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PREOPERATIONAL RADIATION SURVEILLANCE OF THE WIPP PROJECT BY EEG DURING 1991

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FOREWORD

The purpose of the New Mexico Environmental Evaluation Group (EEG) is to conduct an independent technical evaluation of the Waste Isolation Pilot Plant (WIPP) Project to ensure the protection of the public health and safety and the environment. The WIPP Project, located in southeastern New Mexico, is being constructed as a repository for the disposal of transuranic (TRU) radioactive wastes generated by the national defense programs. The EEG was established in 1978 with funds provided by the U. S. Department of Energy (DOE) to the State of New Mexico. Public Law 100-456, the National Defense Authorization Act, Fiscal Year 1989, Section 1433, assigned EEG to the New Mexico Institute of Mining and Technology and continued the original contract DE-AC04-79AL10752 through DOE contract DE-AC04-89AL58309.

EEG performs independent technical analyses of the suitability of the proposed site; the design of the repository, it's planned operation, and its long-term integrity; suitability and safety of the transportation systems; suitability of the Waste Acceptance Criteria and the generator sites' compliance with them; and related subjects. These analyses include assessments of reports issued by the DOE and its contractors, other federal agencies and organizations, as they relate to the potential health, safety and environmental impacts from WIPP. Another important function of EEG is the independent environmental monitoring of background radioactivity in air, water, and soil, both on-site and off-site.

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ACRONYMS

CAM	Continuous Air Monitor
CFR	Code of Federal Regulations
CH-TRU	Contact Handled Transuranic
Ci	Curies
CPM	Counts Per Minute
DOE	U. S. Department of Energy
EEG	Environmental Evaluation Group
EPA	U. S. Environmental Protection Agency
FAS	Fixed Air Sampler
FEL	Feet from East Line
FNL	Feet from North Line
FSL	Feet from South Line
FWL	Feet from West Line
HEPA	High Efficiency Particulate Air
HVAS	High Volume Air Sampler
LLD	Lower Limit of Detection
LLD-C	Lower Limit of Detection by Contractor
LVAS	Low Volume Air Sampler
NESHAP	National Emission Standards for Hazardous Air Pollutants
NRC	U. S. Nuclear Regulatory Commission
QA	Quality Assurance
RH-TRU	Remote Handled Transuranic
TRU	Transuranic
WIPP	Waste Isolation Pilot Plant

EXECUTIVE SUMMARY

The purpose of the EEG preoperational monitoring program is to document the existing concentrations of selected radionuclides in various environmental samples collected from the vicinity of the WIPP site prior to the arrival of transuranic waste. The basic methodology for conducting environmental surveillance both on-site and off-site was outlined by Spiegler (1984). This report represents a continuation of the baseline data beginning in 1985, previously reported in EEG-43, EEG-47 and EEG-49. Such radionuclide baseline data are important in order to determine whether WIPP operations will affect concentrations of these radionuclides in the environment. EEG data are consistent with similar data reported by DOE for prior years for the preoperational phase of WIPP.

Since late 1985, the EEG has collected or received as split samples 1,910 air particulate samples, 190 water samples, 16 biota samples and 11 soil/sediment samples. A total of 5,422 specific radionuclide analyses have been performed on these samples.

This report contains the first radiochemical data obtained from analysis of air filters collected from the fixed air sampler located in the underground exhaust air effluent from WIPP. All the radionuclide concentrations were less than their lower limit of detection.

As reported previously in EEG-43, EEG-47, EEG-49, observed concentrations of U-238 daughter radionuclides were not in equilibrium with the parent radionuclide in water samples. This observation is consistent with differential radionuclide mobility in the environment. In a notice of proposed rule making for 40 CFR 141 (U.S.E.P.A. 1991), the Environmental Protection Agency (EPA) National Primary Drinking Water Regulations reflect this in

the effective activity-to-mass conversion factor of 1.3 pCi/μg because the geometric mean of the U-234:U-238 ratio in water supplies is 2.7. Ra-226 and Ra-228 were reported in a number of water samples in concentrations similar to those previously published by EEG and DOE.

In a continuing effort to establish lower limits of detection, EEG provided the contractor laboratory with unused (blank) air filters for radiochemical analysis. Data from these analyses were used to calculate lower limits of detection (LLD) for air samples based upon procedure blanks rather than instrument counting blanks. Similar water blanks have also been submitted for analysis but these data are statistically inadequate at this time for use in LLD calculations.

Radionuclide concentrations in soil and biota samples were consistent with other data reported by EEG and DOE in the WIPP environment.

1.0 INTRODUCTION

The purpose of the Environmental Evaluation Group's (EEG) monitoring program at the Waste Isolation Pilot Plant (WIPP) is to establish baseline measurements of radionuclide concentrations at the WIPP facility and in the surrounding environment. The EEG surveillance parallels the pre-operational baseline measurements program conducted by the U. S. Department of Energy's (DOE) prime contractor.

The WIPP project is intended to be a repository for the disposal of transuranic (TRU) radioactive waste resulting from the defense activities of the United States. The DOE plans to start shipping contact-handled transuranic (CH-TRU) waste to WIPP for a 5-7 year test phase before making a decision to use the facility for permanent disposal of transuranic waste. The test phase includes some experiments with radioactive waste. New plans for experiments with waste were not available at publication.

The WIPP mission is to dispose of up to 176,000 m^3 (6.2 million cubic feet) of CH-TRU waste and 7,080 m^3 (250,000 cubic feet) of remote-handled (RH-TRU) waste (U.S.D.O.E., O.E.R.W.M. 1990). The total radioactivity from CH-TRU waste at WIPP will be about 1.14 x 10^7 Curies (Ci) including a maximum of 5.1 x 10^6 Ci from RH-TRU waste (N.M. and U.S.D.O.E. 1984). Under authorizing legislation (U.S. Congress 1979) Public Law 96-164, the WIPP facility is exempt from U. S. Nuclear Regulatory Commission (NRC) regulations.

The U. S. Environmental Protection Agency (EPA) Standards, 40 CFR Part 191, "Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High Level and Transuranic Radioactive Waste," were promulgated in November 1985 and apply to the WIPP during the operational phase. Subpart A of 40 CFR 191 (U.S.E.P.A. 1999a) limits the combined annual radiation dose to the public to 25 millirems to the whole body and 75 millirems to any critical organ from waste emplacement and storage operations at DOE disposal facilities which are not regulated by NRC. Subpart B of 40 CFR 191 (U.S.E.P.A. 1990b) establishes performance standards for long-term containment and releases of radioactivity to the accessible environment. Subpart B was vacated by the First Circuit Court of Boston in June of 1987 on the grounds that the regulation was less stringent than the requirements of the Clean Water Act of 1971 and failed to follow the Administrative Procedures Act. Within days, the State of New Mexico and DOE signed an agreement in July 1987 to continue assessment of potential compliance with the vacated standard until new standards are promulgated. While WIPP is in the research and development (test) phase, 40 CFR 61 (NESHAP) limits the effective dose to 10 mrem from WIPP airborne emissions.

The Environmental Evaluation Group (EEG) established a pre-operational environmental monitoring program in 1984 under terms of the July 1981 Consultation and Cooperation (C & C) Agreement and the December 1982 Supplemental Stipulated Agreement. The National Defense Authorization Act (U.S. Congress 1988) Public Law 100-456 authorized continued funding of the EEG's environmental monitoring program. Data contained in this report are a continuation of the preoperational monitoring baseline studies outlined in Spiegler (1984) and reported in Kenney et al. (1990) and in Kenney and Ballard (1990) and Kenney (1991). EEG plans to continue pre-operational environmental monitoring until waste starts arriving at WIPP and will continue the monitoring during the operational phase.

2.0 ENVIRONMENTAL SETTING OF THE WIPP SITE

The WIPP facility is located in Eddy County in southeastern New Mexico, approximately 42 km (26 mi) east of Carlsbad (Figure 1). The facility is located on a sandy plain at an

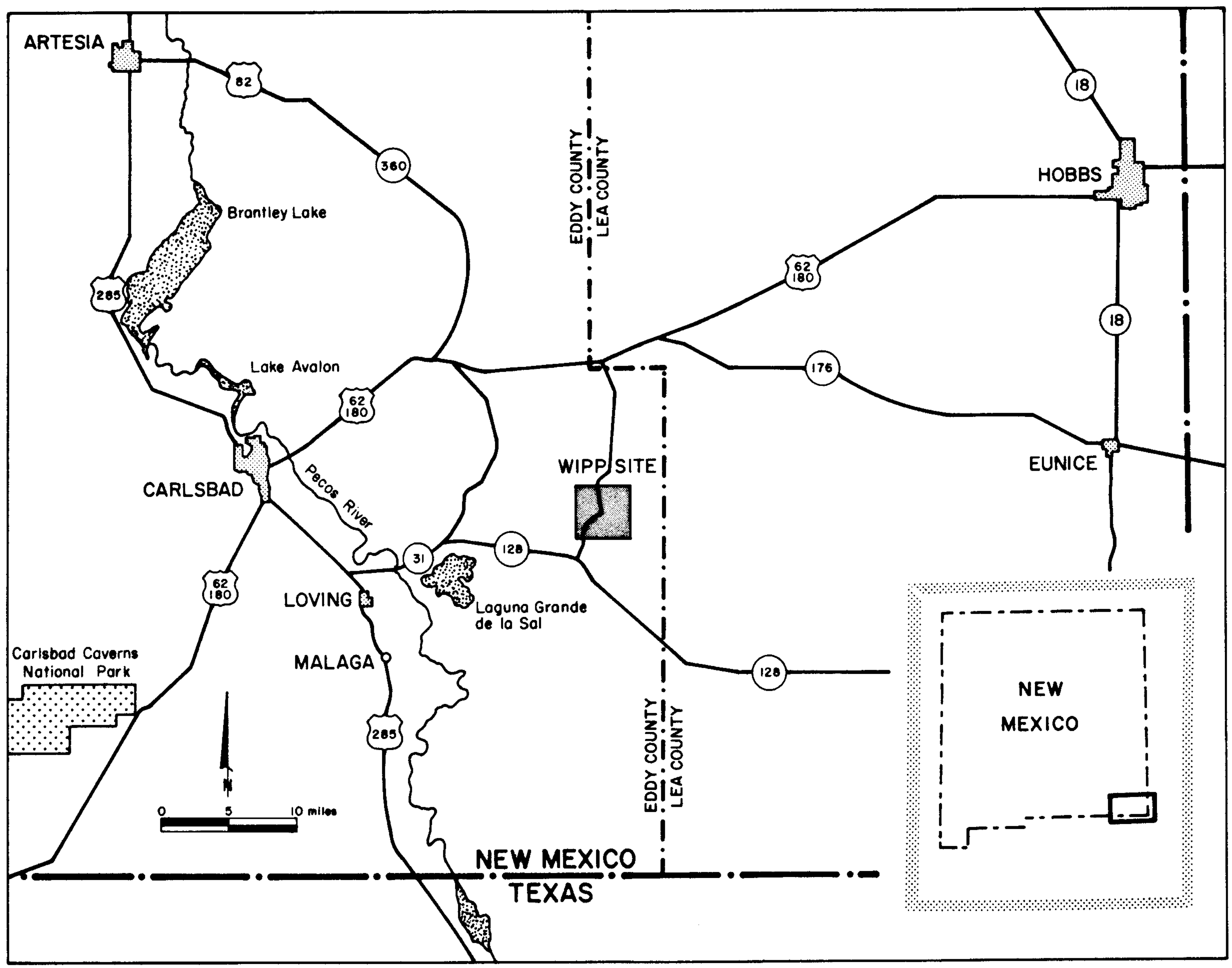

Figure 1. Location of the WIPP Site

elevation of 1,040 m (3,410 ft) above sea level. Prominent natural features near the facility include Livingston Ridge and Nash Draw, about 8 km (5 mi) west of the facility. Nash Draw is a shallow, dog-bone shaped drainage course between 8 km (5 mi) and 18 km (11 mi) in width, characterized by surface impoundments of brine water (Figure 2). Livingston Ridge is a bluff that marks the eastern edges of Nash Draw. Other prominent features of the region include the Pecos River, located about 22 km (14 mi) west of the facility, and the Carlsbad Caverns National Park about 68 km (42 mi) west-southwest of the WIPP facility.

Chaturvedi and Channell (1985) suggest that the two major discharge points for waters from the Rustler Formation are into the Pecos River in an area known as Malaga Bend and into Laguna Grande de la Sal. The Laguna Grande de la Sal receives flow from several springs along the margin of the lake. Potentiometric contours for various zones within the Rustler point to the Laguna Grande de la Sal as a secondary discharge point for the Rustler waters. Because the Rustler Formation lies directly above the Salado Formation which contains the WIPP repository, EEG includes water samples from the discharge of the Rustler Formation areas in the radionuclide baseline program.

The nearest population centers include the village of Loving (population 1,500), located 29 km (18 mi) southwest of the facility, and the city of Carlsbad (population 28,400), located 42 km (26 mi) west of the facility. Other towns within an 80 km (50 mi) radius include Artesia, Eunice, Hobbs, Jal, and Lovington.

The climate in the region of the facility is semi-arid with an average annual precipitation in Carlsbad of 303.23 mm (11.94 in) between 1898 and 1990 (U.S.D.O.C. 1991). During 1990 a total of 405.13 mm (15.95 in) of precipitation was received at the WIPP site (U.S.D.O.C. 1991). Much of the precipitation falls during intense thunderstorms in the spring and summer. Winds are

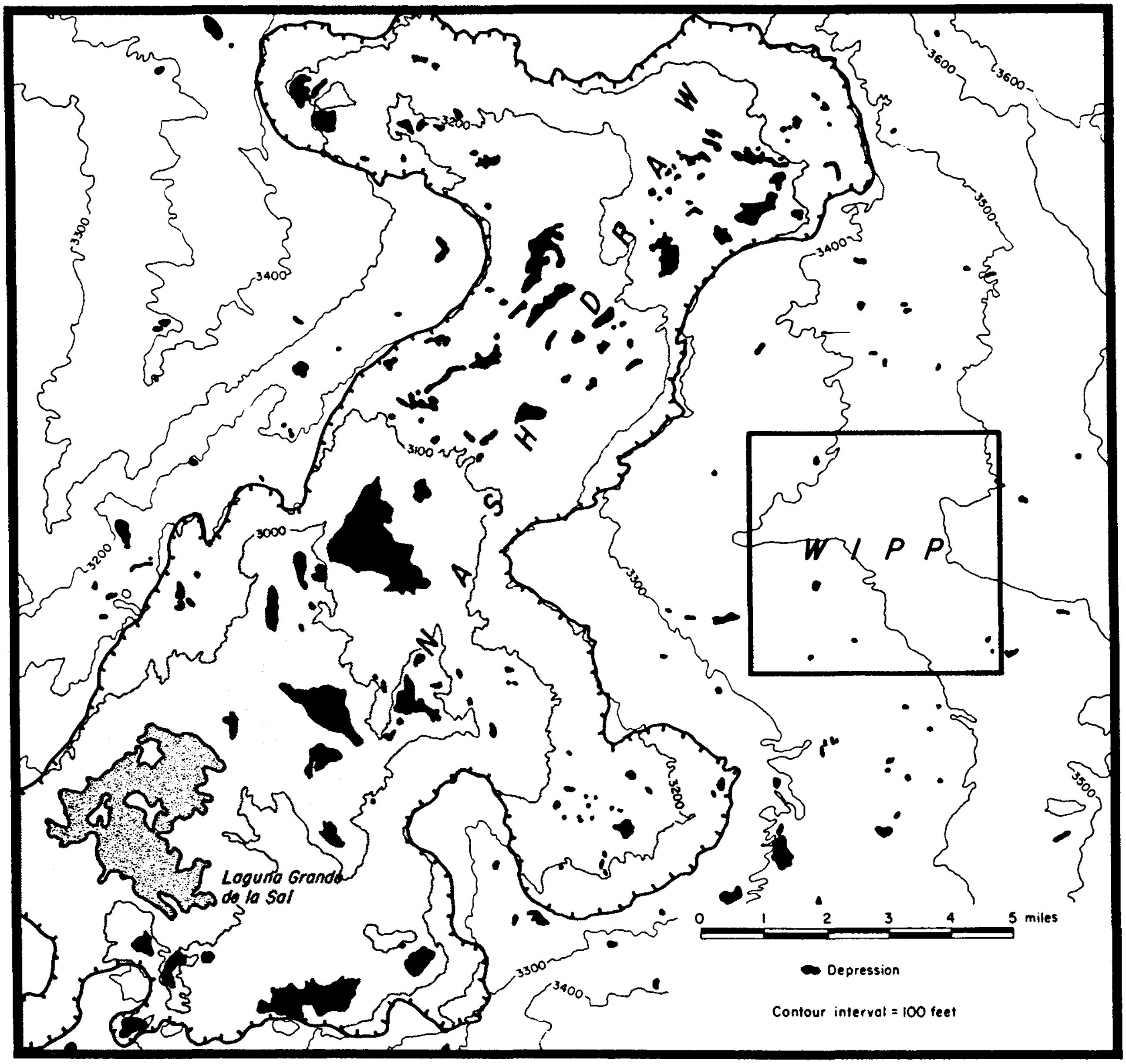

Figure 2. Nash Draw and Depressions Near the WIPP Site, Based on USGS Nash Draw Quadrangle, 15 Minute Series

generally from the southeast toward the northwest (U.S.D.O.E., W.I.P.P. 1991).

Surface structures of the facility are located in sections 20 and 21 of township 22 south, range 21 east, N.M.P.M., in Eddy County, New Mexico. The surface areas around WIPP are divided into several zones (U.S.D.O.E., O.E.R.W.M. 1990) as indicated in Figure 3. Zone I, located in sections 20 and 21 of township 22 south, range 31 east, has an area of 14 ha (35 acres) and contains most of the surface structures associated with WIPP. It is enclosed by chain link fence and patrolled by security guards to maintain restricted access. The secured area boundary surrounds Zone I and is marked with a barbed wire fence. Zone II is the next larger subdivision of the facility although there are no surface markers to identify this zone. Zone II is 728 ha (1,800 acres) in size and represents the maximum extent of the area available for underground development. The WIPP outermost facility boundary, which encompasses 16 square miles, provides a one mile buffer area around Zone II and contains 4,144 ha (10,240 acres or 16 sections) and is known as the WIPP site.

Three ranches (Mills, Smith, and Mobley) have property in the vicinity of the WIPP facility. The Mills ranch headquarters is located 5.6 km (3.5 mi) south-southwest of the facility center, the Smith headquarters is 8.8 km (5.5 mi) west-northwest of the facility, and the Mobley ranch is 9.6 km (6 mi) southwest of the facility. The Mills ranch uses water from "house" and "barn" wells for stock and domestic uses. Water is provided to the Smith ranch from pipelines used by IMC Fertilizer, Inc. (IMCF) and New Mexico Potash Corporation. These pipelines draw from wells completed in the Capitan Reef Formation and the Ogallala Formation, respectively. Mobley ranch uses water hauled from various public water supply systems for domestic use while stock water is obtained from "Mobley Well," located near the ranch headquarters about 10 km (6 mi) from the facility. All ranches

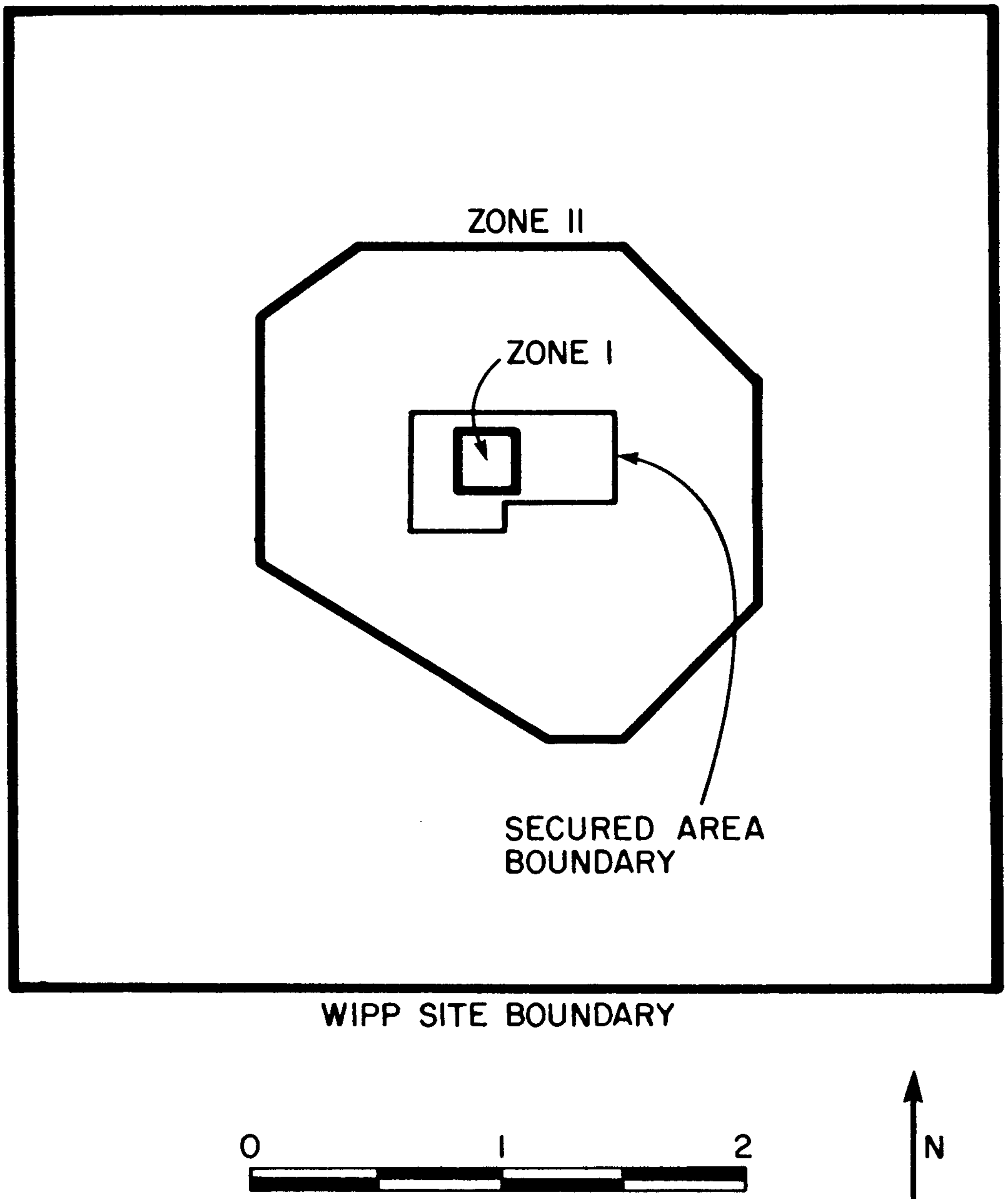

Figure 3. Zones at the WIPP Site

in the area of WIPP use rain catchment ponds for stock water in addition to water produced from wells.

DOE has purchased all potash leases within the 16 sections comprising the WIPP facility. However, there are two active oil and gas leases in the southwest corner of the WIPP site, one in the north-half of Section 31 and one in the south-half of Section 31, T-22-S, R-31-E (Silva and Channell 1992). These two oil and gas leases are at depths greater than 6000 feet and are part of the James Ranch Unit currently operated by Bass Enterprises. In 1982, Bass Enterprises drilled a wildcat well just south of the WIPP site, on Section 6, T-23-s, R-31-N, with intent to deviate north into Section 31. That well was completed to a depth of 4,596 meters (15,078 ft) into the Atoka Formation under Section 31. The impact of drilling additional wells into this lease and the continued production of gas from the existing well are not yet known.

Although there are no dairies within 40 miles of the WIPP facility, a large amount of alfalfa is grown in the Pecos Valley between Roswell and Malaga, New Mexico. The alfalfa crop is used in cattle feeding operations mainly in New Mexico and Texas. Cotton and pecans are the other major crops grown in the Pecos Valley.

Geologically, the WIPP repository horizon is situated at a depth of 655 m (2,150 ft) below land surface in the Permian age Salado Formation (Figure 4). The Salado is a 610 m (2,000 ft) thick bedded-salt formation overlain by the Rustler Formation. The Rustler Formation consists of anhydrite and siltstone beds and contains two water-bearing zones, the Magenta and Culebra Dolomites, at 170 m (568 ft) and 205 m (672 ft) below land surface, respectively. Each of these is approximately 7.5 m (25 ft) thick. Transport in the water-bearing units of the Rustler Formation represents the main potential hydrologic pathway to the biosphere from the repository. The Culebra

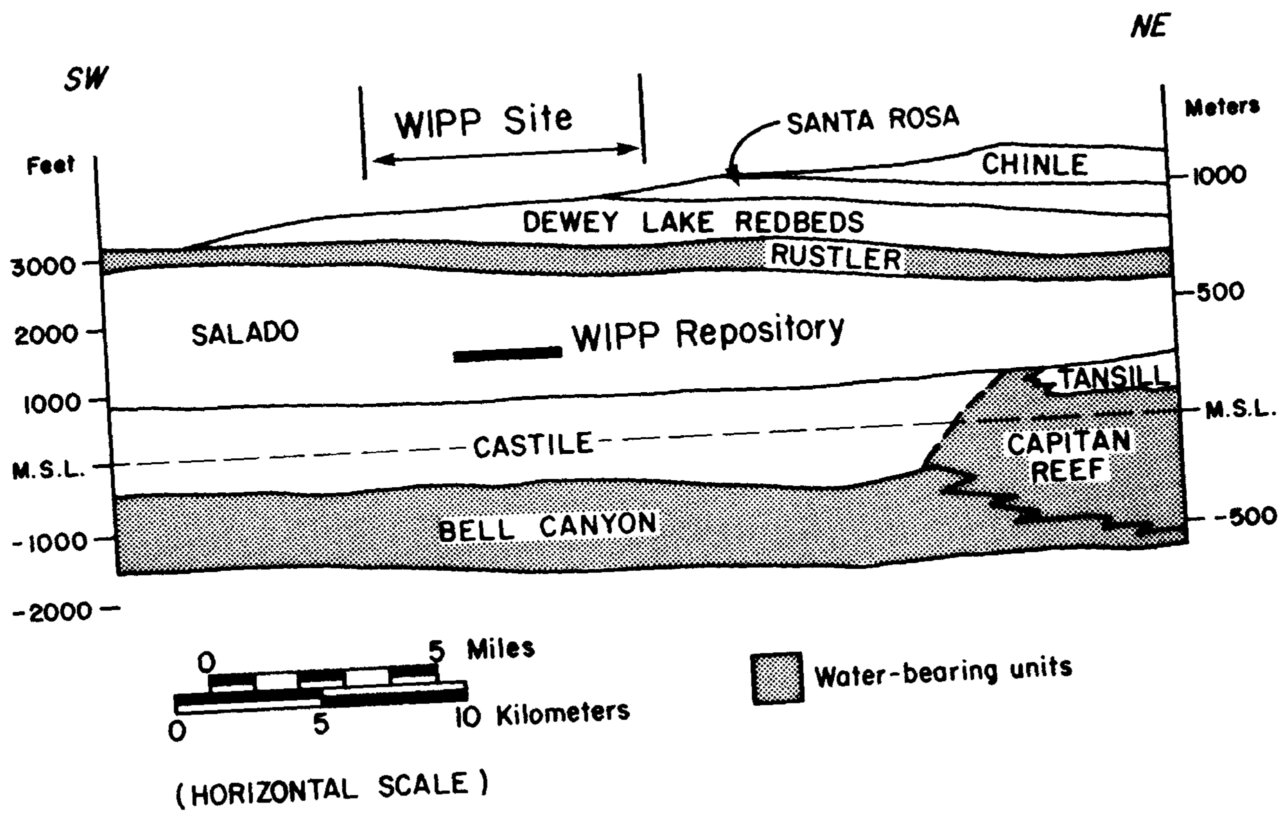

Figure 4. Stratigraphy at the WIPP Site

Dolomite is considered to be the most important hydrologic pathway for release calculations because it is the most transmissive unit in the area. The most recent interpretation (Sandia National Labs 1989) of the Culebra freshwater-head data indicates a southerly flow across the WIPP site with southwesterly flow occurring south of the site. Radiological baseline data for the Culebra and the less productive Magenta Dolomite are being collected because of their importance to long-term release scenarios.

3.0 SUMMARY OF THE PREOPERATIONAL PROGRAM

The EEG implemented a preoperational environmental surveillance plan (Spiegler 1984) to establish baseline data on potential exposure pathways as summarized in Table 1. A high priority continues to be assigned to air sampling and analysis because of the potential for accidents which could result in an airborne release. The air sampling system deployed by EEG provides the potential for early detection of releases and subsequent atmospheric dispersion. The preoperational environmental surveillance program includes sampling of other environmental pathways such as groundwater, surface water, public drinking water, biota, soil, and sediment. Radiochemical analyses of environmental samples are performed for the long-lived radionuclides Pu-238, Pu-239+240, Am-241 (plus the naturally-occurring radionuclides U, Th, Ra) and long-lived fission products, such as Cs-137 and Sr-90, which are found in the WIPP waste.

3.1 Air Surveillance

The exhaust air effluent from the underground mine is not continuously filtered because of the large air flow rate required for mine safety. Provisions have been made to filter exhaust air through the high efficiency particulate air (HEPA) filters

Table 1. EEG Preoperational Radiological Surveillance Program

ENVIRONMENTAL MEDIUM	LOCATION	SAMPLING/ANALYSIS FREQUENCY	PARAMETER
Air	4 Off-site and 3 On-site Low Volume Air Sampler Locations	Continuously/ Quarterly Composite	gross alpha, gross beta, Pu-238, Pu-239+240, Am-241, Cs-137, Sr-90, Th-228, Th-230, Th-232, Ra-226, Ra-228
Surface Water	Pecos River 2 Locations Laguna Grande de La Sal Surface Stock Tanks 5 Locations	Annually/Annually	gross alpha, gross beta, Pu-238, Pu-239+240, Am-241, Tritium, Cs-137, Sr-90, Ra-226, Ra-228, U-233+234, U-235, U-238, Th-228, Th-230, Th-232
Groundwater	22 Wells	Annually/Annually	gross alpha, gross beta, Pu-238, Pu-239+240, Am-241, Tritium, Cs-137, Sr-90, Ra-226, Ra-228, U-233+234, U-235, U-238, Th-228, Th-230, Th-232
Municipal Drinking Water	4 Systems	Annually/Annually	gross alpha, gross beta, Pu-238, Pu-239+240, Am-241, Tritium, Cs-137, Sr-90, Ra-226, Ra-228, U-233+234, U-235, U-238, Th-228, Th-230, Th-232
Soil and Sediment	3 Sites	Annually/Annually	gross alpha, gross beta, Pu-238, Pu-239+240, Cs-137, Sr-90, U-233+234, U-235, U-238, Th-228, Th-230, Th-232
Biota	2 Specimens*	Annually/Annually	Pu-238, Pu-239+240, Am-241, Tritium, Cs-137
Facility Effluents			
Air	2 Underground Ventilation Exhaust (Stations A & B)	Continuously/ Quarterly Composite	gross alpha, gross beta, Pu-238, Pu-239+240, Am-241, Cs-137, Sr-90, Th-232, Th-230, Th-228, Ra-226, Ra-228
Sewage	1 Lagoon	Semiannually	gross alpha, gross beta, Pu-238, Pu-239+240, Am-241, Tritium, Cs-137, Sr-90, Ra-226, Ra-228, U-233+234, U-235, U-238, Th-228, Th-230, Th-232
Storm Water Runoff	WIPP Zone I	Annually	gross alpha, gross beta, Pu-238, Pu-239+240, Am-241, Tritium, Cs-137, Sr-90, Ra-226, Ra-228, U-233+234, U-235, U-238, Th-228, Th-230, Th-232

*Sampling performed by DOE

should a release be detected. The pressure drop across the HEPA filters is large and would result in much lower exhaust air flow rates. Hence, there is the potential for chronic, unfiltered, low-level releases of TRU contaminants during the emplacement, test or retrieval process. Acute releases could result from accidents prior to the shifting of exhaust air through the HEPA filters.

The fixed air sampler (FAS) at stations A and B sample at a flow rate of 56.6 l/min (2 ft^3/min). Filters are changed following approximately 24 hours of sampling which produces a nominal sample volume of 81.6m^3 (2,880 ft^3). Filters are not normally changed on weekends and holidays due to the low dust loading. Quarterly composites of FAS filters collected from stations A and B each contain an air sample volume of approximately 7,344 m^3 (259,200 ft^3). A tamper evident seal is installed on the FAS with each new filter and a strip chart showing the air flow through the system during the sampling period is collected with each loaded filter. Flow is regulated through each FAS through use of an anemometer and flow controller. EEG staff are present for each filter exchange, data and flow chart collection.

To detect acute releases, the first level of air sampling (excluding the effluent air sampling to be done in the exhaust ducts at Stations A and B) occurs inside of zone I of the facility in the predominant downwind direction. Air samples are collected using continuously operated low volume air samplers (LVAS) which collect air particulates on 102 mm (4 in) diameter borosilicate microfiber filters at a rate of 142 l/min (5 ft^3/min). A typical sampling period lasts for seven days which provides a sample volume of approximately 1.4 x 10^6 liters (5 x 10^4 ft^3). The sample volume is used in the calculation to determine radionuclide activity concentration, lower limit of detection (LLD), and analytical error.

The air sample filter is located at a distance equal to or greater than the height of the instrument housing in an upward facing, non-directional configuration. The filter is protected from rain and snow degradation through the use of a rain shield described by Liu and Pui (1980). Wind tunnel test performed at the University of Minnesota with sampling devices using the rain shield design indicate high aspiration efficiency with little dependence on wind speed (Liu and Pui 1980).

Air sampling is accomplished by strategic placement of low volume air samplers within WIPP Zones I and II (Figure 5). The LVAS designated as Site-1 is located approximately 225 m (740 ft) northwest of the underground exhaust stack within the Zone I boundary. The Site-1 sampler is approximately 90 m (300 ft) from the north line (FNL) of Zone I and 150 m (500 ft) from the east line (FEL) of Zone I. The LVAS designated as Site-2 is located approximately 500 m (1,600 ft) northeast of the WIPP exhaust shaft and unit Site-3 is located approximately 1,000 m (3,300 ft) northwest of the WIPP exhaust shaft (Figure 6).

Low volume air samplers are also continuously operated in Artesia, Carlsbad, Hobbs, and Loving, New Mexico. A typical LVAS station is shown in Figure 7. The LVAS in Artesia is located near the west end of Jaycee Park near the intersection of 26th and Dr. R. W. Harper Drive (township 22S, range 25E, section 24). The Carlsbad LVAS is located near the intersection of McKay Street and Guadalupe Street (township 22S, range 27E, section 6). The Loving LVAS is located near the intersection of 5th Street and Elm Street atop the Loving Fire Station (township 23S, range 28E, section 21). The LVAS in Hobbs is located near the intersection of Dalmont Street and Snyder Street (township 18S, range 38E, section 34). The air samplers are located on rooftops in Carlsbad, Hobbs, and Loving to provide required security for the samplers.

Figure 6. Typical WIPP Site Low Volume Air Sampling Station (S-2)

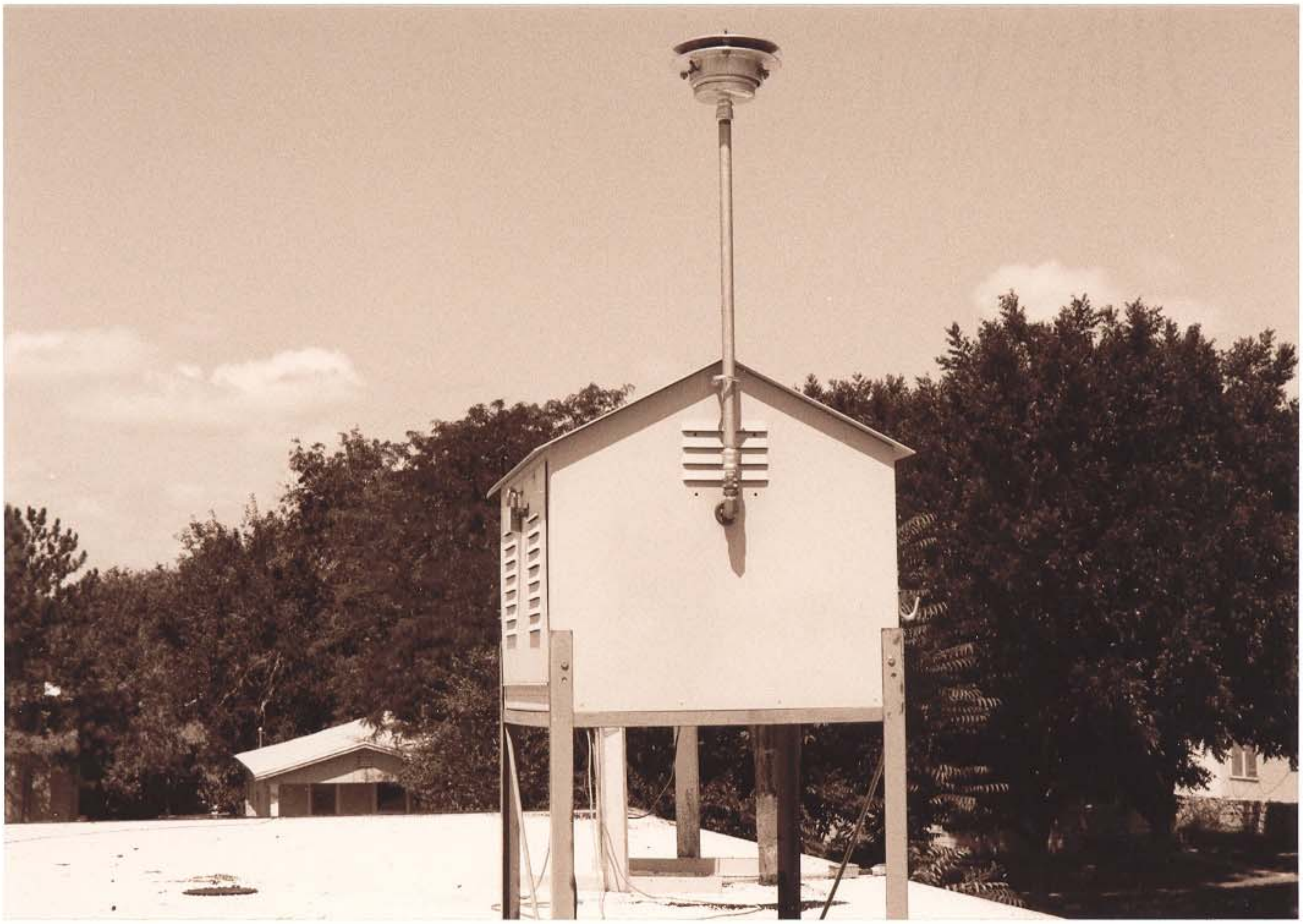

Figure 7. Typical Community Low Volume Air Sampling Station (Carlsbad)

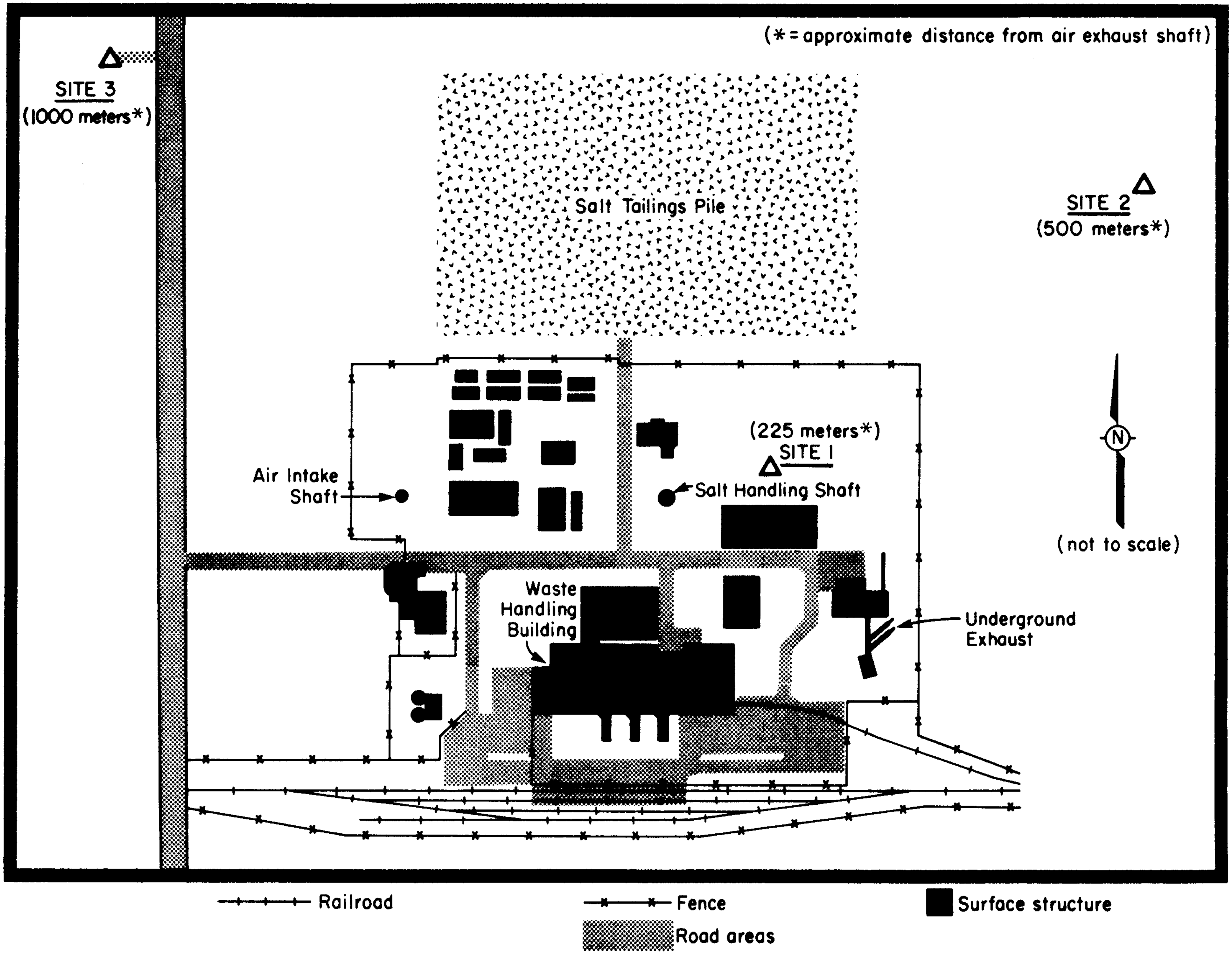

Figure 5. Air Sampling Locations

It should be noted that from 1985 until January 1, 1990, high volume air samplers (HVAS) were used in the air sampling program in these communities for 24 hours every sixth day. As the expected time of TRU waste receipt approached, the HVAS which were operated intermittently were replaced with continuously operated LVAS systems in each community. The change in sampling hardware provides for continuous air sampling in the population centers near the WIPP facility.

3.2 Water Surveillance

Groundwater samples are collected from water-bearing zones of the Santa Rosa, Dewey Lake Redbeds, Culebra Dolomite Member of the Rustler, Magenta Dolomite Member of the Rustler, Bell Canyon, and Capitan Reef formations. Water samples from 12 wells listed on Table 2 are collected by DOE and immediately provided to EEG as splits from their sample. The 12 observation wells are located at the 8 locations shown on Figure 8. The samples accepted by EEG are sent to contract laboratory for radiochemical analysis. Due to budget limitations not all samples are accepted and analyzed by EEG. The location and formation sampled is indicated for each well in Table 2. Surface water samples are collected by EEG staff.

In all cases, the aliquot designated for radiochemical analysis is acidified with nitric acid to reduce the pH to less than 2.0. Samples designated for tritium determination are collected in 240 mL glass containers with conical-shaped polyethylene caps to prevent ambient air entrapment with the sample. Surface water, groundwater, public drinking water, WIPP wastewater effluent and stormwater effluent samples are sent to a private contractor laboratory for radiochemical analysis. The radiochemical analyses for all water samples are reported in Tables A-9 through A-12 of Appendix A.

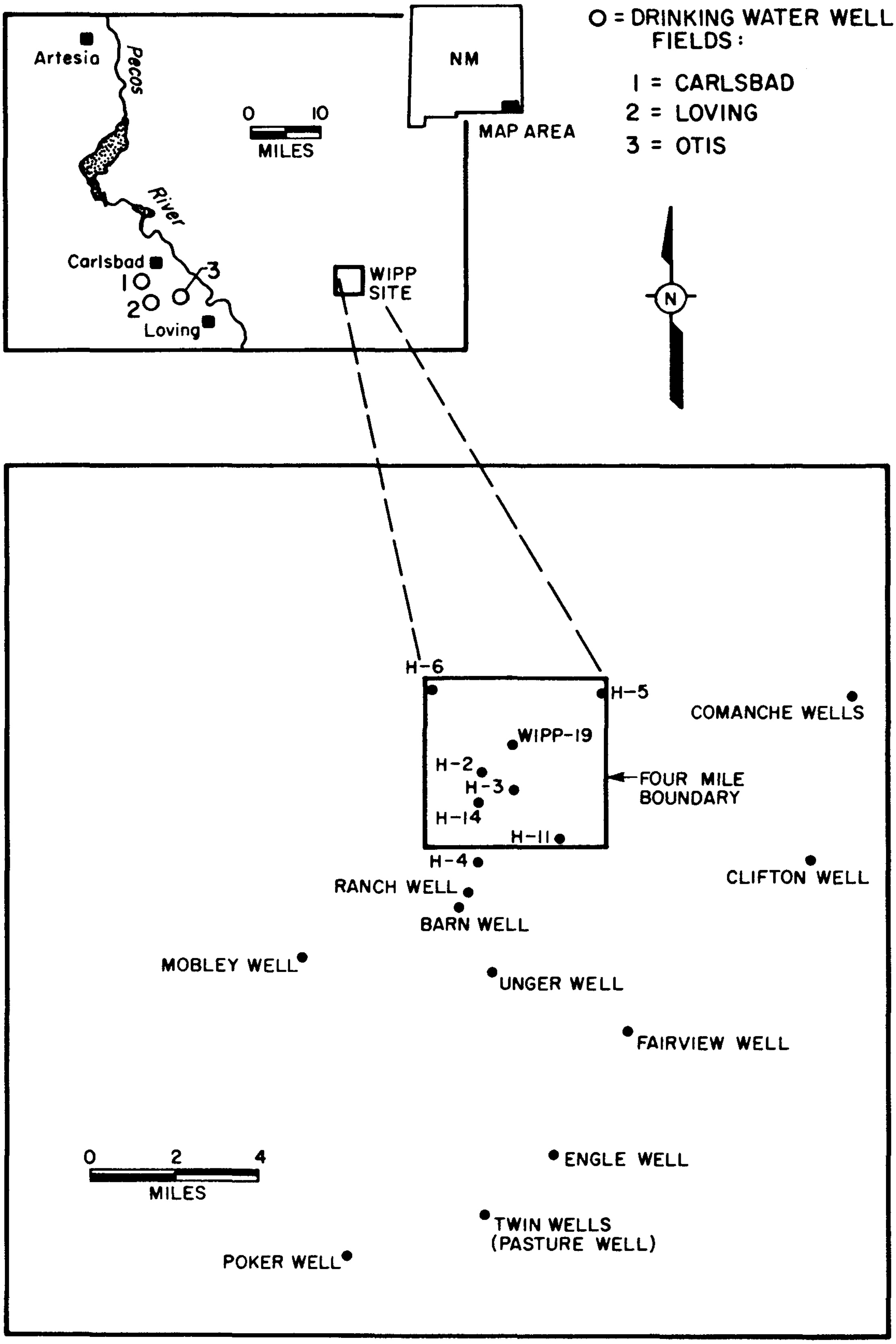

Figure 8. Groundwater Sampling Locations

Table 2. Active Groundwater Sampling Locations

WELL I.D.	TOWNSHIP	RANGE	SECTION	DISTANCE FROM SECTION LINE (FT)	FORMATION SAMPLED
Barn	23S	31E	7	Not Available	Dewey Lake Redbeds[2]
Clifton	23S	32E	3	Not Available	Santa Rosa[2]
Comanche	22S	32E	14	Not Available	Santa Rosa[2]
Engle	24S	32E	4	240.00 FSL[1] 1500.00 FEL[1]	Culebra Dolomite[2]
Fairview	23S	32E	26	Not Available	Dewey Lake Redbeds[2]
Mobley	21S	32E	31	Not Available	Culebra Dolomite[2]
Poker	24S	30E	12	Not Available	Culebra Dolomite[2]
Ranch	23S	31E	7	Not Available	Dewey Lake Redbeds[2]
Twin (Pasture)	24S	31E	17	Not Available	Dewey Lake Redbeds[4]
Unger	23S	31E	17	Not Available	Dewey Lake Redbeds[2]
H-2C	22S	31	29	637.15 FNL[1] 1708.62 FWL[1]	Not Available
H-3B1	22S	31E	29	2085.31 FSL[1] 138.10 FEL[1]	Magenta Dolomite[2]
H-3B3	22S	31E	29	2022.35 FSL[1] 217.30 FEL[1]	Culebra Dolomite[2]
H-4B	23S	31E	5	498.47 FNL[1] 632.54 FWL[1]	Culebra Dolomite[2]
H-4C	23S	31E	5	446.36 FNL[1] 717.89 FWL[1]	Magenta[1]
H-5B	22S	31E	15	1008.30 FNL[1] 236.22 FEL[1]	Culebra Dolomite[3]
H-5C	22S	31E	15	1005.55 FNL[1] 134.95 FEL[1]	Magenta Dolomite[3]
H-6B	22S	31E	18	196.34 FNL[1] 322.96 FWL[1]	Culebra Dolomite[2]
H-6C	22S	31E	18	281.06 FNL[1] 374.47 FWL[1]	Magenta[2]
H-11B3	22S	31E	33	1501.70 FSL[1] 105.20 FEL[1]	Culebra Dolomite[2]
H-14	22S	31E	29	372.60 FSL[1] 562.40 FWL[1]	Culebra Dolomite[2]
WIPP-19	22S	31E	20	2286.50 FNL[1] 12.70 FEL[1]	Culebra Dolomite[2]

[1] From Gonzales (1989)
[2] From Randall (1988)
[3] From Uhland (1987)
[4] From Uhland (1986)

Note:
FNL = feet from north line of section
FEL = feet from east line of section
FSL = feet from south line of section
FWL = feet from west line of section

An interpretation of the groundwater chemistry data is discussed by Chapman (1988). The major ion data are useful in determining flow paths in the water-bearing units above the level of the WIPP repository. Data on the concentrations and distribution of thorium, radium, and uranium may be used to help predict the mobility of similar radionuclides in the hydrogeochemical setting at WIPP. Flow path and radionuclide mobility information are useful for analyzing release scenarios to asses WIPP's compliance with the long-term disposal requirements contained in EPA regulations (40 CFR Part 191). Radionuclide data collected from groundwater samples could become part of the data base used to evaluate long-term performance of the repository, providing documentation of pre-waste levels for later comparison.

The surface water surveillance program consists of routine sampling of eight bodies of water by EEG staff as shown in Figure 9. Due to the size of Laguna Grande de la Sal three collection areas are used to form a composite sample. Water collected from the Pecos River in Carlsbad provides radionuclide baseline data and a comparison for similar data from the Pierce Canyon area of the Pecos about 19 km (12 mi) downstream from Carlsbad. Mercer (1983) suggests that saturated zones in the Rustler Formation discharge to the Pecos River near Malaga Bend, about a mile upstream of where the river enters Pierce Canyon. Because of the role of the Rustler Formation as a hydrologic pathway for radionuclide migration, preoperational data from these regions are important. Radionuclide baseline data are collected from surface water in Laguna Grande de la Sal which is located 13 km (8 mi) southwest of the WIPP facility. The saline lake is in the storm water drainage from the facility and is a discharge point for shallow groundwater in Nash Draw. Because particulates in air emissions from WIPP operations would be expected to fall onto the area watershed, water samples are collected from five nearby rain catchment basins used for stock and game watering and storm water runoff from the Zone I area of

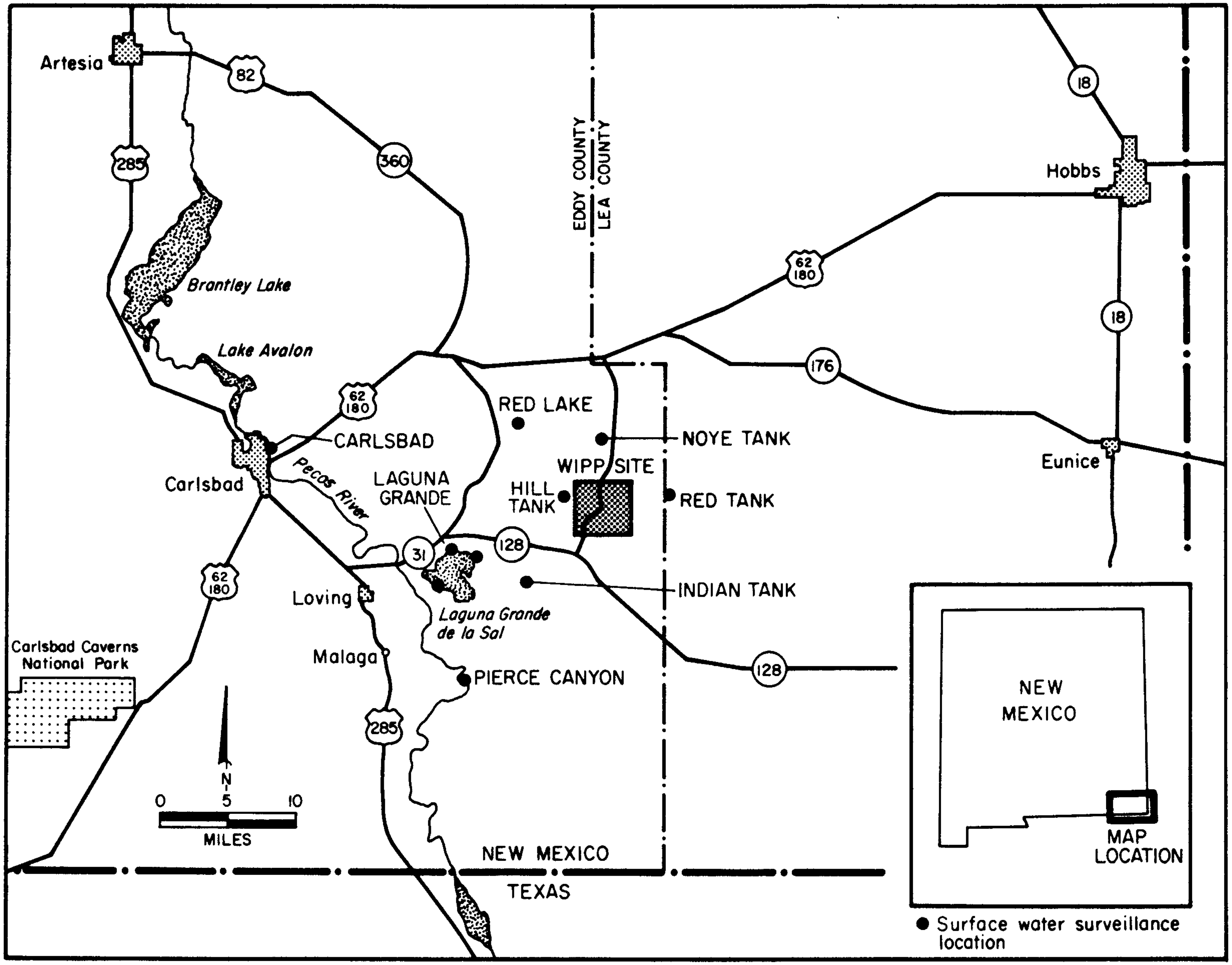

Figure 9. Surface Water Sampling Locations

the facility. Radiochemical data from surface water samples are presented in Table A-9 of Appendix A.

New Mexico Regulations Governing Water Supplies (N.M.H.E.D. 1989) establish a maximum contaminant level (MCL) for Sr-90 at 8 pCi/l, tritium at 20,000 pCi/l, gross alpha at 15 pCi/l, and Ra-226+228 at 5 pCi/l in public community water supply systems. EEG collects and analyzes samples from the Carlsbad, Loving/Malaga, Otis, and WIPP water supply systems (Figure 8). Radionuclide data obtained from these public community drinking water systems during this report period did not exceed these MCLs and are presented in Table A-12 of Appendix A.

Mercer (1983) summarized chemical analyses performed by the U. S. Geological Survey on WIPP well samples. Simpson et al. (1985) reported a wide variety of radionuclide analyses of surface and groundwater in the Delaware Basin in an investigation of the mobility of radionuclides in high-chloride environments.

Field and laboratory results from DOE's water quality sampling program are available in Uhland and Randall (1986), Uhland et al. (1987), Randall et al. (1988), U.S.D.O.E. W.I.P.P. (1990) and U.S.D.O.E. W.I.P.P. (1991). Interpretation of data from groundwater in the Culebra Dolomite Member of the Rustler formation is discussed in Chapman (1988) and Ramey (1985).

3.3 Soil and Sediment Surveillance

Soil and sediment in the area of WIPP contain a record of deposited radioactive fallout from past atmospheric nuclear weapons testing as well as surface contamination from Project Gnome. Cs-137 was one radionuclide identified in the area of the Gnome site during an aerial gamma survey (Berry 1989) which was conducted as a part of WIPP baseline studies. It is believed that a certain amount of this deposited fallout may become resuspended in air particulates under certain atmospheric and soil conditions. Because WIPP TRU waste contain some of the fission products found in fallout, these data are an important component of the environmental baseline data set. In addition, soil samples are routinely available to EEG as split samples from the DOE soil sampling program. Radionuclide data obtained from soil samples collected during this report period are contained in Table A-15 of Appendix A.

3.4 Biota Surveillance

Potential ecosystem transport processes at WIPP include the atmospheric dispersion and subsequent contamination of soil, surface water, and vegetation surrounding the WIPP facility. Although inhalation is the predominant exposure pathway to man, ingestion of game, livestock, or fish that had access to the contaminated environment could also provide a pathway for human exposure (U.S.N.R.C. 1983).

Some EEG biotic samples are received as split samples from the DOE environmental program. Biotic samples are sent to a private laboratory for radiochemical analyses as shown in Table 1. Radiochemical data from analysis of biota samples are presented in Table A-14 of Appendix A.

3.5 WIPP Effluent Surveillance

The two major effluent streams at the WIPP facility are exhaust air from the underground repository waste area and sewage effluent. Unfiltered air is normally exhausted at approximately 201 m^3/s (425,000 ft^3/min) through an exhaust shaft to the environment. The EEG routinely collects samples from a fixed air sampler (FAS) which traps particulates from the unfiltered exhaust air at the top of the exhaust shaft (Station A) before the air is discharged to the environment (Figure 10). Samples from Stations A are sent to a private laboratory for radio-chemical analysis after initial screening in the EEG laboratory.

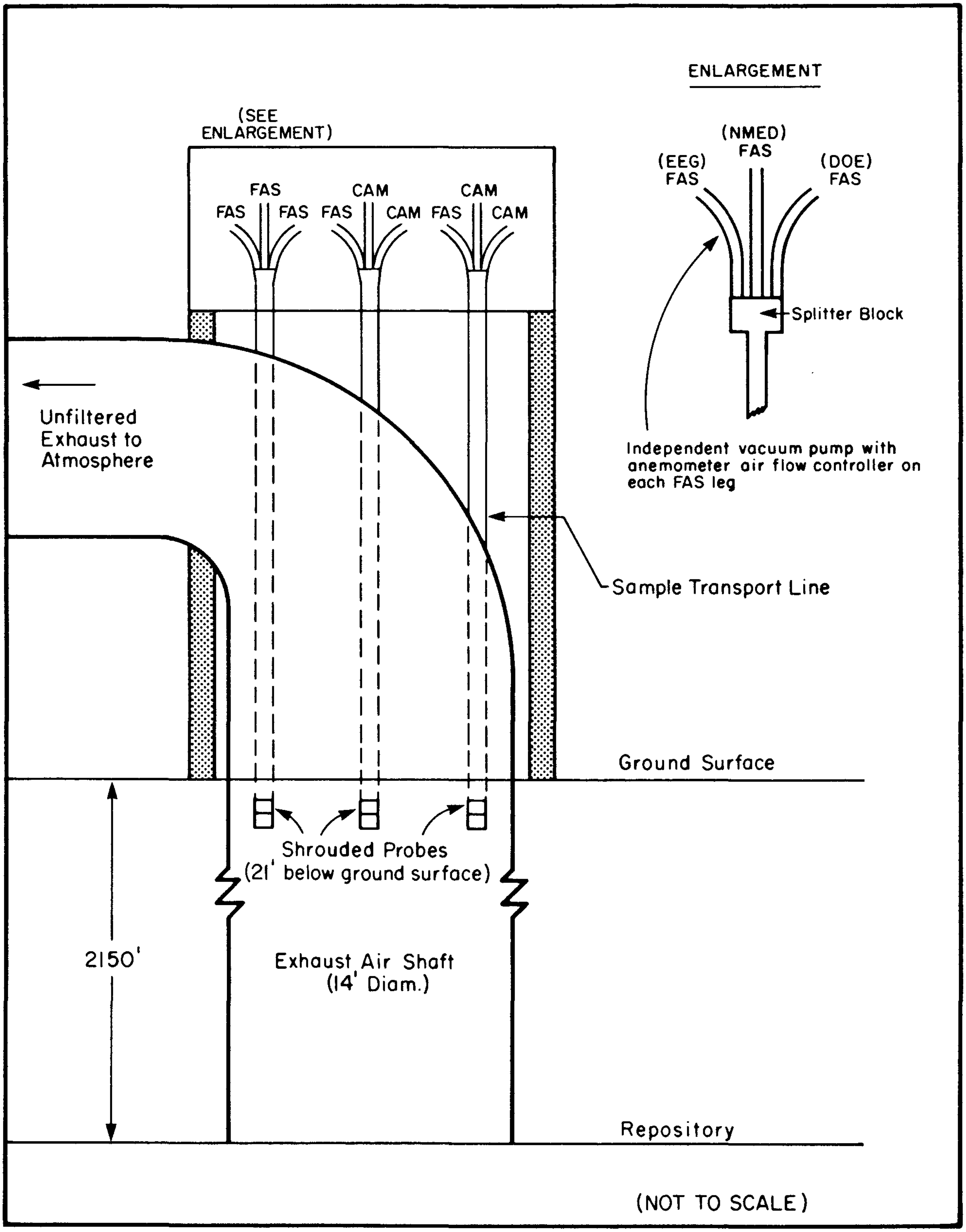

Figure 10. Station A

Although EEG began collecting filters from these FAS locations in October 1990, the methodology was not finalized until October 1991. The analytical radiochemical suite is the same as that indicated for air filters in Table 1. Underground exhaust air will be diverted through high efficiency particulate air filters located on the surface if the continuous air monitor (CAM) in the exhaust shaft on the surface (Station A) detects a significant radioactive release. Air passed through the HEPA filters would then be exhausted to the environment at a rate of 28.3 m^3/s (60,000 ft^3/min) through an alternate exhaust duct and sampled at a FAS designated as Station B. Fixed air samples collected from Station B will be analyzed as described above for Station A samples should HEPA filtration be initiated. EEG will not operate a CAM at either Station A or B because it is DOE's responsibility to advise of an alarm or accident situation.

In order to determine the total amount of radioactivity released from the underground at WIPP in the event of an accident, it is necessary to operate FAS units at both Stations A and B during a suspected release (Figure 11). First, contamination could potentially be released to the environment through the unfiltered exhaust stacks beyond Station A before CAM alarms initiate HEPA filtration. Hence, a FAS at Station A is essential. Second, Station B is sampled with a FAS to quantify any releases which might be discharged from the underground to the environment through leakage or failure of the HEPA filtration system and otherwise verify that no further discharge occurred once the bypass valves close. Through analysis of filters from Stations A and B, EEG should have enough data to determine the extent of any significant release through the repository exhaust air.

Air exhausted from the Waste Handling Building will be double HEPA-filtered continuously before discharge to the environment. DOE will maintain CAM systems and FAS systems in the exhaust duct from this facility at a location designated as Station C. However, due to the low probability of a release through this

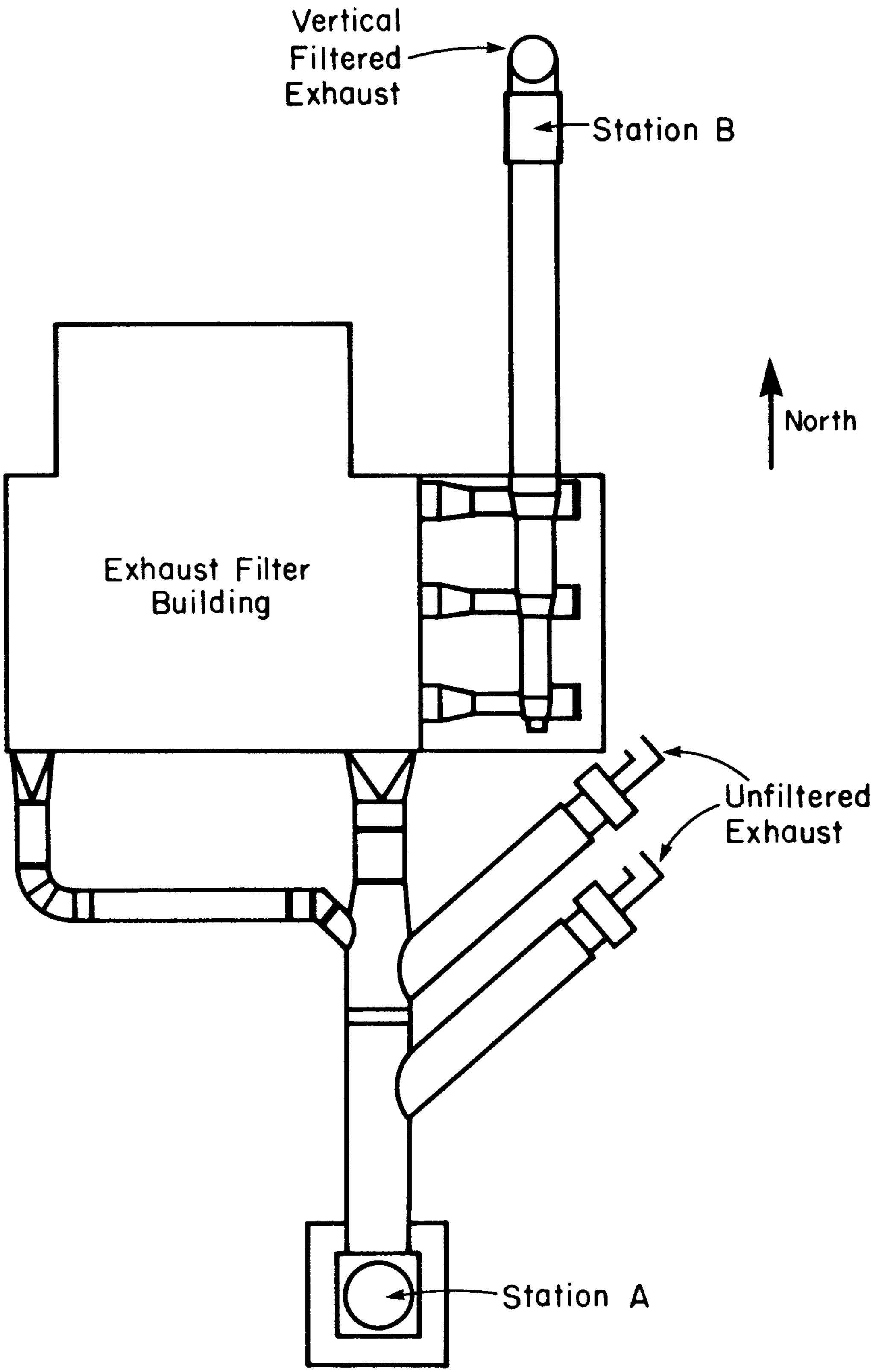

Figure 11. Locations of Station A and B

redundant HEPA-filtered discharge, EEG will not operate a FAS in this exhaust system.

Secondary effluent streams from the WIPP facility are sewage effluent and storm water runoff from Zone I. The WIPP sewage treatment plant consists of two parallel lined solar evaporation ponds followed by parallel lined effluent treatment ponds with final discharge to an unlined absorption bed. Although DOE procedures indicate that potentially contaminated water from waste handling operations will not be introduced into the WIPP sewage system, preoperational monitoring includes sampling of effluent contained in the lined evaporation ponds. Analytical data from radiochemical analyses performed on sewage effluent and storm water samples are contained in Table A-11 of Appendix A.

4.0 DISCUSSION OF FINDINGS

Radiochemical analyses of environmental samples, presented in Appendix A, are required to identify specific radionuclides present in the preoperational WIPP environment. Radiochemical analysis of composite air, water, biota, soil, and sediment samples are performed by a private contractor laboratory. Gross alpha and gross beta activity levels in samples of water and soil were determined using proportional counting systems. Analyses were preceded by one or more chemical separations.

The equations used by EEG's contractor laboratory in reporting individual radionuclide activity concentrations and counting error at the 95 percent confidence level are presented below. The activity concentration for most radionuclides was calculated by the following equation:

$$\text{Radionuclide Activity Conc.} = \frac{(\text{Net CPM})}{(E)\ (V)\ (Rc)\ (Rs)\ (K_1)\ (K_2)}$$

Where:

Radionuclide Activity Conc. = μCi/ml

Net Counts per minute (CPM) = gross CPM - background CPM

E = Counting efficiency (counts per disintegration)

V = Sample volume or weight (ml or g)

Rc = Fractional chemical yield of carrier

Rs = Fractional average recovery for standards

K_1 = 3.7 X 10^4 disintegrations/second-μCi

K_2 = 60 seconds/minute

The 2 sigma analytical error was calculated from the following equation:

$$\text{Analytical Error} = \frac{1.96\ [(S/D_s) + (B/D_b)]^{1/2}}{(E)\ (V)\ (R_c)\ (R_s)\ (K_1)\ (K_2)}$$

Where:

Analytical Error = μCi per volume unit (ml or g)

1.96 = Factor to achieve 95 percent confidence level

S = Sample gross count rate

B = Blank counts

D_s = Sample counting time in minutes

D_b = Blank counting time in minutes

R_c = Fractional chemical yield of carrier

R_s = Fractional average recovery for standards

E = Counting efficiency (counts per disintegration)

V = Volume of sample (ml or g)

K_1 = 3.7 x 10^4 disintegrations/second-μCi

K_2 = 60 seconds per minute

The EEG contractor laboratory routinely reports a lower limit of detection (LLD-C) for each analysis based on the results of a periodic determination of the background of the counting instrument but without other factors of the analytical chemical separation process. The contractor laboratory's LLD-C can be summarized as follows:

$$LLD\text{-}C = (4.66)(S_b)/(K_1)(E)(V)(Y)(e)^{(-\lambda)(\Delta t)}$$

Where:

4.66 = Factor to achieve 95% confidence

LLD-C = lower limit of detection (microcurie/milliliter) based upon instrument background alone

S_b = standard deviation of instrument bkg (cps)

E = counting efficiency (cps/dps)

V = sample volume (cc)

Y = fractional yield of radiochemistry

K_1 = 3.7 x 10^4 disintegrations per second per microcurie

λ = decay constant

Δt = elapsed time, collection to count

This formulation of the LLD-C for a single measurement is intended to follow the guidance of the HASL Procedures Manual (U.S.D.O.E., E.M.L. 1990) and similar sources.

However, a survey of the radiochemical data from environmental samples collected between 1985 and 1988 (Kenney et al. 1990) found that Cs-137 was reported at a concentration of 3.3 E-9 μCi/ml (LLD-C = 2.0 E-9 μCi/ml) in water from the Rustler Formation. The sample in question was collected from an environmental media and under geophysical conditions that would make it highly unlikely that the sample would contain fallout Cs-137 at the concentration reported. It appears that the high Cs-137 concentration was the result of incomplete potassium (K-40) precipitation followed by a beta count which attributed the activity to Cs-137. Radiochemical data collected during 1991 indicated the presence of Pu-238 at the LLD-C in four water samples, Pu-239+240 and AM-241 at the LLD-C in three water samples. Although other environmental monitoring programs have reported similar baseline measurements (Reith et al. 1986, Banz et al. 1987) it is not likely that these analyses represent true detection of environmental levels of fallout radionuclides but

are instead a result of inappropriate procedure blanks used to calculate the LLD-C. These errors might have been prevented through the use of more appropriate procedure blanks.
An independent computation of LLD based upon Nuclear Regulatory Commission (NRC) Regulatory Guide 4.14 (U.S.N.R.C. 1980) is used in this report to calculate LLDs for air sample analyses. To realize the conditions for which the formula for calculating LLD is applicable in a given analytical measurement, one of the following requirements should be met:

a) The value of the standard deviation of repeated measurements of appropriate procedure blanks (S_b) must be well known from theoretical considerations and knowledge of the measurement system stability, or

b) The standard deviation is determined under current conditions from a series of replicate measurements on a stable dependable well-known blank. The restated definition of LLD is:

$$LLD = (4.66)(S_b)/(K_1)(E)(V)(Y)(e)^{(-\lambda)(\Delta t)}$$

Where:

LLD = the lower limit of detection (microcurie per milliliter) based upon measurements of a stable well-known blank

S_b = the standard deviation of repeated measurements of appropriate procedure blanks (cps)

E = the counting efficiency (counts per disintegration)

V = the sample volume (milliliters)

Y = the fractional radiochemical yield (when applicable)

K_1 = 3.7×10^4 disintegrations/second-μCi

λ = the radioactive decay constant for the particular radionuclide

Δt = the elapsed time between sample collection and counting

It is clear that a procedure for determining S_b based solely on the observed counts in a detector with a blank sample (or no sample at all) would be subject to a systematic error if the analytic procedure itself added counts to the background in addition to electronic noise, background radiation penetrating the detector shield, etc. The most reliable source of data with which to estimate S_b in such cases is data from a blank "sample" which is a quantity of the environmental medium (air sample filter or water) devoid of the activity of interest. Suitable blanks of this sort have been submitted to the contractor laboratory for analysis in the past. At the time of this report, enough data of this sort has accumulated to begin to estimate air sample LLDs on this basis (Table 3).

Due to the lack of sufficient data from blank water samples (procedure blanks), LLDs based upon the above equation were not calculated by EEG for water sample data and, therefore, the contractor's LLD-Cs continue to be reported here.

One important objective of the EEG's preoperational environmental surveillance program is to better understand the radionuclide concentration values and lower limits of detection in environmental samples from the vicinity of the WIPP facility. In a method consistent with the format outlined in NRC Regulatory Guide 4.14 (1980), EEG reports all environmental radionuclide concentrations as values, including values less than the lower limit of detection (LLD) or less than zero.

4.1 Air Data

Gross alpha and gross beta data are summarized in Figures B-1 through B-7 of Appendix B and presented in Tables B-1 through B-7 of Appendix B. Nondestructive measurements of gross alpha and gross beta activity were performed on air samples in the EEG laboratory in Carlsbad, New Mexico. Following a minimum of 170 hours of decay, gross alpha activity of air filters averaged

TABLE 3. RADIONUCLIDE LLD DATA (AIR FILTERS)

RADIONUCLIDE	NUMBER OF BLANKS	MEAN CONCENTRATION (pCi/FILTER COMPOSITE)	STANDARD DEVIATION	LLD (pCi/FILTER COMPOSITE) AT 95% CONFIDENCE
AMERICIUM-241	27	0.12	0.27	1.27
CESIUM-137	27	0.69	2.08	9.71
PLUTONIUM 239+240	27	-0.19	0.49	2.29
PLUTONIUM-238	27	0.02	0.19	0.90
RADIUM-226	27	0.20	0.75	3.51
RADIUM-228	27	1.04	3.11	14.50
STRONTIUM-90	27	0.38	1.75	8.17
THORIUM-228	27	0.71	1.01	4.71
THORIUM-230	27	0.30	0.42	1.96
THROIUM-232	27	0.21	0.48	2.23

3.15 E-15 μCi/ml and gross beta activity averaged 2.09 E-14 μCi/ml. These average activities are consistent with data reported in EEG-43 (Kenney et al. 1990), EEG-47 (Kenney and Ballard 1990), EEG-49 (Kenney 1991) and DOE preoperational data (Reith et al. 1986; Banz et al. 1987; U.S.D.O.E., W.I.P.P. 1988; U.S.D.O.E., W.I.P.P. 1989; and U.S.D.O.E. W.I.P.P. 1990).

Analytical radiochemistry data obtained from composites of air filter samples are contained in Tables A-1 through A-8 of Appendix A. As discussed previously, the LLD values are calculated using activity data from procedure blanks. The report of thorium decay products at or above the LLD (Table 4) is consistent with previously reported data collected as part of the DOE preoperational baseline program.

4.2 Water Data

Radiochemistry data provided by the contractor laboratory are presented in Table A-9 through A-12 of Appendix A. Table 4 is a summary of the number of instances where the WIPP samples exceed or equal the lower limit of detection (LLD or LLD-C). The LLD-Cs reported for all water data are those provided by the contractor laboratory and are based upon a standard deviation of instrument background as discussed previously. As additional procedure blanks are provided to the laboratory for analysis, the data base will be used to calculate LLDs based upon the above method derived from the formula in NUREG Guide 4.14 (U.S.N.R.C. 1980).

Radionuclides from the uranium, thorium, and radium decay chains were reported equal to or above the LLD-C, which is consistent with previous work reported by EEG (Kenney et al. 1990; Kenney and Ballard 1990; Kenney 1991) and DOE (Reith et al. 1986; Banz et al. 1987; U.S.D.O.E., W.I.P.P. 1988; and U.S.D.O.E., W.I.P.P. 1989). Although Pu-238, Pu-239+240 and Am-241 in water samples collected during 1991 are reported at activities equal to or greater than the LLD-C and in DOE baseline reports (Reith et al.

TABLE 4. SUMMARY OF RADIOCHEMICAL DATA GREATER THAN OR EQUAL TO LLD OR LLD-C

ANALYSIS	GROUNDWATER*		SURFACE WATER*		SOIL & SEDIMENT*		BIOTA*		PUBLIC WATER*		AIR SAMPLE		EFFLUENT WATER*	
	NO.>LLDc	TOTAL	NO.>LLDc	TOTAL	NO.>LLDc	TOTAL	NO.>LLDc	TOTAL	NO.>LLDc	TOTAL	NO.>LLD	TOTAL	NO.>LLDc	TOTAL
Am-241	2	2	1	8	NA		0	1	0	4	0	29	0	2
Cs-137	0	2	0	8	0	2	0	1	0	4	0	29	0	2
GROSS ALPHA	0	2	3	8	0	2	NA		2	4	0	29	1	2
GROSS BETA	0	2	6	8	2	2	NA		0	4	0	29	2	2
Pu-238	0	2	2	8	0	2	0	1	2	4	0	29	0	2
Pu-239+240	1	2	2	8	1	2	0	1	0	4	0	29	0	2
Ra-226	1	2	6	8	NA		NA		3	4	0	29	1	2
Ra-228	0	2	1	8	NA		NA		0	4	0	29	0	2
Sr-90	0	2	1	8	1	2	NA		0	4	0	29	0	2
TRITIUM	0	2	0	8	NA		0	1	0	4	NA		0	2
Th-228	0	2	6	8	2	2	NA		0	4	1	29	0	2
Th-230	1	2	7	8	2	2	NA		0	4	6	29	1	2
Th-232	0	2	4	8	2	2	NA		0	4	3	29	0	2
U-233+234	2	2	8	8	2	2	NA		3	4	NA		2	2
U-235	2	2	1	8	0	2	NA		1	4	NA		0	2
U-238	2	2	8	8	2	2	NA		3	4	NA		2	2

* = LLD-C CONTRACTOR REPORTED LOWER LIMIT OF DETECTION

1986 and Banz et al. 1987), the use of inappropriate procedure blanks could have resulted in artificially low LLD-C values as previously discussed.

4.3 Soil and Sediment Data

Data obtained from radiochemical analysis of soil samples collected approximately 100 meters (322 ft) northwest of the WIPP meteorological tower and 100 meters (322 ft) northeast of WIPP well designated as H-2C are contained in Table A-13 of Appendix A. Radionuclides from the uranium and thorium decay chains were detected at concentrations above the contractor laboratory's LLD-C. Plutonium 239+240 was reported in one soil sample above the contractor's LLD-C. Detection of plutonium 239+240 in soil and sediment samples has been reported by DOE (Banz et al. 1987).

4.4 Biota Data

Radiochemical data obtained from a sample of Brantley Farms' alfalfa hay are contained in Table A-14 of Appendix A. The hay composing the sample was collected in the vicinity of Highway 285 and State Road 31 (township 23S ,range 28E, section 7) approximately 30 km (19 miles) west-southwest of the WIPP facility. There are no values reported above the contractor laboratory's reported lower limit of detection, which is comparable to previous data found in Kenney et al. (1990), Kenney and Ballard (1990), and historical data collected by Bradshaw and Louderbough (1987).

4.5 Station A Air Effluent

Table A-13 of Appendix A contains radiochemical data obtained from analysis of air filters collected from the FAS located in the WIPP underground exhaust system, designated as station A. Due to changing methodology and hardware associated with station A, only data from samples collected during the fourth quarter of

1991 are considered valid. DOE has not published radiochemical data from FAS filters collected from station A, therefore comparison with other data is not possible.

5.0 QUALITY ASSURANCE

Quality assurance (QA) for the purposes of this report is defined as the use of standardized practices and procedures to assure that the highest level of quality is maintained for the data. The QA program consists of an ongoing comparison of analytical data with previous data collected by EEG and other organizations, review of radiochemical quality control, submission of blank samples, recognized reference standards and the use of accepted practices for sample acquisition, handling and analysis.

The procedures used for sample acquisition, handling, and screening are contained in the Environmental Evaluation Group's Environmental Procedures Manual (EPM). This manual is based upon widely recognized procedures such as American Public Health Association (1971), U. S. Environmental Protection Agency (1989), and Corley et al. (1981).

The Environmental Evaluation Group's contract laboratory for radiochemical analysis of environmental samples maintains a separate QA program. The major components of the contractor program include periodic calibration of counting instruments using standards traceable to the National Institute of Standards Technology, routine determination of chemical yields, and frequent assessment of the quality of reagents. The contractor laboratory participates in the Crosscheck Laboratory Intercomparison Program, which is administered by the Environmental Protection Agency, and the U. S. Department of Energy Quality Assessment Program.

EEG conducts audits of the procedures, data reduction techniques, quality assurance control plan, quality assurance manual check-list and the annual QA inspection report used by the contract laboratory. In addition a review is conducted of the contract laboratory's performance in the DOE Quality Assessment Program and the EPA Crosscheck Laboratory Intercomparison Program.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The data contained in this report continue the measurement of baseline of radionuclide concentrations in certain critical environmental media on and in the vicinity of the WIPP facility. The data found in this report closely parallel those found in previous reports generated for the WIPP site (Reith et al. 1986; Banz et al. 1987; U.S.D.O.E., W.I.P.P. 1988; U.S.D.O.E., W.I.P.P. 1989; Kenney et al. 1990; Kenney and Ballard 1990; Kenney 1991) in terms of preoperational levels of the primordial and fallout radionuclides in the WIPP environment.

As more "procedure blank" data become available from the analysis of air filter blanks and water blanks, more realistic lower limits of detection (LLDs) can be calculated. However, other problems associated with measuring very low levels of radionuclides in the environment will continue. One purpose of conducting environmental baseline measurements is to better understand these uncertainties before waste arrives at the WIPP facility.

For the first time, this EEG annual report contains data obtained from the underground effluent air at WIPP. These data will continue to be collected to gain a better understanding of the uncertainties associated with analysis of air particulates combined with diesel smoke mixed with mine dust.

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APPENDIX A

Note: Counting Error is 1.966 σ (95% Confidence Level)

Note: "Quarter" is Calendar Quarter

TABLE A1. RADIOCHEMICAL DATA FROM COMMUNITY AIR SAMPLES. FIRST QUARTER 1991.

ARTESIA, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml	
AMERICIUM-241	-3.86E-18	1.54E-17	7.00E-17	1.27
CESIUM-137	-6.6E-17	3.3E-16	5.4E-16	9.71
PLUTONIUM-238	-1.65E-18	4.41E-18	1.26E-16	2.29
PLUTONIUM-239+240	7.17E-18	1.65E-17	4.96E-17	0.9
RADIUM-226	2.8E-17	9.4E-17	1.9E-16	3.51
RADIUM-228	-3.9E-17	2.3E-16	8.0E-16	14.5
STRONTIUM-90	7.2E-17	1.9E-16	4.5E-16	8.17
THORIUM-228	5.5E-17	5.0E-17	1.2E-16	2.23
THORIUM-230	2.4E-16	6.6E-17	2.6E-16	4.71
THORIUM-232	8.3E-17	3.9E-17	1.1E-16	1.96

CARLSBAD, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-8.75E-18	1.20E-17	6.94E-17
CESIUM-137	1.1E-16	2.4E-16	5.3E-16
PLUTONIUM-238	-5.47E-19	4.37E-18	1.25E-16
PLUTONIUM-239+240	-2.19E-18	1.15E-17	4.92E-17
RADIUM-226	4.9E-17	9.3E-17	1.9E-16
RADIUM-228	-1.0E-16	2.4E-16	7.9E-16
STRONTIUM-90	1.1E-17	1.7E-16	4.5E-16
THORIUM-228	1.1E-16	6.0E-17	1.2E-16
THORIUM-230	3.1E-16	7.7E-17	2.6E-16
THORIUM-232	1.2E-16	4.9E-17	1.1E-16

HOBBS, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-4.81E-18	1.86E-17	8.12E-17
CESIUM-137	-7.8E-17	2.6E-16	6.2E-16
PLUTONIUM-238	2.40E-18	7.21E-18	1.46E-16
PLUTONIUM-239+240	-2.40E-18	1.32E-17	5.76E-17
RADIUM-226	3.0E-17	1.0E-16	2.2E-16
RADIUM-228	1.9E-16	2.7E-16	9.3E-16
STRONTIUM-90	3.0E-17	2.0E-16	5.2E-16
THORIUM-228	9.0E-17	5.4E-17	1.4E-16
THORIUM-230	2.5E-16	6.0E-17	3.0E-16
THORIUM-232	9.0E-17	3.6E-17	1.3E-16

LOVING, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-8.29E-18	1.33E-17	7.02E-17
CESIUM-137	-3.9E-17	3.3E-16	5.4E-16
PLUTONIUM-238	6.08E-18	1.11E-17	1.27E-16
PLUTONIUM-239+240	-4.42E-18	1.11E-17	4.98E-17
RADIUM-226	-5.5E-18	1.0E-16	1.9E-16
RADIUM-228	-5.0E-17	2.3E-16	8.0E-16
STRONTIUM-90	7.2E-17	2.0E-16	4.5E-16
THORIUM-228	7.2E-17	5.0E-17	1.2E-16
THORIUM-230	2.9E-16	6.1E-17	2.6E-16
THORIUM-232	1.0E-16	3.9E-17	1.1E-16

TABLE A2. RADIOCHEMICAL DATA FROM COMMUNITY AIR SAMPLES. SECOND QUARTER 1991.

ARTESIA, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	3.94E-18	1.64E-17	8.35E-17
CESIUM-137	-6.6E-18	3.0E-16	6.4E-16
PLUTONIUM-238	1.77E-17	2.04E-17	1.50E-16
PLUTONIUM-239+240	-8.54E-18	9.20E-18	5.91E-17
RADIUM-226	3.3E-17	7.2E-17	2.3E-16
RADIUM-228	2.4E-16	1.9E-16	9.5E-16
STRONTIUM-90	2.9E-16	4.1E-16	5.4E-16
THORIUM-228	9.2E-17	1.2E-16	1.5E-16
THORIUM-230	2.0E-16	1.3E-16	3.1E-16
THORIUM-232	1.6E-16	1.2E-16	1.3E-16

CARLSBAD, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-4.58E-18	5.73E-18	7.27E-17
CESIUM-137	-7.4E-17	2.3E-16	5.6E-16
PLUTONIUM-238	-2.86E-18	1.20E-17	1.31E-16
PLUTONIUM-239+240	-7.45E-18	8.02E-18	5.15E-17
RADIUM-226	1.7E-17	6.3E-17	2.0E-16
RADIUM-228	1.7E-16	1.7E-16	8.3E-16
STRONTIUM-90	-5.7E-18	1.7E-16	4.7E-16
THORIUM-228	9.7E-17	6.3E-17	1.3E-16
THORIUM-230	2.3E-16	8.6E-17	2.7E-16
THORIUM-232	6.9E-17	4.6E-17	1.1E-16

HOBBS, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-1.43E-18	6.41E-18	9.05E-17
CESIUM-137	5.7E-17	3.4E-16	6.9E-16
PLUTONIUM-238	-2.85E-18	1.57E-17	1.63E-16
PLUTONIUM-239+240	-9.98E-18	9.98E-18	6.41E-17
RADIUM-226	2.9E-17	7.8E-17	2.5E-16
RADIUM-228	3.4E-16	2.3E-16	1.0E-15
STRONTIUM-90	2.2E-16	2.9E-16	5.8E-16
THORIUM-228	5.7E-17	6.4E-17	1.6E-16
THORIUM-230	2.9E-16	1.2E-16	3.4E-16
THORIUM-232	9.3E-17	7.1E-17	1.4E-16

LOVING, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	3.43E-18	1.17E-17	8.71E-17
CESIUM-137	1.0E-16	3.0E-16	6.7E-16
PLUTONIUM-238	-2.74E-18	1.44E-17	1.57E-16
PLUTONIUM-239+240	-6.86E-18	1.03E-17	6.18E-17
RADIUM-226	1.4E-17	7.5E-17	2.4E-16
RADIUM-228	4.2E-16	2.2E-16	9.9E-16
STRONTIUM-90	2.5E-16	3.1E-16	5.6E-16
THORIUM-228	7.5E-17	5.5E-17	1.5E-16
THORIUM-230	3.2E-16	9.6E-17	3.2E-16
THORIUM-232	1.2E-16	6.2E-17	1.3E-16

TABLE A3. RADIOCHEMICAL DATA FROM COMMUNITY AIR SAMPLES. THIRD QUARTER 1991.

ARTESIA, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	1.04E-17	1.76E-17	1.32E-16
CESIUM-137	0.0E+00	2.0E-15	1.0E-15
PLUTONIUM-238	-3.11E-18	1.14E-17	2.37E-16
PLUTONIUM-239+240	0.00E+00	2.07E-18	9.32E-17
RADIUM-226	1.0E-17	1.7E-16	3.6E-16
RADIUM-228	-2.8E-16	5.3E-16	1.5E-15
STRONTIUM-90	-1.1E-16	2.0E-16	8.5E-16
THORIUM-228	3.1E-17	3.1E-17	2.3E-16
THORIUM-230	1.6E-16	6.2E-17	4.9E-16
THORIUM-232	0.0E+00	1.0E-17	2.0E-16

CARLSBAD, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-1.57E-18	2.35E-18	9.95E-17
CESIUM-137	0.0E+00	1.1E-15	7.6E-16
PLUTONIUM-238	-2.35E-18	9.40E-18	1.79E-16
PLUTONIUM-239+240	-7.83E-19	2.35E-18	7.05E-17
RADIUM-226	4.7E-17	1.2E-16	2.7E-16
RADIUM-228	4.7E-17	4.1E-16	1.1E-15
STRONTIUM-90	8.6E-17	2.4E-16	6.4E-16
THORIUM-228	7.8E-17	3.9E-17	1.7E-16
THORIUM-230	7.8E-17	4.7E-17	3.7E-16
THORIUM-232	2.4E-17	2.4E-17	1.5E-16

HOBBS, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-5.94E-19	1.19E-18	7.54E-17
CESIUM-137	0.0E+00	9.5E-16	5.8E-16
PLUTONIUM-238	-1.78E-18	6.53E-18	1.36E-16
PLUTONIUM-239+240	0.00E+00	1.19E-18	5.34E-17
RADIUM-226	2.4E-17	9.5E-17	2.1E-16
RADIUM-228	3.4E-16	4.3E-16	8.6E-16
STRONTIUM-90	-4.8E-17	1.8E-16	4.9E-16
THORIUM-228	1.8E-17	1.8E-17	1.3E-16
THORIUM-230	5.9E-17	3.0E-17	2.8E-16
THORIUM-232	2.4E-17	1.8E-17	1.2E-16

LOVING, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	2.59E-18	7.14E-18	8.24E-17
CESIUM-137	0.0E+00	1.0E-15	6.3E-16
PLUTONIUM-238	2.59E-18	1.10E-17	1.49E-16
PLUTONIUM-239+240	0.00E+00	1.30E-18	5.84E-17
RADIUM-226	3.2E-17	1.0E-16	2.3E-16
RADIUM-228	3.2E-17	3.8E-16	9.4E-16
STRONTIUM-90	3.2E-17	1.8E-16	5.3E-16
THORIUM-228	1.9E-17	1.9E-17	1.4E-16
THORIUM-230	1.3E-16	4.5E-17	3.1E-16
THORIUM-232	2.6E-17	1.9E-17	1.3E-16

TABLE A4. RADIOCHEMICAL DATA FROM COMMUNITY AIR SAMPLES. FOURTH QUARTER 1991.

ARTESIA, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	4.58E-18	6.54E-18	8.30E-17
CESIUM-137	0.0E+00	1.9E-16	6.3E-16
PLUTONIUM-238	-1.57E-17	1.90E-17	1.50E-16
PLUTONIUM-239+240	3.27E-18	3.92E-18	5.88E-17
RADIUM-226	1.3E-17	1.2E-16	2.3E-16
RADIUM-228	3.0E-16	3.4E-16	9.5E-16
STRONTIUM-90	1.3E-16	2.2E-16	5.3E-16
THORIUM-228	1.3E-17	2.6E-17	1.5E-16
THORIUM-230	1.9E-16	5.9E-17	3.1E-16
THORIUM-232	3.3E-17	2.0E-17	1.3E-16

CARLSBAD, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-5.85E-19	2.34E-18	7.44E-17
CESIUM-137	0.0E+00	1.6E-16	5.7E-16
PLUTONIUM-238	-1.41E-17	1.70E-17	1.34E-16
PLUTONIUM-239+240	0.00E+00	5.85E-19	5.27E-17
RADIUM-226	9.4E-17	1.1E-16	2.1E-16
RADIUM-228	1.8E-16	3.5E-16	8.5E-16
STRONTIUM-90	5.9E-17	1.8E-16	4.8E-16
THORIUM-228	3.5E-17	2.9E-17	1.3E-16
THORIUM-230	1.2E-16	4.7E-17	2.8E-16
THORIUM-232	1.2E-17	1.2E-17	1.1E-16

HOBBS, NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	0.00E+00	7.57E-18	8.01E-17
CESIUM-137	0.0E+00	2.0E-16	6.1E-16
PLUTONIUM-238	-7.57E-18	1.96E-17	1.45E-16
PLUTONIUM-239+240	1.89E-18	3.16E-18	5.68E-17
RADIUM-226	1.9E-17	1.1E-16	2.2E-16
RADIUM-228	3.8E-17	3.0E-16	9.1E-16
STRONTIUM-90	1.3E-16	2.1E-16	5.2E-16
THORIUM-228	6.3E-18	2.5E-17	1.4E-16
THORIUM-230	2.5E-16	6.9E-17	3.0E-16
THORIUM-232	5.7E-17	3.2E-17	1.2E-16

LOVING,NEW MEXICO

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	0.00E+00	3.51E-18	7.43E-17
CESIUM-137	0.0E+00	1.8E-16	5.7E-16
PLUTONIUM-238	-1.58E-17	1.70E-17	1.34E-16
PLUTONIUM-239+240	7.61E-18	7.61E-18	5.27E-17
RADIUM-226	7.6E-17	1.1E-16	2.1E-16
RADIUM-228	1.1E-16	3.0E-16	8.5E-16
STRONTIUM-90	-5.9E-17	2.1E-16	4.8E-16
THORIUM-228	1.2E-17	2.3E-17	1.3E-16
THORIUM-230	4.1E-16	8.8E-17	2.8E-16
THORIUM-232	3.5E-17	2.3E-17	1.1E-16

TABLE A5. RADIONUCLIDE DATA FROM WIPP SITE AIR SAMPLES. FIRST QUARTER 1991.

S1-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	0.00E+00	2.12E-17	8.98E-17
CESIUM-137	-9.9E-17	3.3E-16	6.9E-16
PLUTONIUM-238	0.00E+00	5.65E-18	1.62E-16
PLUTONIUM-239+240	-5.65E-18	1.41E-17	6.36E-17
RADIUM-226	3.5E-17	1.2E-16	2.5E-16
RADIUM-228	1.4E-17	2.6E-16	1.0E-15
STRONTIUM-90	-7.1E-17	2.5E-16	5.8E-16
THORIUM-228	1.1E-16	8.5E-17	1.6E-16
THORIUM-230	2.8E-16	9.9E-17	3.3E-16
THORIUM-232	5.7E-17	4.9E-17	1.4E-16

S2-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	1.79E-18	3.31E-17	1.14E-16
CESIUM-137	-3.6E-17	4.7E-16	8.7E-16
PLUTONIUM-238	3.58E-18	1.16E-17	2.05E-16
PLUTONIUM-239+240	-7.16E-18	1.79E-17	8.05E-17
RADIUM-226	2.7E-17	1.5E-16	3.1E-16
RADIUM-228	-2.0E-16	3.8E-16	1.3E-15
STRONTIUM-90	1.6E-16	3.0E-16	7.3E-16
THORIUM-228	1.8E-16	8.9E-17	2.0E-16
THORIUM-230	5.2E-16	1.2E-16	4.2E-16
THORIUM-232	1.8E-16	7.2E-17	1.8E-16

S3-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-1.31E-17	3.82E-17	1.18E-16
CESIUM-137	-6.5E-17	4.9E-16	9.1E-16
PLUTONIUM-238	-1.87E-18	7.46E-18	2.14E-16
PLUTONIUM-239+240	-7.46E-18	1.87E-17	8.39E-17
RADIUM-226	0.0E+00	1.6E-16	3.3E-16
RADIUM-228	1.9E-16	3.6E-16	1.4E-15
STRONTIUM-90	-4.7E-17	3.1E-16	7.6E-16
THORIUM-228	1.5E-16	1.1E-16	2.1E-16
THORIUM-230	2.2E-16	1.0E-16	4.4E-16
THORIUM-232	1.1E-16	7.5E-17	1.8E-16

TABLE A6. RADIONUCLIDE DATA FROM WIPP SITE AIR SAMPLES. SECOND QUARTER 1991.

S1-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	6.88E-18	1.55E-17	7.28E-17
CESIUM-137	-4.6E-17	2.3E-17	5.6E-16
PLUTONIUM-238	8.03E-18	1.55E-17	1.31E-16
PLUTONIUM-239+240	-4.01E-18	9.17E-18	5.16E-17
RADIUM-226	1.7E-17	6.3E-17	2.0E-16
RADIUM-228	1.6E-16	1.9E-16	8.3E-16
STRONTIUM-90	1.8E-16	2.5E-16	4.7E-16
THORIUM-228	1.8E-16	8.0E-17	1.3E-16
THORIUM-230	2.8E-16	9.2E-17	2.7E-16
THORIUM-232	4.0E-17	3.4E-17	1.1E-16

S2-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-3.36E-18	7.55E-18	1.07E-16
CESIUM-137	9.2E-17	3.4E-16	8.1E-16
PLUTONIUM-238	-6.71E-18	1.76E-17	1.92E-16
PLUTONIUM-239+240	-8.39E-18	1.26E-17	7.55E-17
RADIUM-226	5.0E-17	9.2E-17	2.9E-16
RADIUM-228	2.1E-16	3.0E-16	1.2E-15
STRONTIUM-90	-1.7E-16	4.0E-16	6.9E-16
THORIUM-228	1.5E-16	9.2E-17	1.9E-16
THORIUM-230	4.0E-16	1.5E-16	4.0E-16
THORIUM-232	1.1E-16	7.6E-17	1.6E-16

S3-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-1.33E-18	6.01E-18	8.48E-17
CESIUM-137	-1.1E-16	3.1E-16	6.5E-16
PLUTONIUM-238	8.68E-18	1.87E-17	1.53E-16
PLUTONIUM-239+240	1.27E-17	1.40E-17	6.01E-17
RADIUM-226	4.7E-17	7.3E-17	2.3E-16
RADIUM-228	1.7E-16	2.1E-16	9.7E-16
STRONTIUM-90	1.8E-16	3.3E-16	5.5E-16
THORIUM-228	4.7E-17	4.7E-17	1.5E-16
THORIUM-230	1.9E-16	9.3E-17	3.1E-16
THORIUM-232	4.7E-17	4.7E-17	1.3E-16

TABLE A7. RADIONUCLIDE DATA FROM WIPP SITE AIR SAMPLES. THIRD QUARTER 1991.

S1-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	7.04E-18	1.17E-17	7.45E-17
CESIUM-137	0.0E+00	1.1E-15	5.7E-16
PLUTONIUM-238	-1.76E-18	6.45E-18	1.34E-16
PLUTONIUM-239+240	0.00E+00	1.17E-18	5.28E-17
RADIUM-226	2.9E-17	9.4E-17	2.1E-16
RADIUM-228	1.5E-16	3.5E-16	8.5E-16
STRONTIUM-90	1.8E-16	1.9E-16	4.8E-16
THORIUM-228	4.7E-17	2.3E-17	1.3E-16
THORIUM-230	7.0E-17	2.9E-17	2.8E-16
THORIUM-232	2.3E-17	1.8E-17	1.1E-16

S2-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	2.55E-18	6.38E-18	8.10E-17
CESIUM-137	0.0E+00	1.1E-15	6.2E-16
PLUTONIUM-238	-2.55E-18	7.65E-18	1.46E-16
PLUTONIUM-239+240	0.00E+00	1.28E-18	5.74E-17
RADIUM-226	1.9E-17	1.0E-16	2.2E-16
RADIUM-228	1.8E-16	3.1E-16	9.2E-16
STRONTIUM-90	3.2E-17	2.1E-16	5.2E-16
THORIUM-228	3.8E-17	2.6E-17	1.4E-16
THORIUM-230	2.4E-16	6.4E-17	3.0E-16
THORIUM-232	4.5E-17	2.6E-17	1.3E-16

S3-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	0.00E+00	1.06E-18	6.74E-17
CESIUM-137	0.0E+00	1.0E-15	5.2E-16
PLUTONIUM-238	1.59E-18	8.49E-18	1.22E-16
PLUTONIUM-239+240	0.00E+00	1.06E-18	4.78E-17
RADIUM-226	5.3E-18	8.0E-17	1.9E-16
RADIUM-228	1.8E-16	4.1E-16	7.7E-16
STRONTIUM-90	1.2E-16	1.8E-16	4.3E-16
THORIUM-228	8.0E-17	3.2E-17	1.2E-16
THORIUM-230	1.3E-16	4.2E-17	2.5E-16
THORIUM-232	2.1E-17	1.6E-17	1.0E-16

TABLE A8. RADIOCHEMICAL DATA FROM WIPP SITE AIR SAMPLES. FOURTH QUARTER 1991.

S1-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	2.39E-18	5.38E-18	8.08E-17
CESIUM-137	0.0E+00	2.0E-16	6.2E-16
PLUTONIUM-238	-7.78E-18	1.85E-17	1.46E-16
PLUTONIUM-239+240	1.79E-18	3.59E-18	5.73E-17
RADIUM-226	6.0E-18	1.1E-16	2.2E-16
RADIUM-228	-1.7E-16	3.4E-16	9.2E-16
STRONTIUM-90	2.0E-16	1.9E-16	5.2E-16
THORIUM-228	1.2E-17	1.8E-17	1.4E-16
THORIUM-230	2.2E-16	5.4E-17	3.0E-16
THORIUM-232	1.2E-17	1.2E-17	1.2E-16

S2-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-5.75E-19	2.30E-18	7.31E-17
CESIUM-137	0.0E+00	1.5E-16	5.6E-16
PLUTONIUM-238	-1.50E-17	1.61E-17	1.32E-16
PLUTONIUM-239+240	0.00E+00	5.75E-19	5.18E-17
RADIUM-226	0.0E+00	1.0E-16	2.0E-16
RADIUM-228	4.0E-17	2.6E-16	8.3E-16
STRONTIUM-90	2.9E-17	1.8E-16	4.7E-16
THORIUM-228	4.6E-17	3.5E-17	1.3E-16
THORIUM-230	2.0E-16	5.8E-17	2.7E-16
THORIUM-232	2.9E-17	2.3E-17	1.1E-16

S3-WIPP SITE

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	-5.69E-19	2.85E-18	7.23E-17
CESIUM-137	0.0E+00	1.8E-16	5.5E-16
PLUTONIUM-238	-1.25E-17	1.71E-17	1.30E-16
PLUTONIUM-239+240	2.28E-18	3.98E-18	5.12E-17
RADIUM-226	5.7E-18	9.7E-17	2.0E-16
RADIUM-228	1.3E-16	2.4E-16	8.3E-16
STRONTIUM-90	4.6E-17	1.8E-16	4.7E-16
THORIUM-228	4.6E-17	2.8E-17	1.3E-16
THORIUM-230	1.8E-16	5.1E-17	2.7E-16
THORIUM-232	2.3E-17	1.7E-17	1.1E-16

TABLE A9. RADIOCHEMICAL DATA FROM SURFACE WATER SAMPLES

NUCLIDE	PECOS RIVER AT CARLSBAD 03/06/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	HILL TANK 01/08/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM 241	0.00E+00	1.00E-11	1.0E-11	AMERICIUM 241	2.00E-11	2.00E-11	3.0E-11
CESIUM 137	1.0E-10	6.0E-10	1.0E-09	CESIUM 137	0.0E+00	1.0E-09	1.0E-09
GROSS ALPHA	-4E-09	1E-08	2E-08	GROSS ALPHA	2E-09	2E-09	3E-09
GROSS BETA	1E-09	9E-09	1E-08	GROSS BETA	2E-08	3E-09	4E-09
PLUTONIUM 238	0.00E+00	2.00E-11	1.0E-11	PLUTONIUM 238	0.00E+00	1.00E-11	1.0E-11
PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11	PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11
RADIUM 226	2.0E-10	3.0E-10	2.0E-10	RADIUM 226	2.0E-10	2.0E-10	2.0E-10
RADIUM 228	1.0E-10	5.0E-10	8.0E-10	RADIUM 228	6.0E-10	8.0E-10	1.3E-09
STRONTIUM 90	-2.0E-10	4.0E-10	6.0E-10	STRONTIUM 90	1.0E-10	4.0E-10	7.0E-10
THORIUM 228	0.0E+00	1.0E-10	1.0E-10	THORIUM 228	1.0E-10	1.0E-10	1.0E-10
THORIUM 230	1.0E-10	1.0E-10	1.0E-10	THORIUM 230	2.0E-10	1.0E-10	1.0E-10
THORIUM 232	0.0E+00	1.0E-10	1.0E-10	THORIUM 232	1.0E-10	1.0E-10	1.0E-10
TRITIUM	2E-07	2E-07	3E-07	TRITIUM	2E-07	2E-07	3E-07
URANIUM 234	1.8E-09	3.0E-10	1.0E-10	URANIUM 234	1.0E-10	1.0E-10	1.0E-10
URANIUM 235	0.0E+00	1.0E-10	1.0E-10	URANIUM 235	0.0E+00	1.0E-10	1.0E-10
URANIUM 238	8.0E-10	2.0E-10	1.0E-10	URANIUM 238	1.0E-10	1.0E-10	1.0E-10

TABLE A9. RADIOCHEMICAL DATA FROM SURFACE WATER SAMPLES, continued.

NUCLIDE	NOYE TANK 01/08/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	RED TANK 01/08/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM 241	0.00E+00	1.00E-11	1.0E-11	AMERICIUM 241	0.00E+00	1.00E-11	1.0E-11
CESIUM 137	0.0E+00	1.0E-09	1.0E-09	CESIUM 137	0.0E+00	1.0E-09	1.0E-09
GROSS ALPHA	2E-09	2E-09	3E-09	GROSS ALPHA	2E-08	7E-09	6E-09
GROSS BETA	2E-08	3E-09	4E-09	GROSS BETA	3E-08	4E-09	5E-09
PLUTONIUM 238	1.00E-11	1.00E-11	1.0E-11	PLUTONIUM 238	0.00E+00	1.00E-11	1.0E-11
PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11	PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11
RADIUM 226	3.0E-10	2.0E-10	2.0E-10	RADIUM 226	9.0E-10	4.0E-10	1.0E-10
RADIUM 228	4.0E-10	8.0E-10	1.3E-09	RADIUM 228	4.0E-10	6.0E-10	9.0E-10
STRONTIUM 90	3.0E-10	4.0E-10	7.0E-10	STRONTIUM 90	2.0E-10	4.0E-10	6.0E-10
THORIUM 228	1.0E-10	1.0E-10	1.0E-10	THORIUM 228	4.0E-10	2.0E-10	1.0E-10
THORIUM 230	0.0E+00	1.0E-10	1.0E-10	THORIUM 230	4.0E-10	2.0E-10	1.0E-10
THORIUM 232	0.0E+00	1.0E-10	1.0E-10	THORIUM 232	3.0E-10	1.0E-10	1.0E-10
TRITIUM	1E-07	2E-07	3E-07	TRITIUM	2E-07	2E-07	3E-07
URANIUM 234	2.0E-10	1.0E-10	1.0E-10	URANIUM 234	3.0E-10	1.0E-10	1.0E-10
URANIUM 235	0.0E+00	1.0E-10	1.0E-10	URANIUM 235	0.0E+00	1.0E-10	1.0E-10
URANIUM 238	2.0E-10	1.0E-10	1.0E-10	URANIUM 238	2.0E-10	1.0E-10	1.0E-10

TABLE A9. RADIOCHEMICAL DATA FROM SURFACE WATER SAMPLES, continued.

NUCLIDE	LAGUNA GRANDE 11/01/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	INDIAN TANK 11/01/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM 241	1.00E-11	1.00E-11	1.0E-11	AMERICIUM 241	3.00E-11	4.00E-11	4.0E-11
CESIUM 137	0E+00	2E-09	2E-09	CESIUM 137	0E+00	1E-09	1E-09
GROSS ALPHA	1E-07	2E-06	3E-06	GROSS ALPHA	3E-09	2E-09	3E-09
GROSS BETA	2E-05	1E-06	4E-06	GROSS BETA	1E-08	3E-09	4E-09
PLUTONIUM 238	3.00E-11	5.00E-11	5.0E-11	PLUTONIUM 238	0.00E+00	1.00E-11	4.0E-11
PLUTONIUM 239+240	0.00E+00	1.00E-11	2.0E-11	PLUTONIUM 239+240	1.00E-11	1.00E-11	1.0E-11
RADIUM 226	3E-08	1E-09	2E-10	RADIUM 226	2.0E-10	3.0E-10	2.0E-10
RADIUM 228	1E-08	2E-09	2E-09	RADIUM 228	1.6E-09	1.3E-09	2.0E-09
STRONTIUM 90	1.2E-09	4.0E-10	7.0E-10	STRONTIUM 90	3.0E-10	4.0E-10	7.0E-10
THORIUM 228	1.6E-09	1.3E-09	1.1E-09	THORIUM 228	1.0E-10	1.0E-10	1.0E-10
THORIUM 230	3.0E-10	1.0E-09	3.0E-10	THORIUM 230	1.0E-10	1.0E-10	1.0E-10
THORIUM 232	0.0E+00	1.0E-10	3.0E-10	THORIUM 232	1.0E-10	1.0E-10	1.0E-10
TRITIUM	8E-08	1.6E-07	2.7E-07	TRITIUM	-3E-08	2E-07	3E-07
URANIUM 234	3E-08	1E-09	1E-10	URANIUM 234	2.0E-10	1.0E-10	1.0E-10
URANIUM 235	3.0E-10	1.0E-10	1.0E-10	URANIUM 235	0.0E+00	1.0E-10	1.0E-10
URANIUM 238	1E-08	1E-09	1E-10	URANIUM 238	1.0E-10	1.0E-10	1.0E-10

TABLE A9. RADIOCHEMICAL DATA FROM SURFACE WATER SAMPLES, continued.

NUCLIDE	RED LAKE 11/04/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	PECOS AT PIERCE CANYON 11/04/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM 241	0.00E+00	1.00E-11	5.0E-11	AMERICIUM 241	0.00E+00	1.00E-11	1.0E-11
CESIUM 137	0E+00	1E-09	2E-09	CESIUM 137	0E+00	1E-09	1E-09
GROSS ALPHA	8E-09	4E-09	4E-09	GROSS ALPHA	-2E-09	1E-08	2E-08
GROSS BETA	3E-08	4E-09	4E-09	GROSS BETA	-1E-09	2E-08	3E-08
PLUTONIUM 238	2.00E-11	3.00E-11	4.0E-11	PLUTONIUM 238	1.00E-11	1.00E-11	1.0E-11
PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11	PLUTONIUM 239+240	1.00E-11	1.00E-11	1.0E-11
RADIUM 226	0.0E+00	3.0E-10	2.0E-10	RADIUM 226	0.0E+00	3.0E-10	2.0E-10
RADIUM 228	1.0E-09	1.3E-09	2.0E-09	RADIUM 228	7.0E-10	1.7E-09	2.9E-09
STRONTIUM 90	0.0E+00	4.0E-10	7.0E-10	STRONTIUM 90	2.0E-10	3.0E-10	6.0E-10
THORIUM 228	3.0E-10	1.0E-10	1.0E-10	THORIUM 228	0.0E+00	1.0E-10	1.0E-10
THORIUM 230	3.0E-10	1.0E-10	1.0E-10	THORIUM 230	1.0E-10	1.0E-10	1.0E-10
THORIUM 232	2.0E-10	1.0E-10	1.0E-10	THORIUM 232	0.0E+00	1.0E-10	1.0E-10
TRITIUM	3E-08	2E-07	3E-07	TRITIUM	-4E-08	2E-07	3E-07
URANIUM 234	1.0E-10	1.0E-10	1.0E-10	URANIUM 234	4.6E-09	5.0E-10	1.0E-10
URANIUM 235	0.0E+00	1.0E-10	1.0E-10	URANIUM 235	0.0E+00	1.0E-10	1.0E-10
URANIUM 238	1.0E-10	1.0E-10	1.0E-10	URANIUM 238	2.2E-09	3.0E-10	1.0E-10

TABLE A10. RADIOCHEMICAL DATA FROM GROUNDWATER SAMPLES.

NUCLIDE	MILLS RANCH WELL 7/16/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	BARN WELL 7/18/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM 241	1.00E-11	2.00E-11	1.0E-11	AMERICIUM 241	2.00E-11	2.00E-11	2.0E-11
CESIUM 137	1.0E-10	6.0E-10	1.1E-09	CESIUM 137	0.0E+00	6.0E-10	9.0E-10
GROSS ALPHA	0E+00	2E-08	4E-08	GROSS ALPHA	5E-09	5E-09	8E-09
GROSS BETA	2E-09	2E-08	3E-08	GROSS BETA	5E-09	4E-09	6E-09
PLUTONIUM 238	0.00E+00	3.00E-11	1.0E-11	PLUTONIUM 238	-2.0E-11	2.00E-11	2.0E-11
PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11	PLUTONIUM 239+240	1.00E-11	2.00E-11	1.0E-11
RADIUM 226	1.0E-10	2.0E-10	1.0E-10	RADIUM 226	0.0E+00	2.0E-10	2.0E-10
RADIUM 228	1.0E-10	9.0E-10	1.4E-09	RADIUM 228	4.0E-10	7.0E-10	1.2E-09
STRONTIUM 90	6.0E-10	6.0E-10	1.0E-09	STRONTIUM 90	0.0E+00	6.0E-10	1.0E-09
THORIUM 228	0.0E+00	1.0E-10	1.0E-10	THORIUM 228	0.0E+00	1.0E-10	1.0E-10
THORIUM 230	4.0E-10	1.0E-10	1.0E-10	THORIUM 230	0.0E+00	1.0E-10	1.0E-10
THORIUM 232	0.0E+00	1.0E-10	1.0E-10	THORIUM 232	0.0E+00	1.0E-10	1.0E-10
TRITIUM	8E-08	1E-07	2E-07	TRITIUM	2E-08	1E-07	2E-07
URANIUM 234	8.8E-09	7.0E-10	4.0E-10	URANIUM 234	3.1E-09	4.0E-10	1.0E-10
URANIUM 235	1.0E-10	1.0E-10	1.0E-10	URANIUM 235	1.0E-10	1.0E-10	1.0E-10
URANIUM 238	3.4E-09	4.0E-10	1.0E-10	URANIUM 238	1.3E-09	2.0E-10	1.0E-10

TABLE A11. RADIOCHEMICAL DATA FROM WIPP EFFLUENT WATER SAMPLES.

NUCLIDE	WIPP STORMWATER 9/15/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	WIPP SEWAGE EFFLUENT 04/18/91 ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM 241	1.00E-11	2.00E-11	2.0E-11	AMERICIUM 241	0.00E+00	1.00E-11	1.0E-11
CESIUM 137	0.0E+00	1.0E-10	1.2E-09	CESIUM 137	0E+00	1E-09	1E-09
GROSS ALPHA	3E-09	2E-08	3E-09	GROSS ALPHA	1E-09	6E-09	1E-08
GROSS BETA	9E-09	3E-09	4E-09	GROSS BETA	5E-08	6E-09	7E-09
PLUTONIUM 238	0.00E+00	1.00E-11	1.0E-11	PLUTONIUM 238	0.00E+00	1.00E-11	1.0E-11
PLUTONIUM 239+240	1.00E-11	1.00E-11	2.0E-11	PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11
RADIUM 226	1.0E-10	3.0E-10	2.0E-10	RADIUM 226	2.0E-10	7.0E-10	2.0E-10
RADIUM 228	-7.0E-10	8.0E-10	1.4E-09	RADIUM 228	-6.0E-10	8.0E-10	1.3E-09
STRONTIUM 90	0.0E+00	5.0E-10	8.0E-10	STRONTIUM 90	-7.0E-10	8.0E-10	1.4E-09
THORIUM 228	0.0E+00	2.0E-10	1.0E-10	THORIUM 228	-1.0E-10	1.0E-10	1.0E-10
THORIUM 230	-1.0E-10	2.0E-10	1.0E-10	THORIUM 230	1.0E-10	1.0E-10	1.0E-10
THORIUM 232	-1.0E-10	1.0E-10	1.0E-10	THORIUM 232	0.0E+00	1.0E-10	1.0E-10
TRITIUM	1E-07	1E-07	2E-07	TRITIUM	0E+00	2E-07	3E-07
URANIUM 234	2.0E-10	1.0E-10	1.0E-10	URANIUM 234	5.0E-10	2.0E-10	1.0E-10
URANIUM 235	0.0E+00	1.0E-10	1.0E-10	URANIUM 235	0.0E+00	1.0E-10	1.0E-10
URANIUM 238	2.0E-10	1.0E-10	1.0E-10	URANIUM 238	3.0E-10	2.0E-10	1.0E-10

TABLE A12. RADIOCHEMICAL DATA FROM PUBLIC DRINKING WATER SAMPLES.

	WIPP WATER SUPPLY 10/30/91				LOVING WATER SUPPLY 10/30/91		
NUCLIDE	ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM-241	0.00E+00	1.00E-11	2.0E-11	AMERICIUM-241	0.00E+00	1.00E-11	1.0E-11
CESIUM-137	0.0E+00	1.0E-09	1.4E-09	CESIUM-137	0.0E+00	1.0E-09	1.5E-09
GROSS ALPHA	3E-09	2E-09	3E-09	GROSS ALPHA	4E-09	3E-09	4E-09
GROSS BETA	3E-09	2E-09	4E-09	GROSS BETA	3E-09	3E-09	5E-09
PLUTONIUM-238	2.00E-11	2.00E-11	2.0E-11	PLUTONIUM-238	2.00E-11	2.00E-11	3.0E-11
PLUTONIUM-239,240	0.00E+00	1.00E-11	1.0E-11	PLUTONIUM-239,240	0.00E+00	1.00E-11	1.0E-11
RADIUM-226	1.0E-10	2.0E-10	1.0E-10	RADIUM-226	1.0E-10	2.0E-10	1.0E-10
RADIUM-228	5.0E-10	7.0E-10	1.1E-09	RADIUM-228	8.0E-10	1.6E-09	2.6E-09
STRONTIUM-90	0.0E+00	4.0E-10	6.0E-10	STRONTIUM-90	3.0E-10	4.0E-10	7.0E-10
THORIUM-228	0.0E+00	1.0E-10	1.0E-10	THORIUM-228	0.0E+00	1.0E-10	1.0E-10
THORIUM-230	0.0E+00	1.0E-10	1.0E-10	THORIUM-230	0.0E+00	1.0E-10	1.0E-10
THORIUM-232	0.0E+00	1.0E-10	1.0E-10	THORIUM-232	0.0E+00	1.0E-10	1.0E-10
TRITIUM	-1E-08	2E-07	3E-07	TRITIUM	5E-08	2E-07	3E-07
URANIUM-233,234	1.2E-09	3.0E-10	1.0E-10	URANIUM-233,234	2.2E-09	4.0E-10	1.0E-10
URANIUM-235	0.0E+00	1.0E-10	1.0E-10	URANIUM-235	0.0E+00	1.0E-10	1.0E-10
URANIUM-238	5.0E-10	2.0E-10	1.0E-10	URANIUM-238	4.0E-10	2.0E-10	1.0E-10

TABLE A12. RADIOCEMICAL DATA FROM PUBLIC DRINKING WATER SAMPLES, continued.

	CARLSBAD WATER SUPPLY 03/06/91				OTIS WATER SUPPLY 03/06/91		
NUCLIDE	ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)	NUCLIDE	ACTIVITY (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
AMERICIUM 241	0.00E+00	1.00E-11	3.0E-09	AMERICIUM 241	0.00E+00	1.00E-11	1.0E-11
CESIUM 137	3.0E-10	5.0E-10	3.0E-09	CESIUM 137	1.0E-10	5.0E-10	9.0E-10
GROSS ALPHA	0E+00	3E-09	4E-09	GROSS ALPHA	0E+00	5E-09	8E-09
GROSS BETA	2E-09	2E-09	3E-09	GROSS BETA	3E-09	4E-09	7E-09
PLUTONIUM 238	5.00E-11	3.00E-11	3.0E-09	PLUTONIUM 238	1.00E-11	2.00E-11	1.0E-11
PLUTONIUM 239+240	0.00E+00	1.00E-11	3.0E-09	PLUTONIUM 239+240	0.00E+00	1.00E-11	1.0E-11
RADIUM 226	6.0E-10	4.0E-10	3.0E-09	RADIUM 226	2.0E-10	5.0E-10	2.0E-10
RADIUM 228	1.0E-10	5.0E-10	3.0E-09	RADIUM 228	7.0E-10	5.0E-10	8.0E-10
STRONTIUM 90	5.0E-10	4.0E-10	3.0E-09	STRONTIUM 90	1.0E-10	4.0E-10	7.0E-10
THORIUM 228	0.0E+00	1.0E-10	3.0E-09	THORIUM 228	0.0E+00	1.0E-10	1.0E-10
THORIUM 230	0.0E+00	1.0E-10	3.0E-09	THORIUM 230	0.0E+00	1.0E-10	1.0E-10
THORIUM 232	0.0E+00	1.0E-10	3.0E-09	THORIUM 232	0.0E+00	1.0E-10	1.0E-10
TRITIUM	5E-08	2E-07	3E-07	TRITIUM	-8E-08	2E-07	3E-07
URANIUM 234	7.0E-10	2.0E-10	3.0E-09	URANIUM 234	2.9E-09	4.0E-10	1.0E-10
URANIUM 235	0.0E+00	1.0E-10	3.0E-09	URANIUM 235	1.0E-10	1.0E-10	1.0E-10
URANIUM 238	2.0E-10	2.0E-10	3.0E-09	URANIUM 238	8.0E-10	2.0E-10	1.0E-10

TABLE A13. RADIOCHEMICAL DATA FROM WIPP UNDERGROUND EFFLUENT AIR SAMPLES.

WIPP STATION A. EFFLUENT AIR
FOURTH QUARTER 1991

NUCLIDE	ACTIVITY uCi/ml	COUNTING ERROR uCi/ml	LLD uCi/ml
AMERICIUM-241	7.02E-18	1.55E-17	1.78E-16
CESIUM-137	0.0E+00	4.6E-16	1.4E-15
PLUTONIUM-238	9.83E-18	5.62E-17	3.22E-16
PLUTONIUM-239+240	0.00E+00	1.40E-18	1.26E-16
RADIUM-226	-1.1E-16	2.5E-16	4.9E-16
RADIUM-228	1.3E-16	8.3E-16	2.0E-15
STRONTIUM-90	2.2E-16	7.0E-16	1.1E-15
THORIUM-228	2.8E-17	5.6E-17	3.1E-16
THORIUM-230	1.5E-16	8.4E-17	6.6E-16
THORIUM-232	2.8E-17	2.8E-17	2.8E-16

TABLE A14. RADIOCHEMICAL DATA FROM BIOTA SAMPLES 1991.

	ALFALFA HAY BRANTLEY FARMS JUNE 1991.		
NUCLIDE	ACTIVITY (uCi/g)	COUNTING ERROR (uCi/g)	LLD-C (uCi/g)
AMERICIUM-241	0.00E+00	1.00E-11	1.00E-11
CESIUM-137	0.0E+00	1.0E-10	1.0E-10
PLUTONIUM-238	0.00E+00	1.00E-11	1.00E-11
PLUTONIUM-239+24	0.00E+00	1.00E-11	1.00E-11

TABLE A15. RADIOCHEMICAL DATA FROM SOIL SAMPLES

100 METERS NORTHWEST OF WIPP METEROLOGICAL TOWER
04/18/91

NUCLIDE	ACTIVI (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
CESIUM-137	0.0E+00	1.0E-07	1.0E-07
GROSS ALPHA	0E+00	6E-06	1E-05
GROSS BETA	9E-06	5E-06	7E-06
PLUTONIUM-238	0.00E+0	1.00E-08	1.00E-08
PLUTONIUM-239+240	0.00E+0	1.00E-08	1.00E-08
STRONTIUM-90	1.4E-06	9.0E-07	1.4E-06
THORIUM-228	4.0E-07	1.0E-07	1.0E-07
THORIUM-230	3.0E-07	1.0E-07	1.0E-07
THORIUM-232	4.0E-07	1.0E-07	1.0E-07
URANIUM-233+234	2.0E-07	1.0E-07	1.0E-07
URANIUM-235	0.0E+00	1.0E-07	1.0E-07
URANIUM-238	2.0E-07	1.0E-07	1.0E-07

100 METERS NORTHEAST OF WIPP WELL H2C
04/18/91

NUCLIDE	ACTIVI (uCi/ml)	COUNTING ERROR (uCi/ml)	LLD-C (uCi/ml)
CESIUM-137	0.0E+00	1.0E-07	1.0E-07
GROSS ALPHA	3E-06	6E-06	1E-05
GROSS BETA	9E-06	5E-06	7E-06
PLUTONIUM-238	0.00E+0	1.00E-08	1.00E-08
PLUTONIUM-239+240	0.00E+0	1.00E-08	1.00E-08
STRONTIUM-90	2.0E-07	4.0E-07	7.0E-07
THORIUM-228	4.0E-07	1.0E-07	1.0E-07
THORIUM-230	6.0E-07	2.0E-07	1.0E-07
THORIUM-232	4.0E-07	1.0E-07	1.0E-07
URANIUM-233+234	3.0E-07	1.0E-07	1.0E-07
URANIUM-235	0.0E+00	1.0E-07	1.0E-07
URANIUM-238	3.0E-07	1.0E-07	1.0E-07

APPENDIX B

TABLE B2. LVAS SITE: CARLSBAD, NEW MEXICO

SAMPLE DATE	GROSS ALPHA (CPM)	GROSS ALPHA BKG. (CPM)	GROSS BETA (CPM)	GROSS BETA BKG. (CPM)	SAMPLE VOL. (m3)	ALP EFF.	BET EFF.	SAMPLE WEIGHT (g)	NET ALPHA (uCi/ml)	NET BETA (uCi/ml)
01/03/91	1.83	0.33	180.50	155.03	1212	0.23	0.34	0.0352	2.42E-15	2.78E-14
01/10/91	1.47	0.13	170.53	154.33	1434	0.23	0.34	0.0194	1.83E-15	1.5E-14
01/17/91	1.37	0.13	177.03	154.33	1424	0.23	0.34	0.0271	1.7E-15	2.11E-14
01/25/91	1.73	0.33	169.00	134.97	1613	0.23	0.34	0.0286	1.7E-15	2.8E-14
01/31/91	2.30	0.23	170.60	139.67	1235	0.23	0.34	0.0314	3.28E-15	3.32E-14
02/07/91	3.07	0.20	189.33	154.27	1433	0.23	0.34	0.0431	3.92E-15	3.24E-14
02/14/91	2.50	0.23	183.30	145.23	1400	0.23	0.34	0.0450	3.17E-15	3.6E-14
02/21/91	1.50	0.40	163.13	143.33	1458	0.23	0.34	0.0516	1.48E-15	1.8E-14
02/28/91	1.77	0.37	135.10	98.07	1400	0.23	0.34	0.0492	1.96E-15	3.5E-14
03/05/91	0.63	0.17	147.67	143.33	1002	0.23	0.34	0.0188	8.99E-16	5.74E-15
03/14/91	1.07	0.50	164.50	137.37	1869	0.23	0.34	0.1304	5.97E-16	1.92E-14
03/22/91	1.70	0.30	156.23	110.00	1609	0.23	0.34	0.0780	1.7E-15	3.81E-14
03/28/91	0.90	0.40	156.73	142.60	1209	0.23	0.34	0.0639	8.1E-16	1.55E-14
04/11/91	3.93	0.30	172.57	133.80	1865	0.24	0.34	0.0668	3.65E-15	2.75E-14
04/18/91	2.90	0.27	156.43	137.97	1428	0.24	0.34	0.0595	3.46E-15	1.71E-14
04/25/91	2.87	0.23	156.73	134.57	1419	0.24	0.34	0.0674	3.49E-15	2.07E-14
05/02/91	2.03	0.30	148.10	132.33	1431	0.24	0.34	0.0942	2.27E-15	1.46E-14
05/09/91	2.87	0.33	152.60	132.30	1420	0.24	0.34	0.0769	3.36E-15	1.89E-14
05/16/91	1.87	0.33	157.03	132.30	1422	0.24	0.34	0.0792	2.03E-15	2.3E-14
05/24/91	1.63	0.23	144.20	127.53	1595	0.24	0.34	0.0631	1.65E-15	1.38E-14
05/31/91	2.17	0.27	148.17	126.90	1465	0.24	0.34	0.0560	2.43E-15	1.92E-14
06/06/91	1.80	0.27	143.33	126.90	1237	0.24	0.34	0.0516	2.32E-15	1.76E-14
06/13/91	1.53	0.17	138.00	124.63	1384	0.24	0.34	0.0383	1.84E-15	1.28E-14
06/19/91	1.63	0.17	136.37	124.63	1198	0.24	0.34	0.0514	2.29E-15	1.3E-14
06/27/91	1.67	0.13	154.43	129.27	1594	0.23	0.33	0.0809	1.89E-15	2.16E-14
07/05/91	1.87	0.33	156.90	140.77	1831	0.23	0.33	0.0645	1.64E-15	1.2E-14
07/11/91	1.73	0.17	131.87	108.67	1221	0.23	0.33	0.0337	2.51E-15	2.59E-14
08/09/91	1.93	0.20	160.07	143.93	1568	0.23	0.33	0.0421	2.16E-15	1.4E-14
08/16/91	1.33	0.33	148.90	138.23	1404	0.23	0.33	0.0188	1.39E-15	1.04E-14
08/23/91	2.53	0.30	160.17	143.10	1441	0.23	0.33	0.0359	3.04E-15	1.62E-14
08/30/91	2.07	0.27	162.50	145.07	1403	0.23	0.33	0.0423	2.51E-15	1.7E-14
09/05/91	1.67	0.27	165.03	141.20	1071	0.23	0.33	0.0292	2.56E-15	3.04E-14
09/19/91	1.00	0.20	152.90	150.17	1451	0.23	0.33	0.0269	1.08E-15	2.57E-15
09/26/91	1.83	0.30	158.43	142.73	1375	0.23	0.33	0.0522	2.18E-15	1.56E-14
10/03/91	4.67	0.20	155.77	129.03	1417	0.23	0.34	0.0593	6.17E-15	2.5E-14
10/11/91	4.87	0.40	168.77	127.33	1655	0.23	0.34	0.0904	5.29E-15	3.32E-14
10/18/91	5.53	0.27	173.33	130.47	1414	0.23	0.34	0.1081	7.29E-15	4.02E-14
10/24/91	3.57	0.37	157.77	129.97	1218	0.23	0.34	0.0898	5.15E-15	3.02E-14
11/01/91	3.87	0.13	160.67	131.93	1672	0.23	0.34	0.0625	4.37E-15	2.28E-14
11/07/91	4.33	0.17	163.10	129.97	1201	0.23	0.34	0.0464	6.8E-15	3.66E-14
11/15/91	6.10	0.40	171.27	127.80	1608	0.23	0.34	0.0411	6.94E-15	3.58E-14
11/22/91	2.60	0.27	156.17	140.83	1432	0.23	0.34	0.0234	3.19E-15	1.42E-14
11/27/91	2.43	0.20	152.63	137.93	1000	0.23	0.34	0.0350	4.38E-15	1.95E-14
12/06/91	4.07	0.23	175.87	141.73	1796	0.23	0.34	0.0636	4.18E-15	2.52E-14
12/13/91	3.10	0.33	167.23	141.10	1447	0.23	0.34	0.0447	3.74E-15	2.39E-14
12/19/91	2.27	0.33	155.53	141.10	1221	0.23	0.34	0.0256	3.1E-15	1.57E-14

TABLE B3. LVAS SITE: HOBBS, NEW MEXICO

SAMPLE DATE	GROSS ALPHA (CPM)	GROSS ALPHA BKG. (CPM)	GROSS BETA (CPM)	GROSS BETA BKG. (CPM)	SAMPLE VOL. (m3)	ALP EFF.	BET EFF.	SAMPLE WEIGHT (g)	NET ALPHA (uCi/ml)	NET BETA (uCi/ml)
01/15/91	1.57	0.13	167.17	154.33	1427	0.23	0.34	0.0253	1.98E-15	1.19E-14
01/22/91	1.33	0.33	153.97	134.97	1423	0.23	0.34	0.0176	1.38E-15	1.77E-14
01/29/91	1.90	0.33	171.80	134.97	1428	0.23	0.34	0.0269	2.15E-15	3.42E-14
02/05/91	2.93	0.20	194.53	154.27	1424	0.23	0.34	0.0342	3.75E-15	3.74E-14
02/12/91	2.97	0.23	174.23	145.23	1373	0.23	0.34	0.0428	3.91E-15	2.80E-14
02/19/91	1.80	0.23	160.07	145.23	1424	0.23	0.34	0.0574	2.16E-15	1.38E-14
02/26/91	1.67	0.20	157.73	132.50	1440	0.23	0.34	0.0385	2.00E-15	2.32E-14
03/04/91	1.13	0.17	158.63	143.33	1230	0.23	0.34	0.0392	1.53E-15	1.65E-14
03/12/91	1.67	0.23	164.10	140.53	1646	0.23	0.34	0.0668	1.71E-15	1.90E-14
03/19/91	1.70	0.50	152.13	137.37	1419	0.23	0.34	0.0792	1.66E-15	1.38E-14
03/26/91	0.96	0.30	121.17	110.00	1401	0.23	0.34	0.0410	9.23E-16	1.06E-14
04/16/91	2.50	0.30	157.37	133.80	1229	0.24	0.34	0.0398	3.36E-15	2.54E-14
04/23/91	3.33	0.23	151.00	134.57	1408	0.24	0.34	0.0503	4.13E-15	1.55E-14
04/30/91	2.50	0.23	150.47	134.57	1438	0.24	0.34	0.0644	2.96E-15	1.46E-14
05/07/91	2.60	0.30	149.37	132.33	1424	0.24	0.34	0.0541	3.03E-15	1.58E-14
05/14/91	2.00	0.33	145.77	132.30	1419	0.24	0.34	0.0511	2.21E-15	1.26E-14
05/21/91	2.07	0.23	140.40	127.53	1424	0.24	0.34	0.0484	2.43E-15	1.20E-14
05/28/91	2.17	0.23	145.40	121.80	1431	0.24	0.34	0.0323	2.54E-15	2.18E-14
06/04/91	1.50	0.27	146.13	126.90	1434	0.24	0.34	0.0487	1.61E-15	1.78E-14
06/19/91	2.07	0.40	155.10	135.50	1644	0.24	0.34	0.0492	1.91E-15	1.58E-14
06/25/91	1.20	0.40	147.03	135.50	1181	0.24	0.34	0.0480	1.27E-15	1.29E-14
07/02/91	1.77	0.33	155.60	140.77	1445	0.23	0.33	0.0374	1.94E-15	1.40E-14
07/16/91	2.17	0.17	133.73	108.67	1412	0.23	0.33	0.0519	2.77E-15	2.42E-14
07/23/91	2.53	0.17	145.23	122.50	1439	0.23	0.33	0.0483	3.21E-15	2.16E-14
07/30/91	2.53	0.20	N/A	N/A	1374	0.23	N/A	0.0349	3.33E-15	N/A
08/07/91	3.03	0.20	170.13	143.93	1648	0.23	0.33	0.0448	3.37E-15	2.17E-14
08/13/91	1.30	0.33	146.33	143.50	1205	0.23	0.33	0.0238	1.57E-15	3.21E-15
08/21/91	2.57	0.30	169.90	143.10	1627	0.23	0.33	0.0346	2.73E-15	2.25E-14
08/27/91	2.77	0.20	170.03	143.80	1252	0.23	0.33	0.0397	4.01E-15	2.86E-14
09/04/91	2.00	0.27	160.03	141.20	1601	0.23	0.33	0.0442	2.12E-15	1.61E-14
09/09/91	0.83	0.43	154.37	141.70	1015	0.23	0.33	0.0145	7.72E-16	1.70E-14
09/17/91	1.10	0.10	153.00	144.03	1624	0.23	0.33	0.0310	1.21E-15	7.54E-15
09/23/91	0.73	0.27	151.83	141.50	1199	0.23	0.33	0.0183	7.62E-16	1.18E-14
10/02/91	2.53	0.30	175.20	142.73	1824	0.23	0.33	0.0730	2.40E-15	2.43E-14
10/09/91	5.90	0.17	154.33	124.23	1464	0.23	0.34	0.0468	7.67E-15	2.72E-14
10/15/91	5.80	0.40	165.40	127.33	1193	0.23	0.34	0.0619	8.87E-15	4.23E-14
10/22/91	5.93	0.27	169.10	130.47	1405	0.23	0.34	0.0720	7.90E-15	3.64E-14
10/29/91	2.33	0.40	148.23	127.13	1434	0.23	0.34	0.0513	2.64E-15	1.95E-14
11/05/91	5.70	0.13	169.53	131.93	1414	0.23	0.34	0.0270	7.71E-15	3.52E-14
11/12/91	6.23	0.17	165.50	132.50	1427	0.23	0.34	0.0442	8.33E-15	3.06E-14
11/19/91	2.17	0.33	148.27	133.17	1412	0.23	0.34	0.0204	2.54E-15	1.42E-14
11/25/91	1.97	0.27	155.57	140.83	1213	0.23	0.34	0.0219	2.74E-15	1.61E-14
12/03/91	3.53	0.23	169.07	141.73	1647	0.23	0.34	0.0469	3.92E-15	2.20E-14
12/10/91	3.97	0.17	177.80	132.33	1416	0.23	0.34	0.0446	5.26E-15	4.25E-14

TABLE B4. LVAS SITE: LOVING, NEW MEXICO

SAMPLE DATE	GROSS ALPHA (CPM)	GROSS ALPHA BKG. (CPM)	GROSS BETA (CPM)	GROSS BETA BKG. (CPM)	SAMPLE VOL. (m3)	ALP EFF.	BET EFF.	SAMPLE WEIGHT (g)	NET ALPHA (uCi/ml)	NET BETA (uCi/ml)
01/03/91	1.90	0.33	163.33	142.23	1211	0.23	0.34	0.0287	2.54E-15	2.31E-14
01/10/91	1.50	0.33	180.00	155.03	1400	0.23	0.34	0.0165	1.64E-15	2.36E-14
01/17/91	1.43	0.13	179.37	154.33	1302	0.23	0.34	0.0281	1.96E-15	2.55E-14
01/24/91	1.47	0.33	160.27	134.97	1395	0.23	0.34	0.0174	1.60E-15	2.40E-14
01/31/91	3.13	0.23	173.93	139.67	1408	0.23	0.34	0.0461	4.03E-15	3.22E-14
02/07/91	2.83	0.20	190.17	154.27	1418	0.23	0.34	0.0485	3.63E-15	3.35E-14
02/14/91	3.13	0.23	174.00	145.23	1443	0.23	0.34	0.0443	3.93E-15	2.64E-14
02/21/91	1.70	0.40	160.17	143.33	1419	0.23	0.34	0.0552	1.79E-15	1.57E-14
02/28/91	2.17	0.37	136.07	98.07	1444	0.23	0.34	0.0480	2.44E-15	3.49E-14
03/05/91	0.37	0.17	145.73	143.33	1022	0.23	0.34	0.0257	3.83E-16	3.11E-15
03/14/91	2.13	0.50	159.20	137.37	1796	0.23	0.34	0.1199	1.78E-15	1.61E-14
03/22/91	1.23	0.17	164.03	143.90	1583	0.24	0.34	0.0722	1.26E-15	1.68E-14
03/28/91	0.87	0.30	150.43	142.53	1247	0.24	0.34	0.0833	8.58E-16	8.39E-15
04/04/91	2.30	0.27	157.90	135.70	1429	0.24	0.34	0.0624	2.67E-15	2.06E-14
04/11/91	3.03	0.30	163.73	133.80	1427	0.24	0.34	0.0475	3.59E-15	2.78E-14
05/02/91	2.83	0.23	149.70	134.57	1431	0.24	0.34	0.0946	3.41E-15	1.40E-14
05/09/91	2.60	0.30	145.50	132.33	1420	0.24	0.34	0.0705	3.04E-15	1.23E-14
05/16/91	2.17	0.33	147.17	131.30	1399	0.24	0.34	0.0992	2.47E-15	1.50E-14
05/23/91	1.80	0.23	146.63	127.53	1432	0.24	0.34	0.0666	2.06E-15	1.77E-14
05/31/91	2.10	0.23	147.70	121.80	1633	0.24	0.34	0.0569	2.15E-15	2.10E-14
06/06/91	1.83	0.27	147.60	126.90	1214	0.24	0.34	0.0664	2.41E-15	2.26E-14
06/13/91	1.73	0.17	137.03	124.63	1464	0.23	0.33	0.0579	2.09E-15	1.16E-14
06/27/91	2.37	0.20	162.87	138.43	1724	0.23	0.33	0.1011	2.47E-15	1.94E-14
07/05/91	1.53	0.33	151.73	140.77	1629	0.23	0.33	0.0543	1.44E-15	9.19E-15
07/11/91	1.33	0.17	156.30	146.60	1223	0.23	0.33	0.0368	1.87E-15	1.08E-14
08/02/91	2.13	0.30	163.47	142.83	1458	0.23	0.33	0.0417	2.46E-15	1.93E-14
08/09/91	1.47	0.20	157.27	143.93	1406	0.23	0.33	0.0382	1.76E-15	1.29E-14
08/16/91	1.40	0.33	150.77	138.23	1403	0.23	0.33	0.0186	1.49E-15	1.22E-14
08/23/91	2.83	0.20	169.43	143.80	1441	0.23	0.33	0.0403	3.58E-15	2.43E-14
08/30/91	2.03	0.20	159.27	137.97	1382	0.23	0.33	0.0517	2.60E-15	2.10E-14
09/06/91	1.93	0.27	154.87	141.20	1398	0.23	0.33	0.0370	2.34E-15	1.33E-14
09/13/91	1.33	0.33	145.07	135.67	1427	0.23	0.33	0.0276	1.37E-15	8.99E-15
09/20/91	1.47	0.27	154.30	141.50	1423	0.23	0.33	0.0221	1.65E-15	1.23E-14
09/26/91	1.60	0.30	158.50	142.73	1224	0.23	0.33	0.0451	2.08E-15	1.76E-14
10/03/91	3.63	0.20	155.87	127.17	1379	0.23	0.34	0.0606	4.88E-15	2.76E-14
10/11/91	6.30	0.40	168.53	127.33	1649	0.23	0.34	0.0781	7.01E-15	3.31E-14
10/18/91	6.00	0.10	174.43	130.60	1398	0.23	0.34	0.0911	8.26E-15	4.15E-14
10/24/91	4.13	0.37	154.33	129.97	1223	0.23	0.34	0.0805	6.03E-15	2.64E-14
11/01/91	3.70	0.13	151.90	131.93	1701	0.23	0.34	0.0589	4.11E-15	1.55E-14
11/07/91	5.40	0.17	163.30	129.97	1181	0.23	0.34	0.0370	8.68E-15	3.74E-14
11/14/91	5.70	0.40	163.30	127.80	1456	0.23	0.34	0.0333	7.13E-15	3.23E-14
11/21/91	2.10	0.27	151.90	140.83	1415	0.23	0.34	0.0264	2.54E-15	1.04E-14
11/27/91	2.47	0.20	154.37	137.93	1164	0.23	0.34	0.0354	3.81E-15	1.87E-14
12/06/91	4.07	0.23	179.47	141.73	1833	0.23	0.34	0.0719	4.10E-15	2.73E-14
12/13/91	4.07	0.33	169.83	141.10	1471	0.23	0.34	0.0386	4.97E-15	2.59E-14
12/19/91	2.10	0.33	168.33	141.10	1213	0.23	0.34	0.0271	2.85E-15	2.97E-14

TABLE B5. LVAS SITE: S1, WIPP FACILITY

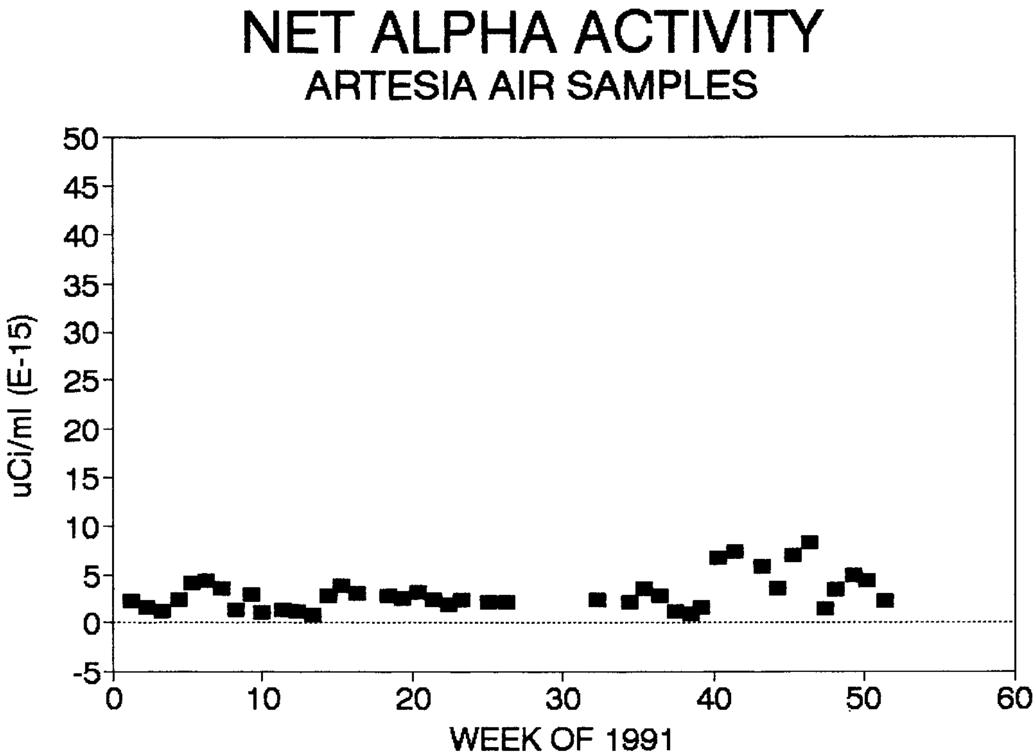
SAMPLE DATE	GROSS ALPHA (CPM)	GROSS ALPHA BKG. (CPM)	GROSS BETA (CPM)	GROSS BETA BKG. (CPM)	SAMPLE VOL. (m3)	ALP EFF.	BET EFF.	SAMPLE WEIGHT (g)	NET ALPHA (uCi/ml)	NET BETA (uCi/ml)
01/22/91	1.13	0.33	142.87	134.97	2734	0.23	0.34	0.0077	5.73E-16	3.83E-15
01/29/91	2.27	0.23	172.13	144.23	1463	0.23	0.34	0.0188	2.73E-15	2.53E-14
02/05/91	3.10	0.20	187.57	154.23	1403	0.23	0.34	0.0204	4.05E-15	3.15E-14
02/12/91	3.40	0.23	170.40	145.23	1436	0.23	0.34	0.0202	4.32E-15	2.32E-14
02/19/91	1.40	0.40	162.70	143.33	1443	0.23	0.34	0.0536	1.36E-15	1.78E-14
02/25/91	1.63	0.40	163.27	143.33	1223	0.23	0.34	0.0407	1.97E-15	2.16E-14
03/12/91	1.73	0.23	167.43	140.53	1595	0.23	0.34	0.0497	1.84E-15	2.23E-14
03/19/91	1.47	0.50	159.83	137.37	1418	0.23	0.34	0.0728	1.34E-15	2.10E-14
03/26/91	1.20	0.30	157.30	110.00	1433	0.23	0.34	0.0283	1.23E-15	4.37E-14
04/02/91	2.27	0.27	149.19	135.70	1412	0.24	0.34	0.0445	2.66E-15	1.27E-14
04/10/91	4.10	0.30	164.17	133.80	1622	0.24	0.34	0.0446	4.40E-15	2.48E-14
04/16/91	2.27	0.27	158.17	137.97	1231	0.24	0.34	0.0403	3.05E-15	2.17E-14
04/23/91	2.83	0.23	156.27	134.57	1378	0.24	0.34	0.0457	3.54E-15	2.09E-14
04/30/91	3.40	0.23	151.90	134.57	1465	0.24	0.34	0.0523	4.06E-15	1.57E-14
05/07/91	2.57	0.30	147.67	132.33	2780	0.24	0.34	0.0667	1.53E-15	7.31E-15
05/14/91	2.43	0.33	149.27	132.30	1388	0.24	0.34	0.0510	2.84E-15	1.62E-14
05/21/91	1.80	0.33	149.73	132.30	1440	0.24	0.34	0.0481	1.92E-15	1.60E-14
05/28/91	2.13	0.23	144.00	127.53	1444	0.24	0.34	0.0243	2.47E-15	1.51E-14
06/04/91	2.30	0.27	149.07	126.90	1449	0.24	0.34	0.0465	2.63E-15	2.03E-14
06/27/91	2.60	0.17	159.83	134.30	1832	0.23	0.33	0.0706	2.60E-15	1.90E-14
07/09/91	1.80	0.17	155.60	146.60	1461	0.23	0.33	0.0210	2.19E-15	8.41E-15
07/17/91	2.43	0.13	139.67	99.27	1651	0.23	0.33	0.0395	2.73E-15	3.34E-14
07/24/91	1.77	0.17	141.60	122.50	1412	0.23	0.33	0.0263	2.22E-15	1.85E-14
07/30/91	1.67	0.20	N/A	N/A	1214	0.23	N/A	0.0158	2.37E-15	N/A
08/06/91	2.23	0.30	162.97	142.83	1425	0.23	0.33	0.0285	2.66E-15	1.93E-14
08/13/91	1.30	0.33	151.20	143.50	1466	0.23	0.33	0.0267	1.29E-15	7.17E-15
08/21/91	2.63	0.30	171.37	143.10	1636	0.23	0.33	0.0255	2.79E-15	2.36E-14
08/28/91	3.10	0.20	167.47	137.97	1423	0.23	0.33	0.0350	3.99E-15	2.83E-14
09/03/91	2.10	0.27	158.67	141.20	1225	0.23	0.33	0.0308	2.93E-15	1.95E-14
09/12/91	1.23	0.33	154.63	135.67	1690	0.23	0.33	0.0247	1.04E-15	1.53E-14
09/19/91	0.57	0.20	154.47	150.17	1442	0.23	0.33	0.0130	4.98E-16	4.07E-15
09/24/91	0.70	0.20	150.30	143.43	1010	0.23	0.33	0.0167	9.70E-16	9.28E-15
10/02/91	5.20	0.20	156.37	127.17	1613	0.23	0.34	0.0364	6.07E-15	2.40E-14
10/10/91	6.40	0.40	162.57	127.33	1637	0.23	0.34	0.0452	7.18E-15	2.85E-14
10/17/91	7.17	0.10	173.73	130.60	1377	0.23	0.34	0.0597	1.00E-14	4.15E-14
10/23/91	3.97	0.27	156.90	130.47	1255	0.23	0.34	0.0536	5.77E-15	2.79E-14
10/30/91	2.20	0.40	152.77	127.13	1443	0.23	0.34	0.0323	2.44E-15	2.35E-14
11/06/91	5.13	0.17	166.90	129.97	1388	0.23	0.34	0.0276	7.01E-15	3.53E-14
11/13/91	5.67	0.17	168.00	132.50	1419	0.23	0.34	0.0294	7.59E-15	3.31E-14
11/20/91	2.27	0.33	145.37	133.17	1395	0.23	0.34	0.0219	2.71E-15	1.16E-14
11/26/91	2.73	0.27	154.10	140.83	1226	0.23	0.34	0.0135	3.94E-15	1.43E-14
12/11/91	3.07	0.33	174.10	141.10	1095	0.23	0.34	0.0233	4.89E-15	3.99E-14
12/20/91	2.30	0.27	167.20	139.90	1867	0.23	0.34	0.0161	2.13E-15	1.94E-14

TABLE B6. LVAS SITE: S2, WIPP FACILITY

SAMPLE DATE	GROSS ALPHA (CPM)	GROSS ALPHA BKG. (CPM)	GROSS BETA (CPM)	GROSS BETA BKG. (CPM)	SAMPLE VOL. (m3)	ALP EFF.	BET EFF.	SAMPLE WEIGHT (g)	NET ALPHA (uCi/ml)	NET BETA (uCi/ml)
01/15/91	1.10	0.13	166.93	154.33	989	0.23	0.34	0.0078	1.92E-15	1.69E-14
01/22/91	1.43	0.33	150.70	134.97	1292	0.23	0.34	0.0083	1.67E-15	1.61E-14
01/29/91	2.87	0.23	166.00	139.67	1389	0.23	0.34	0.0119	3.72E-15	2.51E-14
02/05/91	3.07	0.20	189.83	154.27	1400	0.23	0.34	0.0183	4.02E-15	3.37E-14
02/15/91	3.07	0.23	187.03	145.23	1899	0.23	0.34	0.0244	2.93E-15	2.92E-14
02/26/91	1.60	0.37	128.70	98.07	1423	0.23	0.34	0.0194	1.69E-15	2.85E-14
03/04/91	0.73	0.17	154.23	143.33	1219	0.23	0.34	0.0145	8.99E-16	1.18E-14
03/12/91	1.60	0.23	167.93	140.53	1567	0.23	0.34	0.0416	1.71E-15	2.32E-14
04/02/91	1.90	0.27	149.23	135.70	1376	0.24	0.34	0.0328	2.22E-15	1.30E-14
04/10/91	3.93	0.30	168.13	133.80	1637	0.24	0.34	0.0346	4.16E-15	2.78E-14
04/23/91	3.73	0.23	160.23	134.57	1386	0.24	0.34	0.0369	4.74E-15	2.45E-14
05/03/91	3.47	0.30	156.70	132.33	1911	0.24	0.34	0.0667	3.11E-15	1.69E-14
05/14/91	2.40	0.33	152.67	132.30	1287	0.24	0.34	0.0363	3.02E-15	2.10E-14
05/21/91	1.93	0.23	146.73	127.53	1483	0.24	0.34	0.0374	2.15E-15	1.72E-14
05/28/91	1.77	0.23	145.30	127.53	1401	0.24	0.34	0.0177	2.06E-15	1.68E-14
06/04/91	1.80	0.27	147.53	126.90	1435	0.24	0.34	0.0325	2.00E-15	1.90E-14
07/11/91	2.10	0.17	158.60	146.60	1573	0.23	0.33	0.0191	2.41E-15	1.04E-14
07/18/91	1.70	0.13	139.67	99.27	1378	0.23	0.33	0.0333	2.23E-15	4.00E-14
07/26/91	1.83	0.17	139.13	122.50	1556	0.23	0.33	0.0226	2.09E-15	1.46E-14
08/06/91	2.80	0.30	159.83	142.83	1425	0.23	0.33	0.0187	3.44E-15	1.63E-14
08/14/91	1.63	0.33	153.97	138.23	1662	0.23	0.33	0.0179	1.54E-15	1.29E-14
08/21/91	2.77	0.33	157.53	138.23	1279	0.23	0.33	0.0147	3.73E-15	2.06E-14
08/28/91	3.23	0.20	169.73	137.97	1455	0.23	0.33	0.0234	4.08E-15	2.98E-14
09/03/91	2.07	0.27	159.87	145.07	1191	0.23	0.33	0.0192	2.96E-15	1.70E-14
09/12/91	0.97	0.33	151.80	135.67	1707	0.23	0.33	0.0194	7.27E-16	1.29E-14
09/19/91	0.87	0.20	150.23	150.17	1444	0.23	0.33	0.0092	9.04E-16	6.30E-17
09/24/91	1.07	0.20	150.83	143.43	1009	0.23	0.33	0.0144	1.68E-15	1.00E-14
10/02/91	4.57	0.23	161.23	126.20	1595	0.23	0.34	0.0347	5.32E-15	2.91E-14
10/10/91	6.87	0.40	165.30	127.33	1634	0.23	0.34	0.0298	7.75E-15	3.08E-14
10/16/91	6.07	0.10	169.23	130.60	1181	0.23	0.34	0.0317	9.89E-15	4.33E-14
10/23/91	5.17	0.37	159.70	129.97	1378	0.23	0.34	0.0402	6.82E-15	2.86E-14
10/30/91	2.90	0.40	149.03	127.13	1433	0.23	0.34	0.0247	3.42E-15	2.02E-14
11/06/91	5.87	0.13	167.00	131.93	1411	0.23	0.34	0.0181	7.96E-15	3.29E-14
11/13/91	5.63	0.17	164.57	132.50	1403	0.23	0.34	0.0240	7.63E-15	3.03E-14
11/20/91	2.57	0.27	149.00	140.83	1427	0.23	0.34	0.0112	3.16E-15	7.58E-15
11/26/91	2.57	0.20	155.27	137.93	1213	0.23	0.34	0.0094	3.82E-15	1.89E-14
12/05/91	3.97	0.23	176.80	141.73	1816	0.23	0.34	0.0284	4.03E-15	2.56E-14
12/11/91	2.40	0.17	170.83	132.33	1033	0.23	0.34	0.0163	4.24E-15	4.94E-14
12/20/91	2.87	0.27	170.87	139.90	1858	0.23	0.34	0.0130	2.74E-15	2.21E-14

TABLE B7. LVAS SITE: S3, WIPP FACILITY

SAMPLE DATE	GROSS ALPHA (CPM)	GROSS ALPHA BKG. (CPM)	GROSS BETA (CPM)	GROSS BETA BKG. (CPM)	SAMPLE VOL. (m3)	ALP EFF.	BET EFF.	SAMPLE WEIGHT (g)	NET ALPHA (uCi/ml)	NET BETA (uCi/ml)
01/22/91	1.40	0.33	154.60	134.97	1288	0.23	0.34	0.0104	1.63E-15	2.02E-14
01/29/91	2.53	0.23	168.37	144.23	1374	0.23	0.34	0.0116	3.28E-15	2.33E-14
02/19/91	0.90	0.23	158.70	145.23	1210	0.23	0.34	0.0182	1.08E-15	1.48E-14
02/26/91	2.07	0.20	153.83	132.50	1427	0.23	0.34	0.0187	2.57E-15	1.98E-14
03/04/91	0.87	0.17	148.30	143.33	1042	0.23	0.34	0.0121	1.32E-15	6.32E-15
03/12/91	1.57	0.23	160.73	140.53	1547	0.23	0.34	0.0311	1.70E-15	1.73E-14
03/19/91	1.30	0.50	155.00	137.37	1404	0.23	0.34	0.0639	1.12E-15	1.66E-14
03/26/91	1.57	0.30	156.30	110.00	1431	0.23	0.34	0.0195	1.74E-15	4.29E-14
04/02/91	0.80	0.27	141.33	135.70	1381	0.24	0.34	0.0110	7.20E-16	5.40E-15
04/10/91	3.33	0.30	164.20	133.80	1639	0.24	0.34	0.0290	3.47E-15	2.46E-14
04/16/91	2.50	0.30	150.43	133.80	1179	0.24	0.34	0.0255	3.50E-15	1.87E-14
04/23/91	3.53	0.23	153.23	134.57	1386	0.24	0.34	0.0294	4.47E-15	1.78E-14
04/30/91	2.77	0.23	151.37	134.57	1460	0.24	0.34	0.0320	3.27E-15	1.52E-14
05/07/91	2.73	0.30	150.47	132.33	1303	0.24	0.34	0.0330	3.50E-15	1.84E-14
05/23/91	2.63	0.23	148.70	127.53	1814	0.24	0.34	0.0334	2.48E-15	1.55E-14
05/28/91	1.63	0.23	138.60	121.80	1013	0.24	0.34	0.0125	2.59E-15	2.20E-14
06/04/91	1.63	0.27	145.40	126.90	2404	0.24	0.34	0.0227	1.06E-15	1.02E-14
06/25/91	1.80	0.13	155.23	129.27	1404	0.23	0.33	0.0279	2.33E-15	2.52E-14
07/03/91	2.97	0.33	156.07	140.77	1607	0.23	0.33	0.0272	3.21E-15	1.30E-14
07/01/91	2.40	0.17	161.37	146.60	1573	0.23	0.33	0.0188	2.78E-15	1.28E-14
07/18/91	2.00	0.13	144.40	99.27	1411	0.23	0.33	0.0311	2.59E-15	4.37E-14
07/26/91	1.90	0.17	145.33	122.50	1639	0.23	0.33	0.0214	2.07E-15	1.90E-14
08/06/91	2.67	0.30	161.40	142.83	1435	0.23	0.33	0.0187	3.23E-15	1.77E-14
08/14/91	1.17	0.33	153.20	138.23	1597	0.23	0.33	0.0165	1.03E-15	1.28E-14
08/21/91	2.50	0.33	161.63	138.23	1371	0.23	0.33	0.0157	3.10E-15	2.33E-14
08/28/91	3.07	0.20	170.47	137.97	2877	0.23	0.33	0.0239	1.95E-15	1.54E-14
09/03/91	1.77	0.27	164.53	145.07	1176	0.23	0.33	0.0142	2.50E-15	2.26E-14
09/10/91	0.67	0.33	146.17	135.67	1290	0.23	0.33	0.0135	5.06E-16	1.11E-14
09/19/91	1.13	0.20	157.07	150.17	1848	0.23	0.33	0.0160	9.89E-16	5.10E-15
09/24/91	1.03	0.27	149.60	141.50	1020	0.23	0.33	0.0153	1.47E-15	1.08E-14
10/02/91	4.27	0.23	162.30	126.20	1600	0.23	0.34	0.0319	4.94E-15	2.99E-14
10/10/91	6.57	0.17	163.07	124.23	1670	0.23	0.34	0.0298	7.51E-15	3.08E-14
10/16/91	6.10	0.10	167.83	130.60	1194	0.23	0.34	0.0318	9.84E-15	4.13E-14
10/23/91	6.73	0.27	167.10	130.47	1463	0.23	0.34	0.0393	8.66E-15	3.32E-14
10/30/91	2.50	0.40	142.60	127.13	1434	0.23	0.34	0.0198	2.87E-15	1.43E-14
11/06/91	5.97	0.13	160.63	131.93	1369	0.23	0.34	0.0159	8.34E-15	2.78E-14
11/13/91	5.03	0.17	170.50	132.50	1428	0.23	0.34	0.0239	6.68E-15	3.53E-14
11/20/91	2.23	0.33	145.27	133.17	1395	0.23	0.34	0.0111	2.67E-15	1.15E-14
11/26/91	2.73	0.20	159.00	137.93	1214	0.23	0.34	0.0093	4.09E-15	2.30E-14
12/05/91	4.60	0.23	173.20	141.73	1816	0.23	0.34	0.0259	4.71E-15	2.30E-14
12/11/91	2.57	0.17	177.93	132.33	1053	0.23	0.34	0.0183	4.46E-15	5.74E-14
12/20/91	2.97	0.27	167.70	139.90	1933	0.23	0.34	0.0151	2.74E-15	1.91E-14



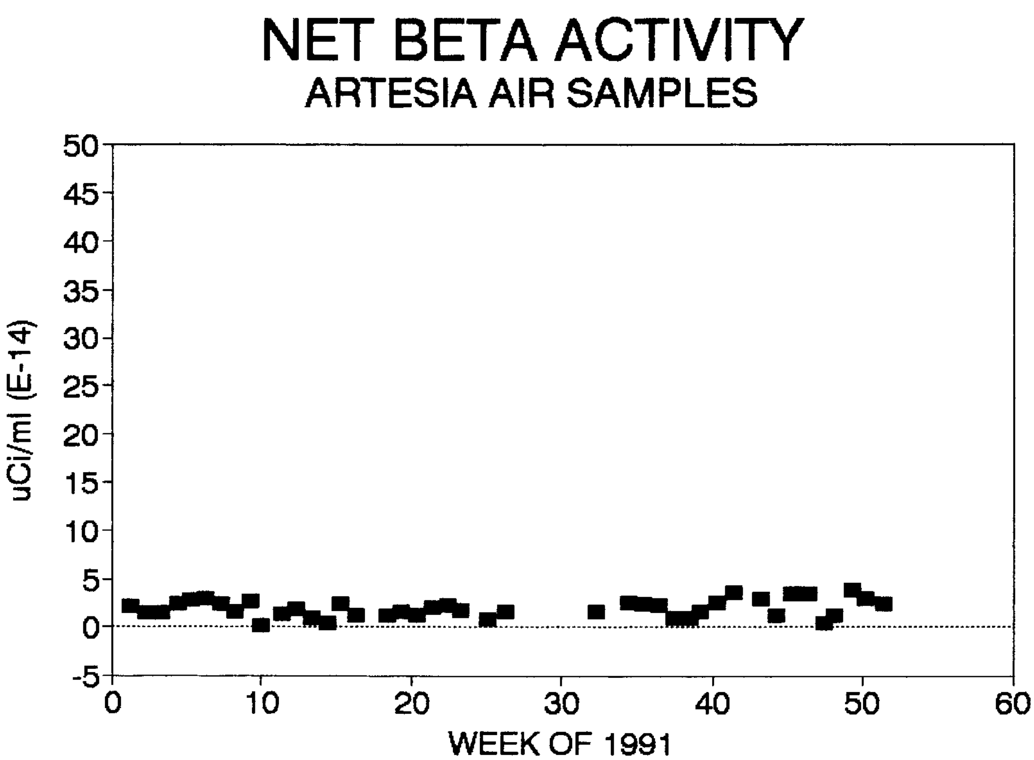
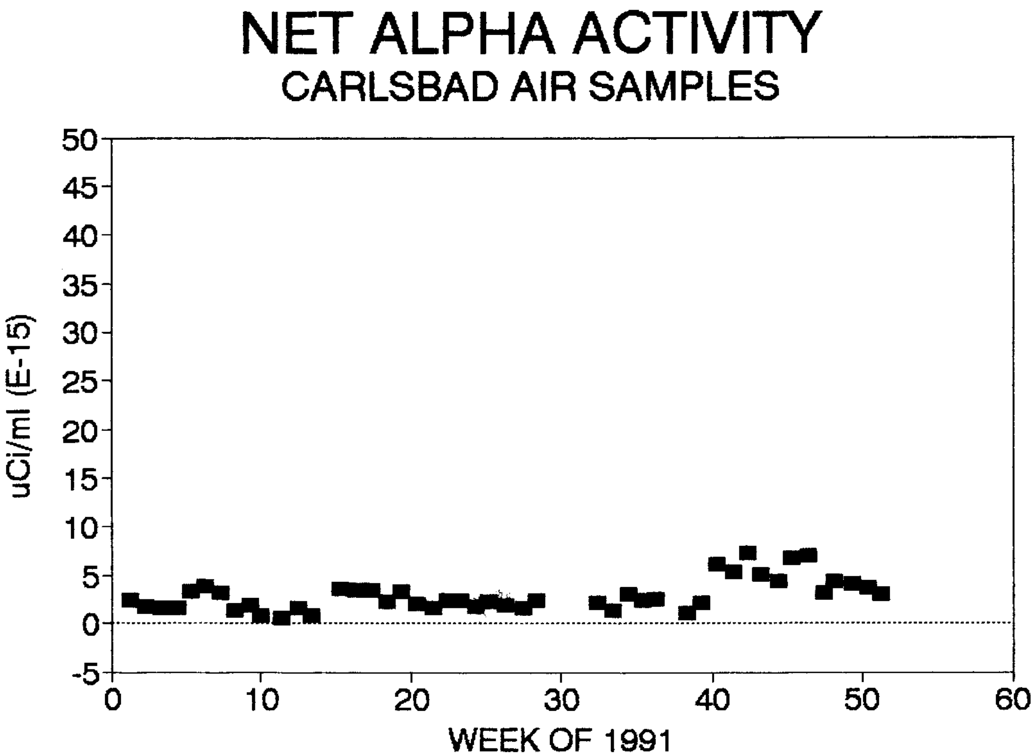


Figure B1. Net Alpha and Beta Activity-Artesia Air Samples-1991



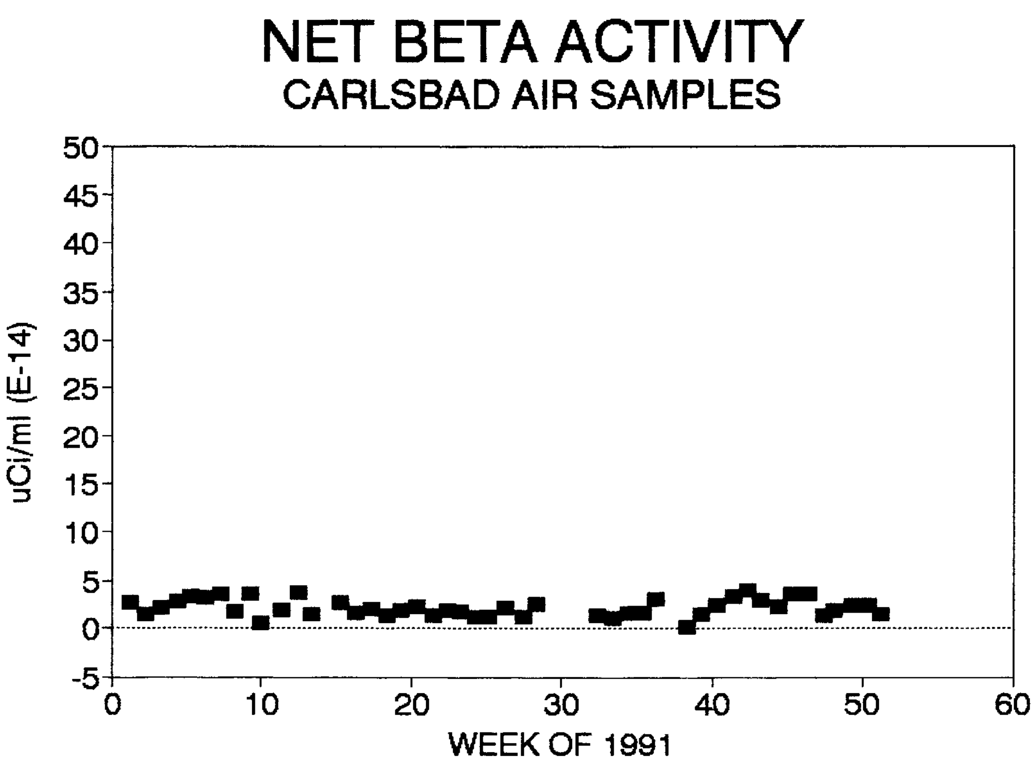
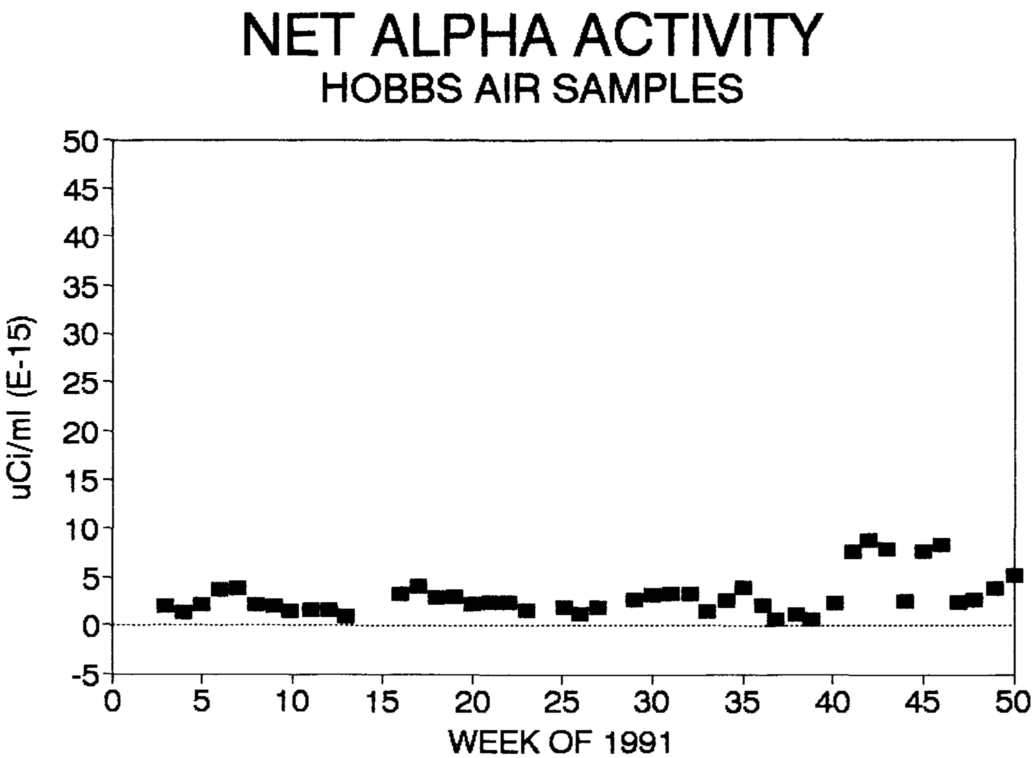


Figure B2. Net Alpha and Beta Activity-Carlsbad Air Samples-1991



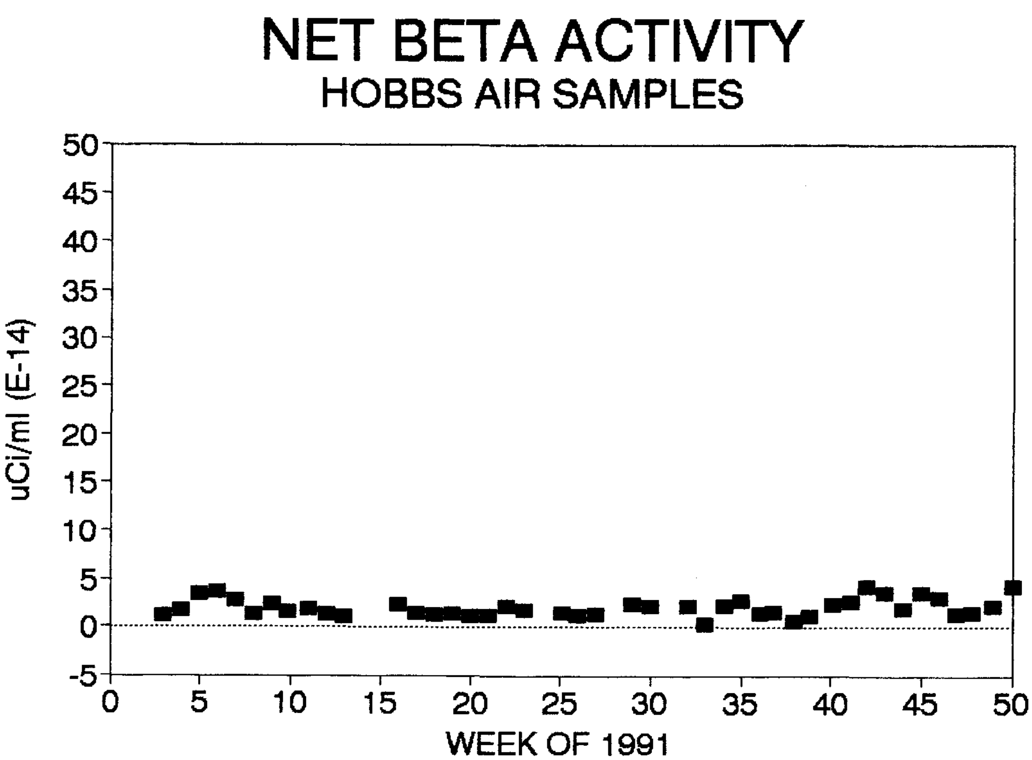
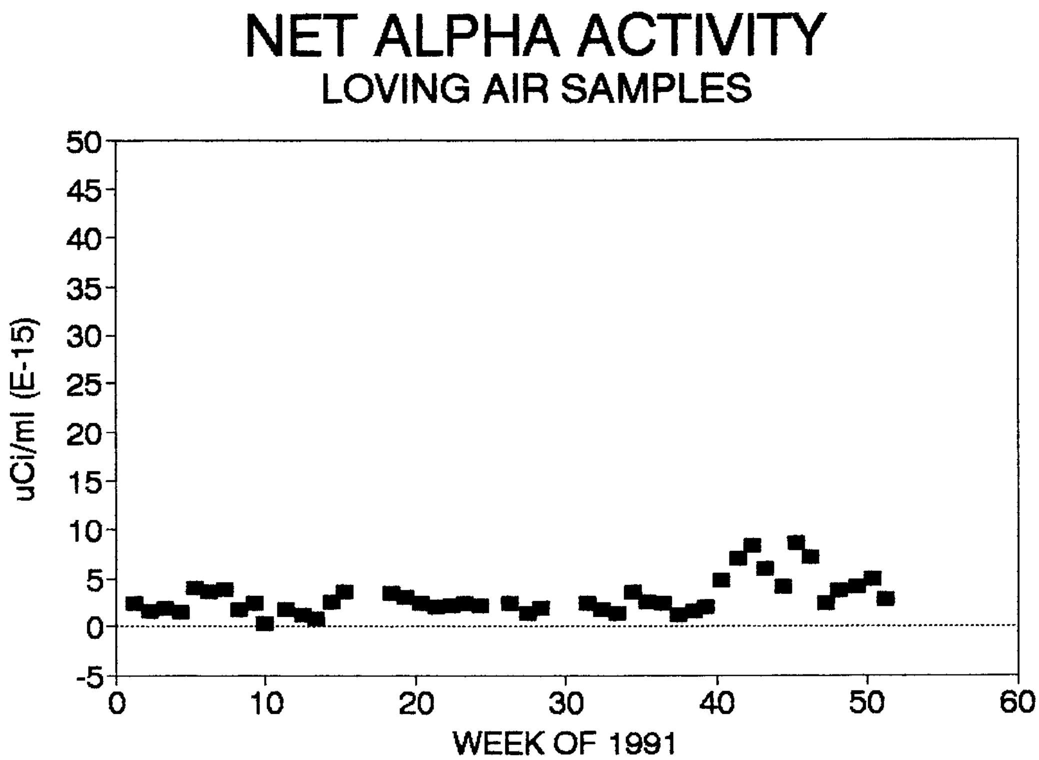


Figure B3. Net Alpha and Beta Activity-Hobbs Air Samples-1991



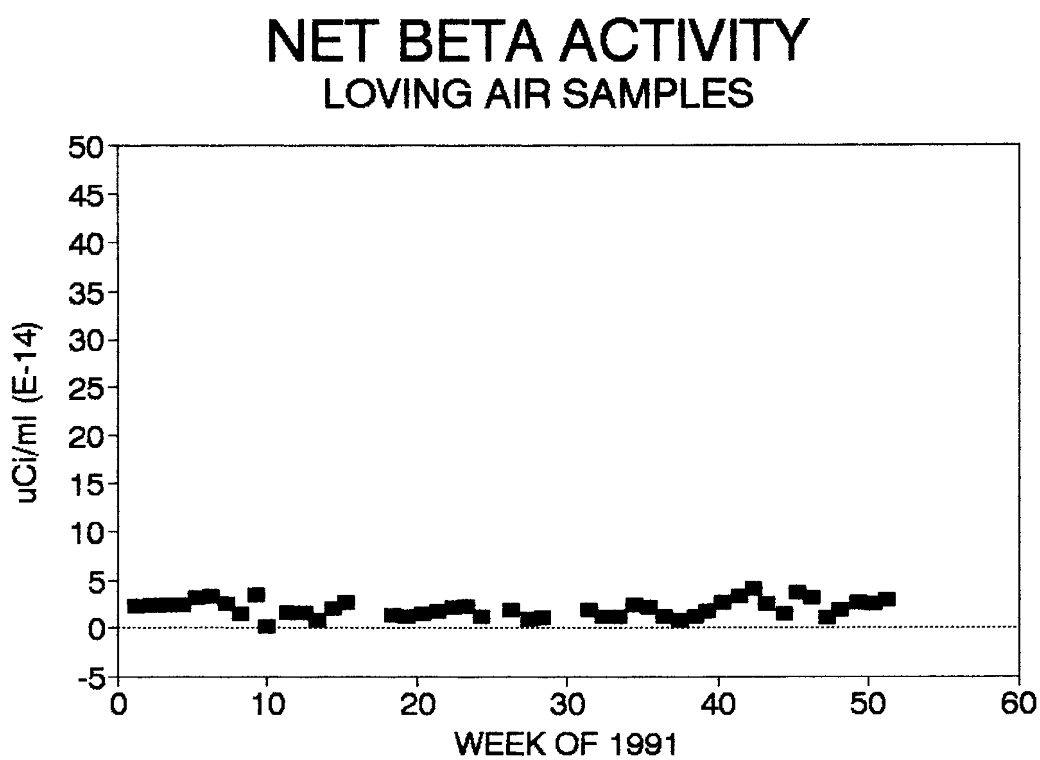
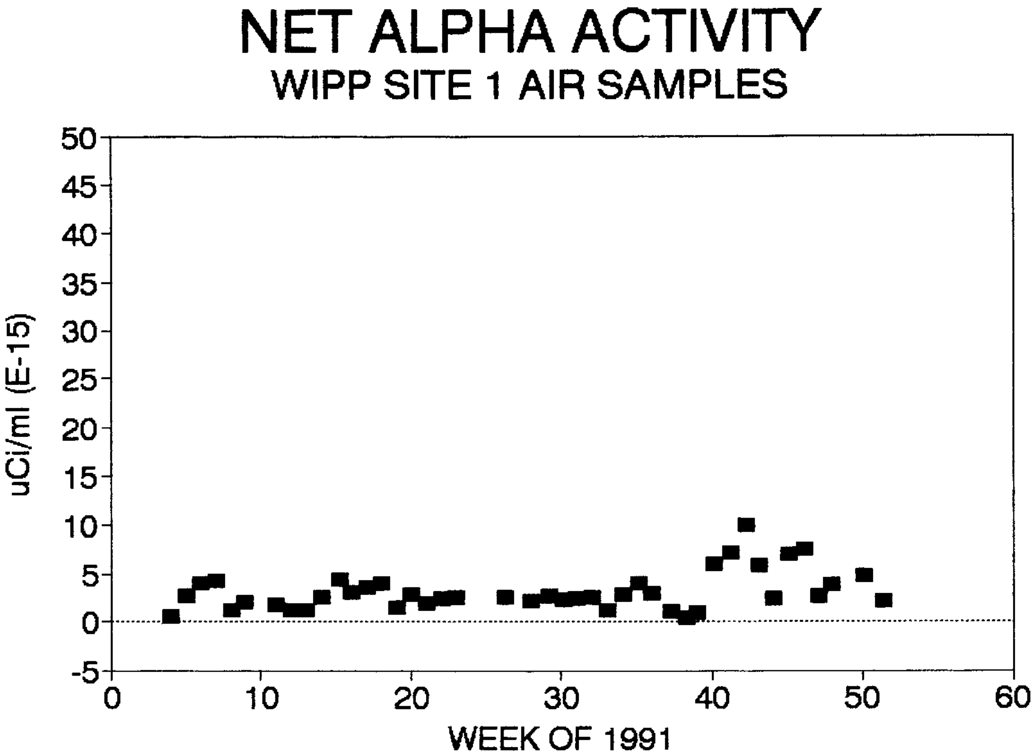


Figure B4. Net Alpha and Beta Activity-Loving Air Samples-1991



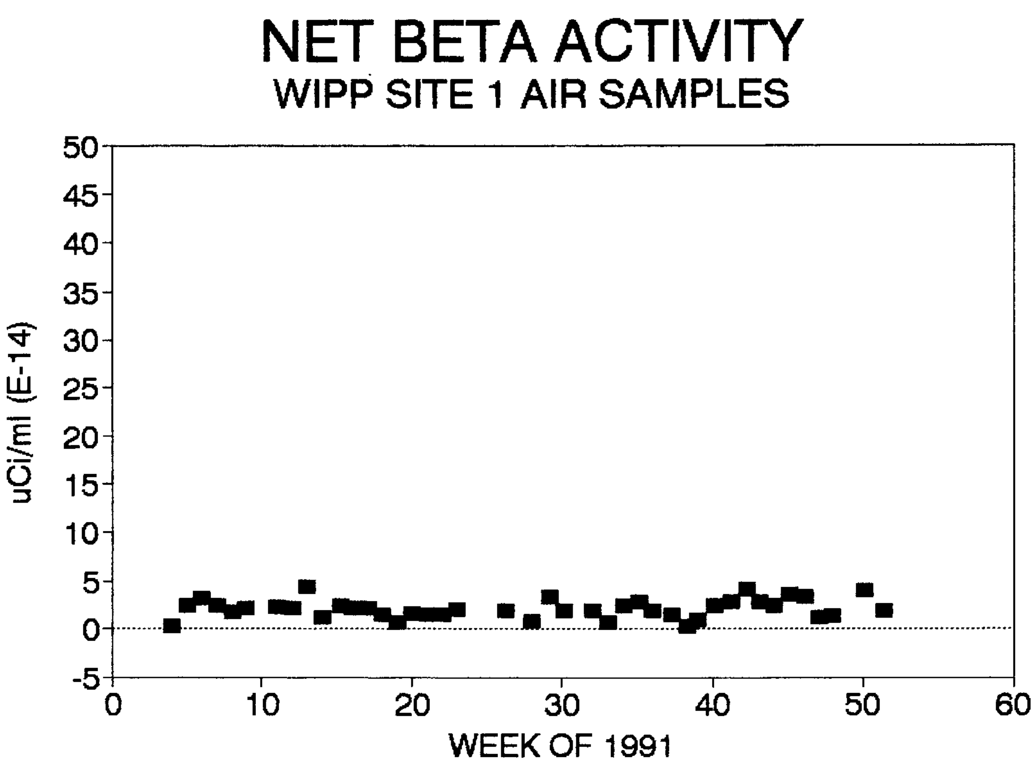
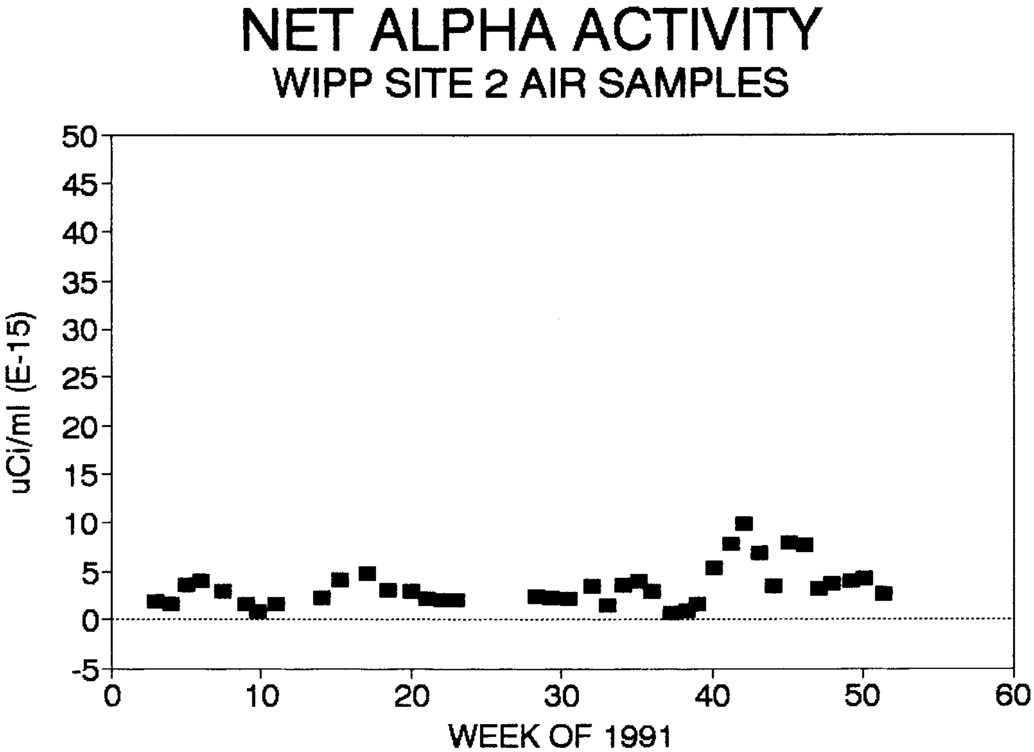


Figure B5. Net Alpha and Beta Activity-WIPP Site 1 Air Samples-1991



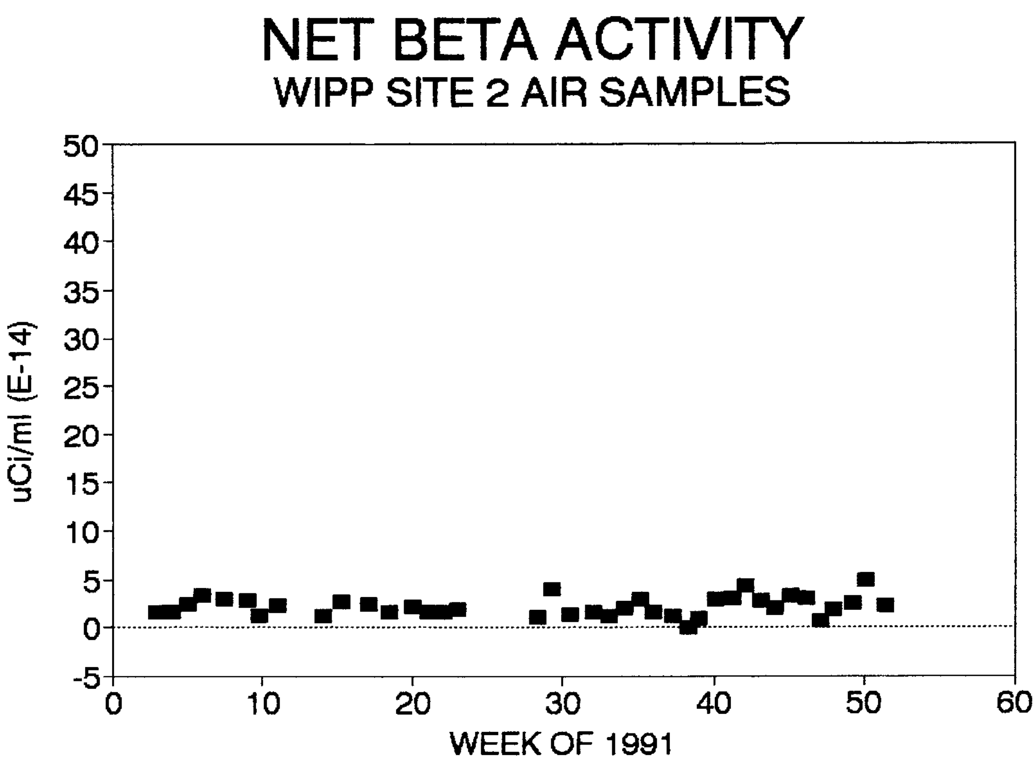
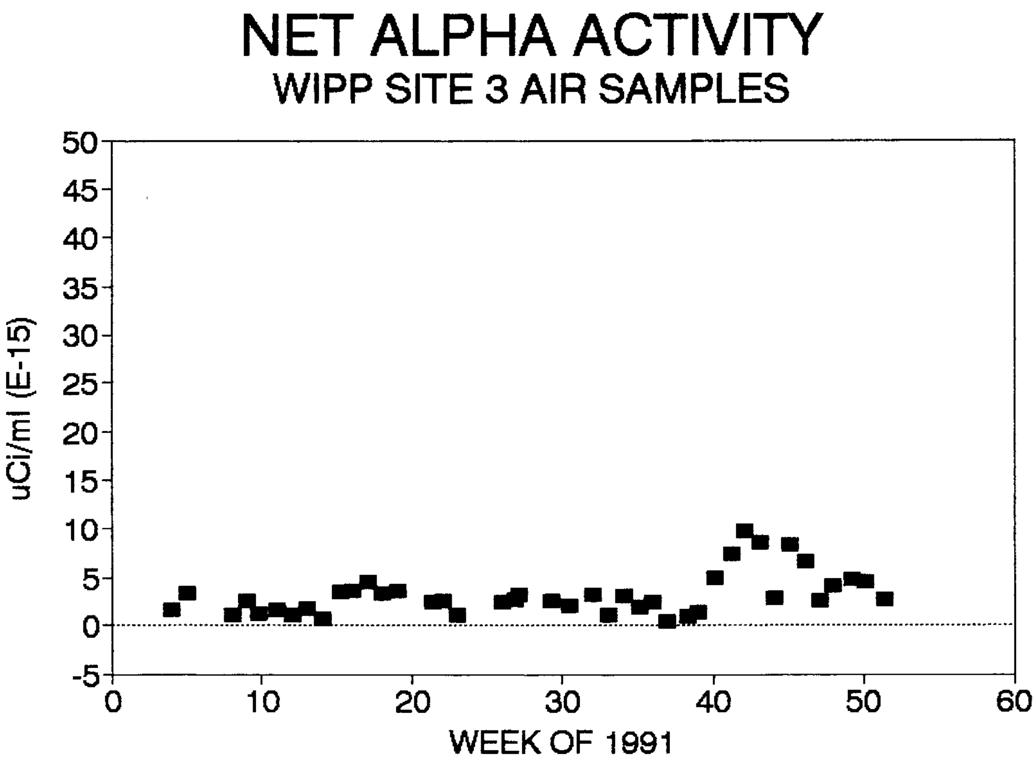


Figure B6. Net Alpha and Beta Activity-WIPP Site 2 Air Samples-1991



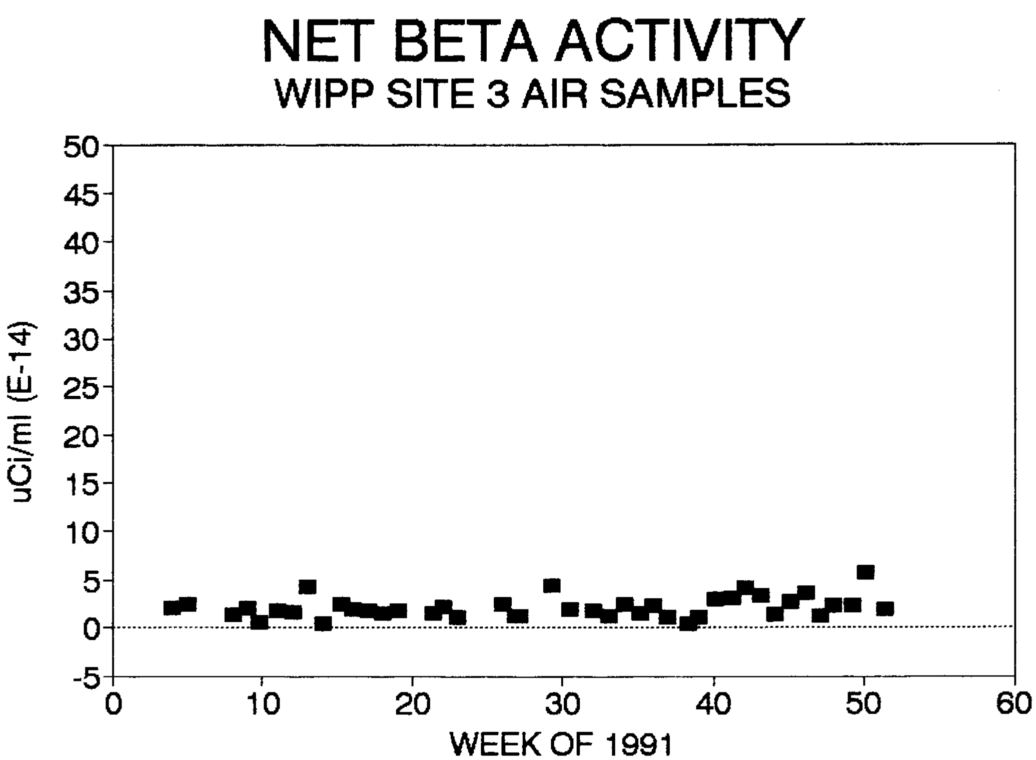


Figure B7. Net Alpha and Beta Activity-WIPP Site 3 Air Samples-1991