance from the discharge point should be chosen to be at least 20 percent of the length of the pond or lake.	Liquid effluents are not discharged from WIPP.
Care should be taken to avoid eddy currents in the sampling location.	Liquid effluents are not discharged from WIPP.

COMMENT	RESPONSE
However, in either case, an investigation should be conducted (e.g., collection of substantial hydrologic and surface-flow data) and documented to show that a different pond or lake than the one used for liquid effluents is independent of local influence from radionuclides of possible plant origin.	Liquid effluents are not discharged from WIPP.
Other offsite sampling locations for ponds or lakes should be at the edge of the effluent mixing zone (based on dye or other local transport studies) and at the nearest point of withdrawal for domestic or other uses.	Liquid effluents are not discharged from WIPP.
The close-in sampling location should be located near the discharge outfall, but beyond the turbulent area caused by the discharge.	Liquid effluents are not discharged from WIPP.
Samples on the traverse or axial sampling lines should be taken at more than one depth and at a minimum of three to five equally-spaced points along each of four radials.	When the water body is of sufficient width and depth, two or three levels are sampled along four or five stations along the traverse.
Traverse or axial studies should be repeated whenever significant change occurs either in the types or quantities of discharges or in the water level of the pond or lake.	There are no liquid effluents discharged from WIPP.

COMMENT	RESPONSE
Chapter V.11.a(2) - The sampling location for drinking water derived from surface-water sources should be of the treated water at the point of maximum probable effluent concentration in the surface water.	Drinking water in the vicinity of the site is derived from groundwater sources.
Samples of untreated water at the same location should also be taken to determine any removal by water treatment and to improve the reliability of dose estimates.	Drinking water in the vicinity of the site is derived from groundwater sources.
Such conditions should be documented and periodically (at least annually) reviewed to determine that the potential doses are still below the criteria on Figure V-1.	Drinking water in the vicinity of the site is derived from groundwater sources.
The sampling location for drinking water derived from ground-water sources should be at the nearest domestically-used well downgradient from the surface (crib, pond, lake, or stream) discharge point.	Liquid effluents are not discharged from WIPP. The groundwater monitoring program does routinely monitor wells downgradient from the site.
Another well (typically in the upper, unconfined aquifer) upgradient from the discharge point should be used for the control or background sample.	Upgradient wells are routinely monitored for use as control points.
Chapter V.11.a(3) - The groundwater monitoring programs should be conducted onsite and in the vicinity of DOE facilities to:	

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COMMENT	RESPONSE
1. Obtain data for the purpose of determining baseline conditions of groundwater quality and quantity;	An extensive network of wells were sampled during the Radiological Baseline Program (RBP) to establish baseline conditions.
2. Demonstrate compliance with and implementation of all applicable regulations and DOE Orders;	Groundwater monitoring around WIPP will show compliance with DOE Order 5480.2 and 40 CFR Parts 264 and 265.
3. Provide data for the early detection of groundwater pollution or contamination;	The location of the wells and the annual sampling schedule will provide early detection of groundwater pollution.
4. Identify existing and potential groundwater contamination sources and to maintain surveillance of these sources; and	Groundwater samples have been collected for 3 years to determine the background physical and chemical characteristics.
5. Provide data upon which decisions can be made concerning land disposal practices and the management of ground water resources.	Baseline data was collected to aid in the decision making process.
The siting and number of ground water monitoring stations should be governed by the nature of ground water use and the location of known and potential sources of pollution.	The OEMP will monitor wells that are upgradient and downgradient from WIPP, as well as wells used for stock and human consumption.
When possible, existing wells should be used.	OEMP water samples will be collected from existing wells.

COMMENT	RESPONSE
Well siting should be directly related to pollutant pathways, but well locations must be chosen carefully to prevent a new well from providing an avenue for pollutants to reach the aquifer.	The OEMP will utilize existing monitoring wells that are located both upgradient and downgradient from WIPP.
Chapter V.11.b - For drinking water systems, the sampling frequency and volume should be chosen to provide adequate sensitivity for the analysis using the general criteria given in Figure V-1.	The FSAR (DOE, 1988a) does not indicate that doses will exceed the 1 mrem/year criteria in Figure V-1, however, drinking water wells in the vicinity of WIPP will be routinely sampled.
At least 50 percent of the data should be greater than the minimum detectable level for all water analyses used for dose calculations.	The WIPP Facility has no liquid effluent pathway. Water analyses are not routinely used for dose calculations.
Chapter V.11.c(1) - The following factors should be considered when selecting water sampling equipment: • Probability for significant fluctuations in concentration of the water sampled; • Potential for significant human impact (dose); • Potential for contaminating the environment; and • Applicability to radionuclide(s) of interest.	Periodic or continuous liquid waste effluents are not to be released to streams or lakes; thus the four factors listed below are not applicable when selecting water sampling equipment for WIPP.

COMMENT	RESPONSE
When the data are to be used for dose calculations, the method should use a fixed-time sampling frequency, similar to that by which water is withdrawn for human consumption. (If the data therefrom are to be used for radionuclide transport or inventory purposes, these samples should be taken with timing proportional to flow rate.)	There are no liquid effluent pathways from WIPP.
When circumstances prohibit this type of automated continuous sampling (e.g., power restrictions, prohibitive pumping requirements, freezing temperatures, etc.), compositing should be performed by manual collection on a frequency based on effluent release and on information on the receiving body of water.	Liquid effluents will not be released from WIPP.
Because the flow of most ground water systems is on the order of centimeters to meters per day (compared with tens or even hundreds of kilometers per day for surface stream flows), periodic grab sampling of ground water should be sufficient.	Periodic grab sampling is used.
Unless circumstances prohibit, ground water grab sampling should be done by pumping, either with a pressure air lift or with a submersible pump. In either case, the pump should be operated for a length of time sufficient to obtain a representative sample of water in the aquifer.	Submersible pumps are used for purging and sampling purposes. Groundwater is pumped for a sufficient time to obtain a representative sample of the aquifer.

COMMENT	RESPONSE
Chapter V.11.c(3) - Therefore, all surface water samples should be carefully taken from beneath the water surface to avoid floating debris and any bottom sediments or growths.	Samples are collected at a depth of 6 to 12 inches below the surface.
So that data are comparable, both fractions should be added in reporting the total concentration.	The total concentration will include the sum of the soluble and insoluble fractions.
Caution should be exercised to prevent water samples being cross-contaminated by reuse of sampling containers.	Sample containers will not be reused.
When obtaining surface water grab samples, the sample container should be rinsed twice with the water being sampled before the actual sample is taken.	Sample containers are rinsed three times prior to taking the actual sample.
When extracting aliquots from a larger water sample, extra effort should be taken to provide that the aliquot is representative of the entire sample.	Samples will be well mixed so that subsequent aliquots will be representative of the entire sample.
Methods for Chemical Analysis of Water and Wastes (EPA 625/6-74-003), Section 11 of the Annual Book of ASTM Standards (1986a), the Environmental Measurement Laboratory (EML) Procedures (HASL-300), and the Radiological and Environmental Sciences Laboratory procedures (IDO-12096), should be used for sample preservation, storage, and analysis methods.	The applicable procedures will be followed for sample preservation, storage, and analysis.

COMMENT	RESPONSE
Radioiodine analyses should not be performed on an acidified sample.	Radioiodine is not monitored.
Chapter V.12 - If the preliminary analysis indicates that the annual effective dose equivalent from ingestion of aquatic foods is five mrem or greater, then sufficient sampling and analysis should be carried out to provide that the foods and radionuclides contributing at least 90 percent of this ingestion dose have been evaluated.	The annual effective dose equivalent from ingestion of aquatic foods is projected to be much less than 0.1 mrem.
If the annual effective dose equivalent is between one and five mrem, then sufficient sampling and analysis should be carried out to provide reasonable assurance that the doses are in this range.	The annual effective dose equivalent from ingestion of aquatic foods is projected to be much less than 0.1 mrem.
When the annual effective dose equivalent is between 1 and 0.1 mrem, then sufficient surveillance should be done to show that the radionuclides are behaving in the environment as expected.	The annual effective dose equivalent from ingestion of aquatic foods is projected to be much less than 0.1 mrem.
Aquatic organisms, sediments, and other predictive environmental media should be sampled and analyzed at least annually to provide compliance with the interim aquatic biota limit of one rad/day.	Fish are monitored annually.

COMMENT	RESPONSE
Chapter V.12.a - If the aqueous effluents are discharged into a surface body of freshwater (pond, lake, stream), then the background sampling point should be far enough from the discharge point for radionuclide concentrations in the water and sediment to be unaffected by the effluents.	Aqueous effluents are not discharged into a surface body of freshwater.
The indicator sampling location should be downstream of the discharge point(s) at a location in which the water is determined to be well-mixed (e.g., based on water-sample traverses).	Aqueous effluents are not discharged to surface streams.
In choosing the locations to be sampled, consideration should be given to the possible migration of fish between upstream and downstream locations.	Liquid effluents are not to be discharged to streams or lakes from WIPP; therefore locating upstream and downstream fish sampling locations is not applicable.
Chapter V.12.a(2) - Studies of fishing pressure and fish consumption, coupled with preliminary radio-chemical analysis of the different types of available fish, should be used to define the proper species to monitor for the purposes of dose calculation.	Selection of fish species used to monitor dose calculations will be based on species populations, fish habitat preferences (i.e., bottom feeders), fishing pressure and consumption, and preliminary radiochemical analyses.
For use in dose calculations, the edible portions of the fish as prepared for human consumption should be analyzed.	Only muscle tissue is analyzed.
In most instances, that includes only the muscle.	Only muscle tissue is analyzed.

COMMENT	RESPONSE
However, the whole fish should be analyzed if it is used for preparation of fish meal or fish burgers.	There are no commercial canneries in the WIPP area.
If fish are the critical pathway, then they should be analyzed by species.	Fish are not a critical pathway.
The following factors should be considered when determining the frequency of sampling: variability of the radionuclide release rates; seasonal variations in the feeding habits of the fish and in the availability to consumers; and, if the freshwater habitat includes a flowing stream, the variability in the stream flow rate.	Seasonal variations in fish behavior, fish consumption patterns and variability in stream flow rates will be considered when determining the frequency of fish sampling. However, as no liquid effluents are to be released by WIPP, the variability of radionuclide release rates is not an applicable factor for consideration.
<u>Chapter V.12.a(3)</u> - The preliminary pathway analysis should include consideration of the amount of water-fowl hunting, if any, in the local area and the number of birds shot.	The preliminary pathway analysis determined that water fowl do not constitute a significant pathway.
If the potential effective dose equivalent is significant, a minimum of two or three birds of each type (bottom feeders, plant eaters, and fish eaters) should be sampled during hunting season.	Waterfowl are not sampled because they are not a significant pathway.
During preparation of the samples for analysis, care should be exercised not to contaminate the edible portions with radionuclides present on the external surfaces of waterfowl.	Waterfowl are not sampled.

COMMENT	RESPONSE
Analysis should include the radionuclides listed above plus any others that prove to be of special concern at a specific site.	Waterfowl are not sampled.
Chapter V.12.b - Sites that are located on the seacoast, an estuary, or a river upstream of an estuary should include consideration of the potential consumption of contaminated marine foods, such as sports and commercial fish and shellfish, in their preliminary pathway analysis.	WIPP is not located in or near a marine environment.
Chapter V.13.a - The need for sediment sampling and the choice of locations and frequency should be based on site-specific evaluations.	Selection of sediment sampling locations and sampling frequency is based on the site-specific evaluation used in determining the surface water sampling program.
These evaluations should consider the potential for offsite exposure of humans, as well as the potential dose to onsite or offsite aquatic organisms (see Chapter V.12).	Offsite exposure to humans and aquatic organisms were considered.
Sediment sampling locations should be based on the type of surface water receiving site liquid effluents.	Liquid effluents are not discharged from WIPP.
For moving bodies of water, such as streams or rivers, sediment sampling locations should include an upstream site beyond any possible facility influence and two downstream locations.	Liquid effluents are not discharged from WIPP to rivers or streams; therefore establishing upstream and downstream sampling locations is not applicable.

COMMENT	RESPONSE
The two downstream locations should be located such that one is near the discharge site and the other is in an area that favors sedimentation, such as the inner bank of a bend in the stream or river (EPA, 1972), the region of a freshwater-saltwater interface, or at a dam impoundment.	As discussed above, establishing downstream sampling locations is not appropriate.
If liquid effluents from a nuclear facility are discharged to a lake, pond, or arroyo, a sediment sample should be taken near the outfall but beyond the turbulent area created by the effluents.	A sediment sample will be taken near the inflow of the effluent pond.
Because sediments are usually not in a critical exposure pathway, an annual frequency for sediment sampling should be sufficient.	Because sediments constitute such an "insignificant" pathway, biennial sampling is conducted.
For rapidly moving streams (e.g., rivers), sediment sampling should be considered in conjunction with the spring freshet (i.e., just before or just after), if one occurs locally.	There are not rapidly moving streams near the WIPP.
For arroyos, the sampling should take place after cessation of water flow (i.e., upon first drying in the spring).	If arroyos are to be sampled, sampling will take place after cessation of water flow.
For ponds or lakes, the timing of sediment sampling should be considered on a site-specific basis, but normally at about the same time each year.	Sediment sampling in ponds and lakes will occur at generally the same time each year.

COMMENT	RESPONSE
Chapter V.13.b - Except for cases where an inventory estimation is desired, representative surface (top five to 10 cm) sediment samples should be collected along with water depth and stream flow (or pond/lake elevation) data at the time of sampling.	Sediment samples are routinely collected from the top 5 to 10 cm of a lake or stream sediment, along with water depth and stream flow.
Every few years, core samples should be taken in areas in which sediments have been most heavily deposited to determine the profile of the historical depositions and to determine trends and changes in control of effluents and their impacts.	Liquid effluents are not to be discharged from the WIPP. If required, sediment samples will be collected from areas of heavy deposition.
All sediment samples should be oven-dried, homogenized (by grinding and blending, as appropriate in accordance with procedures used) and the radioanalytical results reported on the basis of activity per unit dry weight (g or kg).	Sample preparation, analysis and data reporting will be conducted according to the applicable procedures.
LABORATORY PROCEDURES	
Chapter VI.3 - To comply with the sample identification system requirement, all pertinent information on the samples and their analysis should be recorded in a permanent laboratory record book and/or computer system.	All information on sample collection and analysis is recorded in permanent log books and/or on a computer system.

COMMENT	RESPONSE
The sample identification number should indicate the exact location of the record entry or computer file.	The sample identification numbers indicate the sampling subprogram for which the sample is collected as well as the date of sample collection. This information indicates the exact location of the record entry or computer file.
Chapter VI.3.a - Therefore, except for control samples or samples that historically have had very little or no activity, such environmental samples should be surveyed to determine activity levels and to detect transferable contamination before they are brought into the laboratory.	Environmental samples collected in the vicinity of the WIPP should have little to no radioactivity.
Special precautions, such as the use of lead shielding, should be taken with samples that show elevated activity levels.	If a sample shows elevated activity, special precautionary procedures will be followed.
Chapter VI.3.b - Samples that are sent offsite for analysis or for laboratory intercalibration should be monitored for contamination and radiation levels and packaged in a manner that meets applicable transportation regulations and requirements.	If the environmental samples exhibit elevated activity and are to be sent off site, the applicable transportation regulations and requirements will be followed.
Samples that show measurable surface contamination should be repackaged in uncontaminated containers before they are brought into the laboratory.	Sample containers will be thoroughly rinsed after sample collection to eliminate any surface contamination.
Therefore, all inadequately packaged samples should be repackaged before they are brought into the laboratory.	Inadequately packaged samples are repacked prior to laboratory receipt.

COMMENT	RESPONSE
The repackaged samples should be packaged in at least double containers to prevent contamination if one of the containers leaks.	Repackaged samples are placed in double containers.
The outer container should be handled only by a person who has had no contact with the sample or other contaminated materials.	Only uncontaminated individuals handle packaged samples.
The plastic bag should then be heat-sealed airtight.	Outer containers are sealed airtight.
Chapter VI.3.c - High- and low-activity samples should be treated in different laboratories, or at least in separate, distinct locations of the laboratory.	All samples collected contain only very low environmental levels of radioactivity if any levels at all.
The measurements made during sample screening with survey instruments should be among the criteria used to determine which laboratory (location) will receive the sample.	No highly radioactive samples are collected.
Laboratory glassware that has been used in processing highly radioactive samples should be appropriately discarded and not reused.	No highly radioactive samples are collected.
A clean material, such as bench paper, should be used to cover laboratory benches before processing a set of samples.	Bench paper is used to cover lab bench tops.
Periodic surveys of gross activity levels in the laboratory should be conducted to detect any contamination that might occur.	Contract laboratories are required to have an approved QA program. This includes periodic surveys for contamination.

COMMENT	RESPONSE
Detected contamination should be removed by proper decontamination practices.	Proper decontamination practices will be used as appropriate.
Following physical and chemical treatment of the original samples, the resulting samples should again be sealed in plastic bags before being transported to the counting room for counting.	Appropriate handling and storage procedures are used on treated samples prior to counting.
Chapter VI.3.d - Gross beta, gross alpha, and gross gamma measurements should be used to determine the most suitable sample size.	Only environmental levels of radioactivity have been observed at WIPP. Sufficient sample size will be collected to achieve reliable results.
Chapter VI.3.e - Chemical separations should be avoided whenever possible because of the time and expense involved and because of the errors that can result from radionuclide losses during chemical separations.	Chemical separation for certain radionuclides is unavoidable.
Carriers and/or tracers should be introduced at an early stage of any procedure requiring chemical separations under conditions that will maximize isotopic exchange so that chemical yields can be calculated.	Standardized tracers for uranium, plutonium and americium are introduced at an early stage in the separation.
Chapter VI.3.e(1) - Atmospheric concentrations of radionuclides attached to (or in the matrix of) aerosol particles should be measured by directly counting air-filter samples using low-background detector systems without any chemical separation.	Concentrations of certain radionuclides are determined through direct counting of composited filters.

COMMENT	RESPONSE
Photon emitters should be measured directly using germanium diodes without chemical separation.	Air filter particulate samples undergo direct gamma spectroscopy analysis.
Chemical separations should be used only in cases where the concentrations or the photon energies are very low.	Chemical separation is used for determination of nuclides of uranium, plutonium and americium.
If the particulate material is collected on the filter surface, the deposit does not become too thick, and interfering radionuclides are not present, then concentrations of alpha emitters should be measured directly from an air filter using alpha spectrometers.	Alpha emitters are determined through chemical separations and alpha spectrometry.
Samples collected using membrane filters should be counted directly for alpha emitters because membrane filters collect particles on the surface.	Not applicable at WIPP since fiber filters are used.
Samples containing low concentrations of alpha emitters should be collected at high flow rates on fibrous filters and chemically separated before counting.	Alpha emitters are collected on fibrous filters and chemically separated.
Therefore, air-filter samples should be allowed to stand several hours before counting to allow the radon decay products to decay, or several days to allow both radon and thoron decay products to decay, rather than chemically separating the radon and thoron decay products.	Radon and thoron daughters will be allowed to decay before counting.

COMMENT	RESPONSE
Chapter VI.3.e(2) - Phenomenon that should be considered include:	
• The ion exchange of cations between the sample and the container walls (cesium, for example, can exchange with potassium in glass);	This has been considered and samples are collected in poly containers except for tritium samples, which are placed in glass vials.
• The absorption of radionuclides by algae or slime growths on container walls or particulate materials;	This has been considered and samples are pretreated with acid.
• The hydrolysis and resulting sorption of radionuclides on container walls or particulates (this is especially likely at the low acidities typical of natural waters and some process streams);	This has been considered.
• The formation of large flocculent particles from radiocelloids resulting in additional plate-out;	This has been considered and all particles are considered as part of the sample.
• Change in the distribution of radionuclides between aqueous and solid phases as a result of sample pretreatment (e.g., acidification leaching radionuclides from suspended particles);	This has been considered and groundwater samples are filtered to remove suspended particles. Suspended particles in surface waters are considered to be in aqueous phase.
• The conversion of iodides to iodine by biocides, followed by the loss of iodine by vaporization;	No iodines are expected in WIPP waste.

COMMENT	RESPONSE
• The quenching of liquid scintillation cocktails by acids; and	This has been considered, and samples are distilled prior to counting.
• The change of counter geometries by the settling of particles or by their fixation on container walls.	This has been considered, and samples are mixed to resuspend any particles.
The radioanalytical procedures to be used and the purpose of the measurements should govern what, if any, pretreatment is used, because the procedures can be adversely affected by additives used to preserve other radionuclides.	This has been considered, and treatment with nitric acid was selected.
Optimum preservation procedures should be determined by local testing.	This has been considered, and pretreatment with nitric acid is used.
The concentrations of gamma-emitting radionuclides in whole water samples should be measured directly by gamma-ray spectrometry, if such concentrations are high enough for determination.	Water samples are analyzed using gamma spectrometry, chemical separation and liquid scintillation methods.
For accurate measurements, the radionuclide distribution should be uniform throughout the sample.	Samples for analysis are representative and contain uniform distribution of environmental levels of naturally occurring radionuclides.

COMMENT	RESPONSE
If the distribution of the radionuclides between the solid and the aqueous phases is desired, the water sample should be filtered during or as soon as possible after collection and the water and filter counted separately.	Differentiation between solid and aqueous phases is not performed.
If additional precipitate develops later, the water should be filtered again just before counting.	See above.
However, the precipitate in this case should still be considered to be part of the liquid phase.	Any precipitate is considered part of the original liquid phase.
If concentrations of gamma emitters are too low to be measured in the whole sample, the sample should be concentrated by evaporation.	Water samples are analyzed using gamma spectrometry, chemical separation and liquid scintillation methods. Evaporation is used to concentrate samples.
If the concentrations are still too low to be measured in the evaporated sample, or if beta or alpha emitters are to be measured, the radionuclides to be measured should be chemically separated using procedures that will be determined by the radionuclides required.	Water samples are analyzed using gamma spectrometry, chemical separation and liquid scintillation methods.
Chapter VI.3.e(3) - Since the water content of samples can vary widely, soil and sediment samples should be dried according to procedures that have been established for the measurement program, and the measured radionuclide concentrations reported on a dry-weight basis.	Soil and sediment samples are dried according to WIPP Procedures WP 02-307 and WP 02-309. Concentrations are reported on a dry weight basis.

COMMENT	RESPONSE
Oven-drying temperatures ranging from 80°C to 130°C can be used; however, a fixed temperature, such as 110°C, should be used for all samples.	An oven-drying temperature of 100°C is used.
However, to obtain accurate results, the samples should be homogeneous.	Samples are ground and mixed to ensure homogeneity.
So that soil samples are homogeneous, they should be ground to a small particle size and homogenized before counting.	See above.
Small rocks and pebbles should be separated from the sample before counting.	Small rocks and pebbles are removed prior to counting.
Radionuclides of interest in soil and sediment samples should be chemically separated where necessary to obtain the desired sensitivity.	Chemical separation is done on soil samples for Sr, Np, Th, U, Pu, Am, and Cm isotopes.
Chapter VI.3.e(4) - However, when large amounts of biological material are present, wet- or dry-ashing and chemical separations should be performed before counting the samples, especially in the case of alpha- or beta-emitting radionuclides.	Biological materials are ashed and chemical separations are performed prior to counting.
Chapter VI.3.e(5) - Degradable biological materials should be kept frozen until they are processed.	Biological materials are ashed shortly after collection.

COMMENT	RESPONSE
A small amount of acid should generally be added to water samples to inhibit biological growth and the plate-out of dissolved materials on the container walls.	Water samples are preserved using small amounts of nitric acid.
However, acid should not be added in cases where the sample contains radionuclides that are volatile in acid solutions.	None of the radionuclides of interest will completely volatilize in weak nitric acid solutions.
A reducing agent, such as Na_2SO_3, should be added to solutions containing ^{129}I or ^{131}I to prevent the formation and loss of I_2.	Radioiodine is not monitored.
Refrigeration, shielding from light, and filtration should be used when necessary to prevent biological growth and deposition on container walls.	Water samples are filtered, covered from light, and chilled.
Chapter VI.4 - Drinking-water samples should be analyzed using EPA procedures where such methods are available and adequate for the radionuclides of interest.	EPA or EPA comparable procedures will be used as appropriate.
Alternative methods can be used in cases where satisfactory EPA-approved methods are either not available or not adequate. However, such alternative methods should have documented or documentable evidence showing that they give reliable results.	The reliability of alternative analytical methods will be documented.

COMMENT	RESPONSE
Chapter VI.5 - Gross alpha and beta measurements should not be used to characterize a sample.	Complete radiological analyses are used to characterize samples.
Sample characterization should be done using radionuclide-specific analyses.	See above.
Gross alpha measurements should be made using portable alpha meters, activated zinc sulfide scintillators, or equivalent methods.	Gross alpha measurements are made with a Canberra-2201 Low Background Alpha/Beta counter.
Gross beta measurements should be made using gas-proportional counters, and gross gamma measurements should be made using gamma-ray spectrometers.	Gross beta measurements are made with a Canberra-2201 Low Background Alpha/Beta counter or a thin window proportional counter as appropriate. Gamma measurements are made with gamma spectrometers.
Chapter VI.6 - Gamma rays should be measured directly using sodium iodide thallium activated crystals [NaI(T1)], lithium-drifted germanium diodes [Ge(Li)] or intrinsic germanium diodes (IG).	Gamma measurements are made with lithium-germanium and hyper-pure germanium detectors.
Chapter VI.7 - Beta-emitting radionuclides should be measured using ionization, gas-proportional, or liquid scintillation counters.	Beta-emitting radionuclides are measured using liquid scintillation.
Chapter VI.8 - High-resolution alpha spectrometry using silicon surface barrier detectors should be used to determine the concentrations of alpha-emitting radionuclides in thin, uniform samples or in samples that can be deposited as thin, uniform sources.	Alpha emitting radionuclides are electroplated to form a thin uniform source and counted using alpha spectrometry.

COMMENT	RESPONSE
Electrodeposition is the method that should be used to produce thin, uniform sources.	Electrodeposition is used.
Alpha spectrometry should be used primarily for the analysis of actinide radionuclides because the concentrations of these radionuclides in environmental samples are often near the detection limits of the alpha spectrometer, and because large samples are often needed to produce detectable counting rates.	Alpha spectrometry is used on these environmental samples.
Chapter VI.9 - However, standard (professionally accepted) methods should be used when separating radionuclides from interfering radionuclides.	Standard chemical separation methods are used.
Chapter VI.10 - The reported analytical results should include the two sigma error limits.	Reported results include the two sigma values.
The reported error limits should be calculated from the statistical counting error and as many other sources of error as can be identified.	Error values include counting and other errors.
Each random error should be reported separately.	All errors are reported.
The concentrations should be reported as calculated even when they are less than the error limits or negative, because such concentrations are required for the statistical analysis of the data.	All concentrations are reported whether they are negative or less than the error limits.

COMMENT	RESPONSE
In all cases, the error limit should be given so that a detection limit can be inferred.	Error limits are provided.
The results for short-lived radionuclides should be decay-corrected to the midpoint of the sample-collection interval.	Results are decay corrected.
Chapter VI.11 - Except in gamma-ray spectrometry when NBS traceable Standards are used to prepare counting efficiency curves, each counter should be calibrated for each radionuclide to be measured using standards traceable to the NBS.	All standards used are traceable to the NBS.
The standard should have the same geometry as the sample to be counted, and the standard should be well-mixed and remain well-mixed throughout the matrix that is used to produce the standard geometry.	Standards used are of the same geometry and are well mixed.
If a gamma counter is calibrated for several radionuclides, a plot of efficiency versus energy should be prepared and used to identify errors in the calibration of individual radionuclides and to determine the efficiencies of radionuclides for which standards are not available.	Efficiency curves are prepared for the gamma counters.
Chapter VI.12 - Interlaboratory exchanges of samples should be carried out to determine whether the laboratories are obtaining the same results, and to eliminate any problems that are causing discrepancies.	Interlaboratory analytical assessments, including participation in the EPA's Cross-Check Interlaboratory Comparison Program, are performed.

COMMENT	RESPONSE
If samples are available that have not been chemically separated but are still known to be homogeneous, aliquots of these samples should be exchanged so that both the separation procedures and the counting equipment can be compared.	Both separation and counting procedures are compared.
Chapter VI.13 - Therefore, the counter background should be reduced as much as possible.	Counters are lead-shielded and backgrounds are checked regularly.
The counter should be shielded with lead or other materials, such as borated paraffin (to absorb neutrons).	Counters are lead-shielded.
The background of the counter should be kept low by preventing the contamination of the counter by radioactive materials.	Care is taken to avoid contamination of counting equipment.
Therefore, backgrounds should be measured regularly, and the counter decontaminated if background measurement shows evidence of contamination.	Backgrounds are regularly measured and the counters are serviced as appropriate.
Chapter VI.14 - Specific quality assurance activity requirements for laboratory operations at a site should be incorporated in the facility's plan for quality assurance.	Each contract laboratory is responsible for maintaining an approved QA program detailing calibration, source and background counting, yield determinations of radiochemical procedures, replicate/duplicate analyses, and analysis of reagents.

COMMENT	RESPONSE
DATA ANALYSIS AND STATISTICAL TREATMENT	
Chapter VII.1.a - The goals for analyzing effluent monitoring and environmental surveillance data should be: • To estimate radionuclide concentrations at each sampling and/or measurement point for each sampling and/or measurement time, and estimate accuracy and precision; • To compare the estimated radionuclide concentrations at each sampling and/or measurement point to previous concentration estimates at that point to identify changes or inconsistencies in radionuclide levels; • To compare the radionuclide concentrations at each sampling and/or measurement point to the established maximum allowable limit(s) for those radionuclides; and • To compare radionuclide concentrations at single sampling and/or measurement points or groups of points to those at control or other points and evaluate the reliability of those comparisons.	The four goals are addressed in Section 8.0 of the Environmental Monitoring Plan.

COMMENT	RESPONSE
Chapter VII.2 - Analytical precision estimates for radiological analyses should be made from replicate samples.	Replicate samples will be collected and will be used to estimate analytical precision.
Chapter VII.3.a - The analyses performed to determine and reduce the sources of variability should consider the relevancy of the variability source with respect to the actual conditions at the sampling and/or measurement point.	Areas of variability and their relevance to the end result have been considered in the analyses.
Chapter VII.3.b - An estimate of the levels of accuracy and precision required for the data, based on previous site monitoring and surveillance experience, should be used to develop data analysis and handling strategies for the effluent monitoring and environmental surveillance programs.	Estimates of precision and bias will be made.
These strategies should be re-evaluated periodically (or after significant modification to site conditions) to determine whether they are adequate for the present site conditions.	The adequacy of data analysis and handling procedures will be re-evaluated periodically.
Chapter VII.4 - Assumptions about the underlying data distribution are inherent in the calculation of most statistical parameters; therefore, the distribution of the radionuclide concentration data should be established before the calculated parameters are considered valid.	Data distributions will be analyzed for data sets greater than ten.

COMMENT	RESPONSE
Chapter VII.4.a - Radionuclide distributions are typically lognormal, and when appropriate, the raw data should be transformed to logarithms before calculating summary statistics.	Other distributions will be evaluated if neither the normal or lognormal fits the data.
Chapter VII.4.a(1) - Data sets with more than ten points should be tested for normality.	Data sets with more than ten points will be tested for normality.
When such conditions occur (severe discontinuities in the straight line lognormal plot of the data), the data should be re-examined and identifiable subsets analyzed separately.	Data will be analyzed by subsets whenever appropriate.
Chapter VII.4.a(2) - The method of assessing normality should be presented in reports of the data.	Methodologies used for assessing normality will be cited when appropriate.
Chapter VII.4.b - When the data set contains large numbers of extreme values or concentrations below the analytical detection limits, the median, which is less sensitive to extreme values than the mean, should be used to summarize the data.	As discussed in Section 8.3 of the Operational Environmental Monitoring Plan, the median will be used as appropriate.
The data should be transformed to approximate a normal distribution before the central values are calculated.	As discussed in Section 8.0 of the Operational Environmental Monitoring Plan, calculation of the central value will depend upon the data set.

COMMENT	RESPONSE
Chapter VII.4.c - Dispersion in normally distributed data, without large numbers of outliers and less-than-detectable values, should be represented as a variance, a standard deviation, a standard error, or a confidence interval.	Dispersion will be reported as a multiple of the standard deviation for normally distributed data.
Again, data should be transformed if necessary to approximate a normal distribution.	If appropriate, data will be transformed to approximate a normal distribution.
Chapter VII.4.c(1) - For data with substantial numbers of extreme values, other measures should be used to estimate the dispersion around the central value.	See Section 8.3 of the Operational Environmental Monitoring Plan for a complete discussion of the central value calculation.
Chapter VII.4.d(1) - All of the actual values, including those that are negative, should be included in the statistical analyses.	All actual values will be used in the statistical analyses.
Practices such as assigning a zero, the detection limit value, or some in-between value to the below-detectable data point, or discharging those data points can severely bias the resulting parameter estimates and should be avoided.	No provision for such assignments has been made.
When analytical instruments or laboratories do not supply the actual values for readings less than the detection limit, but make some designation such as "ND," the actual values for those data points should be obtained.	Attempts will be made to obtain actual analytical results.

COMMENT	RESPONSE
When obtaining these data points is not possible, at least the number of less-than-detectable values should be obtained.	This is implied under the treatment of missing data.
Chapter VII.4.e(1) - Most of these tests assume a normal distribution, so data should be transformed to approximate the normal distribution before outlier tests are performed.	Only appropriate tests will be performed.
The central values should be calculated separately for identified subgroups of the data.	Data will be subdivided into homogeneous groups.
Graphs of moving averages of the data should also be plotted for each station, as soon as sufficient amounts of data (at least 10 points) are acquired.	Trend analysis, which may include moving averages, will be performed.
Chapter VII.4.e(2) - When outliers that are not attributable to errors are contained in the data set, estimators and statistical tests should be computed with and without the outliers to see if the results of the two calculations are markedly different.	Calculations will be performed with and without outliers.
If the results differ substantially because of outliers in the data, then both results should be reported.	Both results will be reported.

COMMENT	RESPONSE
Chapter VII.4.f - Certain procedures should be followed that will aid in the interpretation of the effluent monitoring data and improve the quality of the results from the program by helping to detect erroneous measurements.	Results of data analysis will be used to detect and correct deficiencies in the sampling procedures.
Comments on the quality of the samples taken should be entered into the data base with the sample radionuclide concentration measurements.	Comments are included in the RADCOMP data base.
In addition to the data collected during the regular sampling program, logs of events that might affect radionuclide concentrations (e.g., precipitation) should be kept.	Supporting data records are maintained.
Chapter VII.5 - The number of significant figures in reported data should reflect the precision in the measured values.	Significant figures are discussed in Section 8.0 of the Operational Environmental Monitoring Plan.
The number of significant figures reported for raw data should reflect the true precision of the measurement technique.	As discussed in Section 8.0 of the Operational Environmental Monitoring Plan, the number of significant figures reported will reflect the measurement precision.
When measurements are multiplied or divided, the number of significant figures in the product or quotient should not exceed that of the least precise measurement used in the calculations.	Calculations involving statistical data will be handled appropriately.

COMMENT	RESPONSE
When measurements are added or subtracted, the recorded precision of the result should not exceed that of the least precise measurement.	Calculations involving statistical data will be handled appropriately.
Chapter VII.6 - Corrections should be made for calculations performed during the transitory period before equilibrium is reached.	Corrections for equilibrium will be made when appropriate.
The recorded accuracy and precision of the calculated radionuclide concentration estimates should not exceed those of the original measured concentration.	See Section 8.0 of the Operational Environmental Monitoring Plan for a discussion of data analysis.
Uncertainties in the length of time between measurement and the initiation of parent decay should be reported and incorporated into the precision estimates for the calculated concentrations.	Parent decay is not a factor in the handling of data involving transuranics.
Chapter VII.7.a - Thus, additional sampling or measurement should be considered to provide an accurate representation of compliance status.	Additional samples will be collected or measurements taken whenever necessary.
Chapter VII.7.b - Concentration estimates from groups of sampling and/or measurement points should be compared using standard (parametric) analysis of variance techniques (Winer, 1971) when the data meet the underlying assumptions of those tests.	Appropriate tests will be performed.

COMMENT	RESPONSE
Standard nonparametric statistical comparison techniques (Hollander and Wolfe, 1973) should be used when the assumptions of the parametric tests are not met by the data.	Appropriate tests will be performed.
Caution should be used when comparing groups of readings from single points over time, because of the likely strong autocorrelation in the time series of data.	Autocorrelation will be considered.
<u>Chapter VII.8</u> - Specific quality assurance activity requirements for data analysis and statistical treatment activities at a site should be incorporated in the quality assurance plan for the facility.	Such requirements for data analysis and statistical treatment have been incorporated into the site quality assurance plan.
DOSE CALCULATIONS	
<u>Chapter VIII.3.a</u> - In applying models and computer programs for estimating public radiation doses, the following three critical assumptions should be evaluated for each application (Hoffman and Baes, 1979): (1) the data available for the input parameters represent the true populations of the parameters (i.e., the data represent reality), (2) the model parameters are statistically independent (i.e., no coupled parameters), and (3) the structure of the model is an approximation of reality (i.e., the model fits the situation encountered).	The model is consistent with the guidelines in Reg. Guide 1.109 (NRC, 1977) on dose assessment. As appropriate the input parameters have been adjusted or modified to reflect actual conditions and activities.

COMMENT	RESPONSE
Although these three conditions can never be completely met, reasonable efforts should be made to evaluate these assumptions in light of the models and data sets selected for site-specific applications.	See above.
Chapter VIII.3.c - Initial assessments should be conducted with very simple models; more detailed models and more detailed assessments should be made as data and knowledge of the system being modeled improve.	Detailed models are used for complex assessments while simpler models with simplifying assumptions are used for less complex assessments.
Chapter VIII.3.d - The results of any modeling application should be viewed as estimates of reality, and not reality itself.	Modeling is designed to provide estimates of reality.
Chapter VIII.4 - The correct operation of computer programs selected for performing the transport calculations for all environmental dose assessments should be verified on a specific computer system.	A detailed method of computer program configuration control and verification is in place for all programs at WIPP.
Chapter VIII.4.a(4) - Atmospheric transport modeling should be conducted by a professional meteorologist or equivalent with modeling experience.	The simple modeling requirements for the WIPP site do not necessitate the need for a professional meteorologist. Equivalent experience necessary to perform the task is available in the Environmental Staff.
Chapter VIII.4.b - Surface- and ground-water modeling in support of the operation of DOE facilities should be conducted by a professional geohydrologist or equivalent with modeling experience.	Due to the geologic nature of this facility, a staff of geohydrologists are employed to supervise this program.

COMMENT	RESPONSE
This modeling should be done using site-specific data and taking into consideration the important characteristics of the site.	As appropriate and available, site-specific data is used for modeling. The Performance Assessment for showing compliance with 40 CFR 191, Subpart B is designed to realistically portray the site and its performance.
Chapter VIII.5 - A summary of the major environmental radiation exposure and transport pathways relevant to operating DOE facilities that should be considered is given in Figure VIII-3.	The potential pathways in Figure VIII-3 were considered in development of the pathways analysis in the WIPP FSAR (DOE, 1988a).
A more complete listing of the potential individual pathways that should be considered in environmental pathway modeling is given in Figure VIII-4.	The potential pathways presented in Figure VIII-4 were considered during development of the FSAR pathway analysis.
Pathway analysis and transport models should be compared or calibrated with field data when such information is available.	Pathway analysis and transport models will be compared with field data and discussed in the annual environmental monitoring reports.
Chapter VIII.7 - So that DOE-controlled sites are in compliance with this limit (absorbed dose limit of one rad/day to native aquatic organisms), an assessment of the potential dose to native aquatic organisms should be conducted and included as part of the site Environmental Monitoring Plan.	Aquatic organisms were considered in the pathway analysis for WIPP.
Instead, a site-specific assessment, using the best available data for a given facility and environment, should be conducted.	Environmental monitoring at WIPP is based upon the site-specific pathway analysis documented in WIPP FSAR.

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COMMENT	RESPONSE
REQUIRED RECORDS AND REPORTS	
Chapter IX.1 - These listings should not be considered all-inclusive, and should be updated as the regulations change.	The OEMP will be updated periodically to reflect current regulations.
QUALITY ASSURANCE	
Chapter X.1.c - Quality assurance is in part an evaluation function that should be performed by an independent organization; however, it includes all of those planned systems and actions necessary to assure quality.	Quality Assurance (QA) oversight is performed by an independent organization at WIPP.
Chapter X.3.a - This plan should specify the control elements (for QC) that will be applied to the monitoring activities.	The 18 control elements of ANSI NQA-1 were used in developing the QA plan for the monitoring activities.
The QA Plan does not have to contain all procedures, guides, quality controls, calibration procedures, etc., but rather it should reference the control elements and assign responsibility for maintenance of documents and procedures.	The QA plan for the monitoring activities references the Westinghouse Quality Program Manual, the Environmental Procedures Manual, and the WIPP Procedure Manual. These manuals contain all procedures, controls, and assigns responsibilities for document maintenance.
The QA Plan should be prepared in conjunction with or approved by the QA organization of the site.	The QA plan was prepared using the site's QA manual and will be approved by the site QA organization.

COMMENT	RESPONSE
Chapter X.5.b(1) - DOE monitoring organizations should participate in other interlaboratory QC programs such as the EPA Environmental Radioactivity Laboratory Intercomparison Studies Program (EPA-600/4-78-032).	Organizations providing analytical support services for the OEMP participate in the EPA Cross-Check Interlaboratory Comparison Program and the International Intercomparisons of Environmental Dosimeters Program.